NATURE

SATURDAY, APRIL 6, 1929.

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Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.

Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3101, Vol. 123]

Educational Broadcasting.

ALREADY we have heard much concerning the powerful influence which broadcasting must have upon what we now accept as civilisation. Its effect in helping to break down national and geographical barriers, and its consequent destruction of the suspicions, hatreds, meannesses, and intolerances which ignorance breeds among peoples living within narrow circles, cannot yet be fully estimated. That effect is a result of a broad and informal educational influence. It is an effect which is inevitable just because broadcasting cannot be other than an educational influence. If that be the case at present, it is clear that, when the possibilities of broadcasting as a formal and deliberately organised means of education are considered, there can be no doubt that an instrument of incalculable value will be shaped for the service of mankind.

The British Broadcasting Corporation is to be congratulated upon the steps it has taken towards linking its activities with the educational system of Great Britain. From its early days it has striven untiringly towards that end. The history of those steps may be briefly described. It began with a committee of inquiry into broadcasting and adult education under Sir Henry Hadow. Then followed an interim committee to deal with that specific problem. Finally, a central council for broadcast adult education was set up under Lord Justice Sankey. That council is composed of representatives of the most important national interests, and it is now completing admirable organisation which will use wireless in the great service of adult education. Meanwhile, the famous Kent experiment in the use of wireless to broadcast to schools having been successfully completed, the B.B.C. has just set up a central council for school broadcasting under the chairmanship of the Right Hon. H. A. L. Fisher, which is composed of similar national interests to the council we have described above. This council is proceeding to deal with the specific problem of broadcasting to schools.

The building of such excellent machinery cannot, of course, be productive of anything but good. If, then, at the very moment when we wholeheartedly welcome it, we also make one or two suggestions for its use, we feel sure that we shall be acquitted of any desire to make querulous and carping criticism at too early a stage. The B.B.C. is, however, a very modern part of modern life, and we would be sorry if it missed the special opportunities it has of taking care that its educational

activities follow, and get the best out of, the changes which are taking place in the structure of our civilisation. That does not mean that it should wholly ignore tradition or indulge in a crude stamping upon our special—almost sanctified—academic traditions. It means the frank recognition of new values which the changes we have mentioned are presenting us.

For our present purposes we have in mind the work of adult education rather than the work of our primary and secondary schools; and we direct attention to what we have called new values because, in a paper on the relation of broadcasting to further education, read recently to the Association of Technical Institutions, we see a tendency to make the old distinction between what is called cultural and what is called vocational education. "I have often wished," said Mr. Siepmann, the author of the paper, "that it were possible to introduce into the technical colleges more subjects representative of the cultural *as opposed to* vocational interests" (our italics). Later he suggested that by "correlating cultural and vocational aims, and by the establishment of a broader basis of instruction, and an attempt to give to the life and work of your institutes a social as well as academic significance," a recruitment of disinterested students would take place. Finally, he is "inclined to think that the technical subject [for the purpose of a broadcast talk] is less appropriate than the cultural," and suggested that, while the B.B.C. will go carefully and sympathetically into the matter, there is no "immediate possibility of the extensive adaptation of our programmes to your needs."

If Mr. Siepmann thinks that those needs include broadcast talks on engineering or chemistry or building, we are sure he does not yet understand the tone and spirit of the modern technical institution. If he thinks that the curriculum of the same institution does not include subjects which he himself would regard as "cultural as opposed to vocational," he is very much mistaken. His errors are, however, common ones and arise out of the words 'technical education.' Much misunderstanding might be removed if Lord Eustace Percy's phrase 'education for industry and commerce' were used. It is a term which may be neither entirely satisfactory nor descriptive, but it would help to do away with much of the false distinction between cultural and vocational education—the new phrase under which the ancient and arid controversies over, and distinctions between, science and art, tends to be revived.

If education is to help in the solution of our problems, we must realise that to treat academic matters apart from social and industrial matters is to fail in all of them. What are usually known as academic or cultural subjects are only a part of education. In themselves they cannot support life as we know it. The spiritual values on which we set so great a store are dependent on what are, at first sight, merely material things. But the two cannot be separated. Education for industry and commerce can be, and is, used to make men and women realise social relationships. Through the grouped course methods of technical institutions, students are shown how one subject is akin to others, how it has value not merely in its own utilitarian content, but also in kinship with others which are at first apparently independent and unconnected.

The process is producing a culture which is wider and nobler than our older notions, a culture which is neither lonely nor snobbish, a culture which does not stop short at pleasant abstractions, but is forging a link between the many sides of our world and humanising industry no less than making it efficient. Those who know technical institutions know that they are places where is taught not only the art of earning a living, but also the sacred art of living itself.

We hope, then, that the B.B.C.'s new educational machinery will not hold too fast to all the parts of academic tradition; that it will realise the vital need for education to march with our changing conditions; that it will be thorough in its examination of phrases like 'cultural and vocational and technical subjects'; and that it will regard the changes to which we have referred not as tending to a blind and formless industrialism, but as the outward forms of the newer values which science has made available for us.

A Criminal Tribe of India.

The Land Pirates of India: an Account of the Kuravers, a Remarkable Tribe of Hereditary Criminals; their Extraordinary Skill as Thieves, Cattle-lifters and Highwaymen, etc., and their Manners and Customs. By W. J. Hatch. Pp. 272 + 16 plates. (London: Seeley, Service and Co., Ltd., 1928.) 21*s.* net.

INDIAN ethnology has been a favourite exercising ground for theorists. Recent political developments have done much to encourage them along certain lines. Starting from above and adopting the view of a dominant social order, they have

tended to neglect the light to be thrown upon cultural history by direct observation of the more primitive races. It is to the credit of the late Sir Herbert Risley, the late Mr. William Crooke, and Mr. Edgar Thurston, to name some of the principal workers only, that they saw the study of India as a whole and each in his own special province linked up the investigation of primitive and advanced on a basis of observed fact regardless of political or social theory. The result is to be seen in Mr. Crooke's conclusions as to the relations of the Hindu pantheon and local godlings, and in Mr. Thurston's treatment of the out-caste and criminal and primitive tribes in the *Madras Gazetteer*.

It is inevitable that such reflections should arise on reading Mr. Hatch's book on the Kuravers, the tribe whose thieving proclivities have endowed them with the name of 'Land Pirates.' It is more than seventy years since officers of the Government whose duties were to prevent dacoity and *Thuggee* first made any study of their peculiarities. Yet beyond the notes of police manuals and the accounts in the *Madras Gazetteer*, practically no attempt has been made to give any account of them commensurate with their interest; and this notwithstanding the fact that these nomad thieves are scattered all over the Madras Presidency, as well as in the Canarese Nadu and the Bombay Presidency, and in the Madras Presidency alone number just under two hundred and twenty-one thousand. The number in the Bombay Presidency also is said to be considerable.

The Kuravers are systematic thieves by descent, by habit, and by proclivity. They work only when they are not able to steal. They wander from village to village but may often earn a lucrative living by a species of blackmail, protecting the villagers from the predatory visits of their fellow tribesmen for a payment. Yet the Kuraver, unlike other criminal tribes, as a rule will not kill in order to rob. Many of them practise palmistry, the term for which in Tamil is said to be the derivation of their name.

It is always interesting, but seldom easy, to trace the origin of a tribe or caste in India. General Hervey, the great authority in the middle of the last century on Indian crime, says the tribe migrated from the south; but one version of their origin makes them the descendants of Prince Dharmaraja by a fortune-teller (*Kuru*), which would point to a northern descent. Their language, however, is Dravidian. Physically they are not a low type, and do not differ materially from the other castes of Southern India. One story adopted by the Kuravers themselves points to their having at one time lived as hunters and having been driven out by pressure of population. Mr. Hatch is no doubt right in rejecting the view that they were originally servants of the temples of Southern India, who were supplanted by the arrival of a higher grade of priests.

The Kuravers are split up into a large number of divisions, normally each hamlet or settlement containing members of one family only. From early times they were distinguished as nomad and settled. Four main divisions fall into a number of subdivisions, but there are also other classifications, generally based upon occupation, although this is not necessarily the occupation followed to-day. Such are the salt merchants, those who split bamboo for the making of baskets, snake charmers, and so on. All these ostensible occupations disguise the real occupation of the members of the tribe, which is thieving.

The Kuravers worship a number of deities. These are, of course, especially propitiated to attain success in thieving expeditions. The temple of Subramania at Palni is much frequented by pilgrims. Another shrine of great sanctity is that at Chidambaram in South Arcot. Magic and superstitious practices loom large in their lives. Mr. Hatch describes a remarkable belief that a man who has been killed by magic may be resuscitated—a dangerous practice, but one which may prove of great utility, as the nerves extracted from the dead man's legs are most efficacious in the practice of further magic against an enemy.

Mr. Hatch has had a long experience of the people of whom he writes; but although he describes the tribe and its life very fully and informatively in certain respects, a more systematic account would have been valued. In the case of marriage, for example, it is desirable to know what, beyond the bride payment, is the basis of arrangement. Marriages are sometimes determined even before the birth of the children, and it is said that a man may claim his sister's two eldest daughters in this way. Within what degrees are marriages forbidden or prescribed? It is also desirable that the position of women should be more precisely defined. Mr. Hatch implies that their prominence and importance in the Kuraver social system is due in part to the fact that their husbands spend so much time in prison, in part to their utility and their skill in the less important branches of the tribal profession. More information upon this and related matters would have been welcome and would have increased the value of this study of a remarkable people.

Alchemical Manuscripts.

(1) *Union Académique Internationale. Catalogue des manuscrits alchimiques grecs.* Publié sous la direction de J. Bidez, F. Cumont, A. Delatte, O. Lagercrantz et J. Ruska. Tome 5 : i. *Les Manuscrits d'Espagne*, décrits par Prof. C. O. Zuretti ; ii. *Les Manuscrits d'Athènes*, décrits par A. Severyns. Pp. v + 174. (Bruxelles : Maurice Lamertin, 1928.) 10 Belgas.

(2) *Union Académique Internationale. Catalogue of Latin and Vernacular Alchemical Manuscripts in Great Britain and Ireland dating from before the XVI Century.* By Dorothea Waley Singer, assisted by Annie Anderson. Vol. 1. Pp. xxiii + 326. (Brussels : Maurice Lamertin, 1928.) n.p.

(3) *Union Académique Internationale. Catalogue des manuscrits alchimiques grecs.* Publié sous la direction de J. Bidez, F. Cumont, A. Delatte, O. Lagercrantz et J. Ruska. Tome 6 : *Michael Psellus, Épître sur la Chrysopée ; Opuscules et extraits sur l'alchimie, la météorologie et la démonologie*, publiés par Joseph Bidez ; en Appendice ; *Proclus, Sur l'art hiératique ; Psellus, Choix de dissertations inédites.* Pp. xiv + 246. (Bruxelles : Maurice Lamertin, 1928.) 15 Belgas.

THE history of alchemy has a twofold claim on our attention. In the first place, it still has its adherents, who are found not merely in the Orient but also in America, Germany, France, and England itself. It was recently related that the philosopher's stone had been prepared at Los Angeles by a woman alchemist, who thus takes rank with Mary the Copt and Cleopatra ; while M. Jollivet Castelot from time to time issues reports of his successful transmutations. That this art should flourish even in the twentieth century is a striking witness to human credulity, and as such may engage the notice of psychologists.

Secondly, alchemy is the direct ancestor of chemistry ; and in view of the modern trend in the philosophy of science, the importance of a study of origins need not be emphasised here. Although there are dissentients, it is commonly believed that chemistry arose in the early years of the Christian era, as a result of the fusion of Egyptian metallurgical and other arts with the mystical philosophies of the Neo-Platonists and Gnostics. Unluckily, the Neo-Platonists regarded matter as the principle of unreality or evil, from which the disciple should attempt to detach himself, while the Gnostics cared little for the phenomena of the sensible world, being much more anxious to attain to a knowledge of the invisible cosmos. It is significant for the later history of the science that one of the earliest chemical writers, Zosimos the Panopolitan, was a Gnostic, while the Neo-Platonic conceptions of sympathetic action, action at a distance, the distinction between occult and manifest properties, the influence of the stars, and the mystical powers of numbers, all permeate chemistry from its beginnings at the time of Plotinus until the close of the seventeenth century. It would, indeed, scarcely be going too far to say that some of these ideas are with us still : nitrogen is manifestly inert but occultly active, and the structure of the atom is ultimately a matter of the relations between numbers, as Prof. Dingle has observed.

To get a clear picture of the development of chemical thought throughout the ages, a great deal of work remains to be done. Even the comparatively recent eighteenth century has been insufficiently studied, and the farther we go back the more hazy does our knowledge become. The first step to rectify this unsatisfactory state of affairs is obviously an investigation and classification of the material at our disposal. The ancient literature of alchemy was incredibly large, and the number of manuscripts which have survived is by no means insignificant. The careful cataloguing of these manuscripts has been undertaken by competent scholars under the patronage of the Union Académique Internationale, and the three volumes now under review represent a valuable continuation of the programme of work.

(1) The fifth volume of the "Catalogue des manuscrits alchimiques grecs" deals with the manuscripts of Spain, described by C. O. Zuretti, and those of Athens, described by A. Severyns. Certain of the Spanish manuscripts furnish useful data for the study of the relations between the principal Greek alchemical works, while others enrich our knowledge of the "Koeranides." The Athenian manuscripts are but five in number, and four of these date only from the eighteenth or nineteenth centuries, the other being of the fourteenth. The modern ones are of value as probably representing more ancient works which have to-day disappeared or lie hidden in obscure libraries.

(2) Of more general interest is the first volume of Mrs. Singer's great catalogue of Latin and vernacular alchemical manuscripts in Great Britain and Ireland, dating from before the sixteenth century. Mrs. Singer's enormous collection of bibliographical data is of course very well known to all historians of science, few of whom are not indebted to her

for information always promptly and generously given. It is therefore with a gratitude partaking of a hope for future favours that we congratulate Mrs. Singer on the appearance of her catalogue and the British Academy on its liberality in bearing the cost of printing it.

In an excellent little introduction, Mrs. Singer explains the direct Greek influence on Latin alchemy. "The iconoclastic disputes in the Byzantine Empire led to the dispersal of artificers, who carried their workshop recipes with them westward. In the work of the eleventh century chronicler, Adam of Bremen, we read of a converted Jew named Paul who, after having visited Byzantium, came to Bremen bringing with him the art of transmuting copper into gold." Several alchemical or rather technological manuscripts of evident Greek ancestry are described in the catalogue, and practical chemistry of a primitive nature was clearly practised in Europe before the great influx of chemical knowledge from Islam in the twelfth and thirteenth centuries. This influx is manifested by the appearance of Arabic names, technical terms, and forms of expression, and in several cases we are in possession of the original Arabic texts of Latin alchemical works. Mrs. Singer's catalogue will doubtless help us to find other such cases, for several of her titles are strongly reminiscent of Arabic alchemical books. We notice, for example, a treatise by 'Mirer,' whom we should guess to be Mahararis, a Muslim alchemist about whom little is known but of whom some writings are extant; and a 'filius Hahmil,' who is undoubtedly Ibn Amyal, as the *incipit* of the manuscript agrees with the opening sentence of an Arabic work by him. These are but foretastes: Mrs. Singer's catalogue is as full of good things as a Christmas pudding and will require even more digestion. We may perhaps direct special attention to the large number of manuscripts in English.

(3) Volume VI. of the Greek catalogue is devoted to a study of Michael Psellus's "Letter on Gold-making," by Joseph Bidez, with appendices on certain inedited dissertations of the same writer and a tract of Proclus "On the hieratic art." Psellus, who was professor at the Academy at Constantinople about the middle of the eleventh century, expressed very enlightened views upon the study of Nature. Contemporary indifference to natural phenomena aroused his indignation as only too likely to perpetuate or re-awaken ancient superstitions. He believed in the possibility of the transmutation of the metals, but denied that a knowledge of alchemy was a secret confined to the initiated. The operation of the alchemist, he considered, finds its explanation in the Aristotelian theory of the four elements, from which everything comes by combination and into which everything is resolved by dissolution. Nothing, he says, is produced without cause: belief in prodigies is merely a result of our lack of comprehension of the causes of phenomena. It is not without interest, in view of the fact that at this time Arabic works were being translated into Greek, that Avicenna had expressed an almost identical opinion in 1022, when he wrote (concerning a 'natural wonder'), "These things appear strange only on account of their infrequent occurrence," the wonder vanishing when the causes are known.

One thing emerges very distinctly from the study of ancient scientific treatises. It is that scientific genius and scientific method are not entirely the monopoly of post-Galilean days, but that the great advance which science has made during the last three hundred years is due in no small degree to better co-ordination and transmission of ideas by a much greater number of workers, rather than to any sudden efflorescence of scientific ability.

E. J. Holmyard.

A Hunter-Naturalist's Memories.

Retrospect: Reminiscences and Impressions of a Hunter-Naturalist in Three Continents, 1851–1928. By Abel Chapman. Pp. xix + 353 + 56 plates. (London and Edinburgh: Gurney and Jackson, 1928.) 25*s.* net.

MR. ABEL CHAPMAN'S "Retrospect" is a fascinating volume, richly illustrated from his own drawings and with coloured plates of singular beauty from those of the late Mr. Joseph Crawshall. While most of the chapters will appeal chiefly to sportsmen, the author, as a trained and vigilant observer of animal behaviour in many lands, provides just the kind of observation usefully to complement work in the laboratory and the museum. He is puzzled by the enigma how animal and vegetable life can persist in waterless, rainless, dewless African deserts.

"In the Sudan we have two closely related forms of the hartebeest group, namely, the Tiang (*Damatescus tiang*) and the Korrigum (*D. korrigum*), animals so nearly alike that a casual observer would scarce differentiate between them; yet, as regards thirst, as wide apart as the poles in their habits. The tiang is a thoroughly bibulous beast. It inhabits the Steppe regions bordering on the White Nile, and is specially careful to resort twice a day to that river . . . and enjoy two long drinks; . . . the korrigum elects to reside permanently in

the waterless deserts of Kordofan, hundreds of miles from the Nile, and where never a drop of pure water can moisten his torrid throat and tongue year in and year out. It is a contrast that passes understanding" (pp. 144-5).

Finding it equally perplexing to comprehend how the plants on which the korrigum feeds can exist without water, Mr. Chapman put the case before the late Sir Isaac Bayley Balfour, and gives the following extract from his reply:

"Plants growing in waterless deserts are variously attuned to their environment. Some may store water to tide them over long periods of drought. Others, such as the mimosas which you indicate, are able to hold such water as they may obtain in the wood-tissues which they form, and also obtain a certain amount from the atmosphere. The roots of these plants spread for long distances, and their rootlets attach themselves very firmly to the particles of sand in the soil. There may be no *free water* in the soil, and yet an adequate amount of what we call 'hygroscopic water' in the particles, and from these particles the root-hairs of plants may get their supplies."

Mr. Chapman differs emphatically with those who entertain what he describes as "the Doctrine of Colour Protection," regarding it as "based upon the supposition or superstition that the Almighty had so camouflaged His creatures as to render the harmless invisible to their enemies; while the enemies themselves were equally aided in their predatory avocation by an obliterative coloration" (p. 118). This is scarcely a fair summary of the conclusion at which many observers have arrived; which, indeed, is confirmed by Mr. Chapman as an experienced field-naturalist, for he admits that many animals assimilate so closely in colour to their environment as to be "virtually invisible to the human eye" (p. 122), but as they are easily detected when they move, he objects to their colouring being pronounced protective.

No one can have given much attention to birds without recognising in how many species colour serves the male for display and the female for concealment during incubation. This is almost universal in the duck tribe; although the Sheldrake, *Tadorna cornuta*, presents a significant exception, the female being well-nigh as brilliantly garbed as her mate, wherefore hereditary prudence causes her to incubate subterraneously in rabbit burrows.

Among fishes also, the remarkable result of Dr. Francis Ward's observation from his subaqueous chamber was to reveal how faithfully the glittering sides of certain fishes reflect surrounding water-weeds, stones, etc., with protective effect. Mr. Chapman's long experience in various climes enables him to show that in very many wild animals their colouring is the reverse of protective; but it is unphilosophic to describe as "poetic theorists" (p. 133) those who recognise a protective result from the colouring of certain other animals.

It is a feature of these reminiscences that while in one chapter the author expresses vigorous dissent from the opinions formed by other naturalists, in another chapter he approves of action founded on those opinions. Thus, while he denounces the enactment of a close time for water fowl in Britain as one of the "long-drawn bungles of those in high places at the instance of hysterical protectionists" (p. 42), he applauds enthusiastically similar legislation which has saved the Spanish ibex, *Capra hispanica*, from extermination (p. 99).

A discussion on the maximum speed of flight attained by different kinds of bird is an interesting essay contribution on a difficult problem which Mr. Chapman does not claim to have solved; but suggests that, whereas Flight-Lieut. Webster in the international aeroplane trials at the Lido in September 1927 registered a speed of 289 miles an hour, the speed of bird-flight has hitherto been greatly under-estimated (Chap. xiv.).

Since this notice was written, the reviewer has learnt with sincere regret that the author is no more—regret that must be shared by all who esteemed Mr. Chapman as an experienced naturalist, a skilful draughtsman, and an entertaining writer.

HERBERT MAXWELL.

Photographic Star Fields.

Isaac Roberts' Atlas of 52 Regions: a Guide to Herschel's Fields (*avec texte anglais et texte français*). Edition commemorating Isaac Roberts' Centenary (1829–1904). By Mrs. Isaac Roberts (*née* Dorothea Klumpke). Pp. 44+61 plates. (London: Wheldon and Wesley, Ltd., n.d.) 42*s*. net.

IN the *Philosophical Transactions*, 1811, Herschel gave a list of fifty-two regions in the sky which he described as showing "extensive diffuse nebulosity." Little attention would appear to have been given to the matter at the time, and it was not until 1862, when Auwers reprinted the list, that we find further mention of the fields in question. Thirty years later, Barnard reprinted the list in *Knowledge*, but again no observations are recorded.

It was to determine the presence and extent of the nebulosity observed by Herschel that, in 1903,

Isaac Roberts undertook a systematic examination of the fifty-two fields. Roberts photographed each field simultaneously with his 20-inch reflector and with a 5-inch Cooke lens. The result of this survey was given in a paper which appeared in the *Monthly Notices, R.A.S.*, vol. 63. In this, Isaac Roberts reported that in four of the regions only had his photographs confirmed Herschel's observations. In the other forty-eight regions no trace of nebulosity was shown on his plates. In recording this he was reporting the result of a survey taken on a definitely determined plan laid down beforehand. The exposure time given to both series of photographs was ninety minutes, this being considered sufficient to show any nebulosity likely to have been seen by Herschel. It was pointed out at the time that both Max Wolf and Barnard had photographed nebulosities in some of these forty-eight areas. There the matter rested for a while, until, in 1926–27, Father Hagen published the results of his visual survey, in which he confirmed Herschel's observations.

As a tribute to the memory of her husband, Mrs. Isaac Roberts now publishes an atlas of the fifty-two regions, consisting of sixty plates, reproduced from the original negatives taken by him in the course of his survey. The atlas is remarkable for the care which has evidently been taken to ensure a faithful copy of the original plates. As photomechanical reproductions of astronomical photographs they are amongst the finest we have seen. The atlas, as a whole, is very tastefully got up, and it is an easy matter to make identifications on the plates, full particulars being given on each sheet. The plates are reproductions in 'negative,' the stars appearing as dots on a white ground; undoubtedly the best way of reproduction. To those interested, this atlas should prove to be one of the greatest value. The plates have been reproduced on an enlarged scale of 10 mm. = 6·3′ for reflector plates and 10 mm. = 32′ in the case of the 5-inch lens photographs.

The text which accompanies the atlas contains a short account of Herschel's observations of the fields, followed by Isaac Roberts' report on the result of his photographic survey. A very full and complete description of the charts, accompanied by tables, is also given. There is also a chart showing the distribution of the fifty-two areas, which are somewhat scattered over the northern hemisphere and extend to 100° N.P.D. In a preface, Father Hagen, Director of the Vatican Observatory, gives a historical account of the observations of these regions of the sky hitherto made.

In publishing this series of plates, Mrs. Isaac Roberts could not have chosen a more fitting manner of paying tribute to the memory of one who was a pioneer in astronomical photography, and whose work in this direction gained for him the well-merited reward of the gold medal of the Royal Astronomical Society. The plates now reproduced are further evidence of the skill and devotion with which he applied himself to his task.

No doubt many will be glad to know that copies of the atlas may be purchased.

Our Bookshelf.

Ice Cream: a Textbook for Student and Manufacturer. By Prof. G. D. Turnbow and L. A. Raffetto. Pp. ix + 407. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 20*s.* net.

The making of ice cream has become an important branch of the dairy industry in the United States, and the above volume has been written to serve as a text-book for students—instruction in ice cream manufacture is now given in thirty of the State colleges in America—and a reference book for those engaged in the trade.

The material in the book is well arranged. First a historical introduction, then, after a discussion of the food value of ice cream, three chapters are given to recipes used in making the many different kinds of ice cream which are mentioned, some of them of an elaborate nature. The use of fresh fruit and fruit juices plays an important part in these recipes. In another chapter the basic materials of ice cream—milk, cream, butter, sugar, gelatine, and eggs—are dealt with, and a number of formulæ by which the proportions of the ingredients for any mixture may be calculated are given. Mixing is followed by pasteurisation and after this operation the mixture is homogenised, to break up the fat globules and increase the dispersion of the fat; then comes the freezing of the mixture. Complicated machinery is required for the last two operations, and a good account of it is furnished. An important chapter is the one dealing with the various engineering questions connected with the running of a modern ice cream plant. As dairy products are the main raw material, methods for their analysis are given, as are also methods of bacterial analysis.

Although the manufacture of ice cream in Great Britain in no way approximates to the industry in the United States, there are no doubt many to whom this book will appeal, and to them it can be strongly recommended. Perhaps in time—and a start has already been made—ice cream will become as popular in England as in America; it is clear that an increase in consumption will be to the benefit of the dairy industry. Already there is a demand on a small scale for instruction in ice-cream making, and two at least of our dairy institutes have taken up the subject.

Dielectric Phenomena. 2: *Electrical Discharges in Liquids.* By S. Whitehead. Edited with a Preface by E. B. Wedmore. (Published for the British Electrical and Allied Industries Research Association, being Reference L/T 30.) Pp. 137. (London: Ernest Benn, Ltd., 1928.) 12*s.* 6*d.* net.

IN the first volume of this treatise, Mr. Whitehead discussed electrical discharges in gases. So long ago as 1905, A. Russell pointed out (*Proc. Phys. Soc.*, vol. 20, p. 49) that the maximum stress at which a spark ensued between spherical electrodes immersed in a gas was constant within certain limits. In 1910 the same physicist pointed out (*idem*, vol. 23, p. 86) that an algebraical expression of the form $A + B/\sqrt{a}$, where A and B are constants and a is the radius of either of two cylindrical electrodes, could be used to predict the stress at which ionisation begins in air.

Since then, an immense amount of research to discover new laws and to show how the results could be applied to testing commercial materials has been done. When the electrodes are in a liquid and the voltage is raised sufficiently, an unstable rise in the small conduction current takes place at a definite voltage. This may discharge the electrodes or may result in the formation of an arc. This phenomenon the author terms 'spark-over in liquids.' Previous to its occurrence, transient flashes sometimes pass between the electrodes, or streamers may spread out into the gap. In rare cases a glow may be observed previous to the sparkover, somewhat similar to the corona we see in air. In most cases the electric strength of a liquid depends on the impurities in the liquid, and hence a distinction has to be made between the electric strength of the pure liquid and the liquid in the commercial state. The author states that theories put forward to explain the variation in the electric strength of liquids generally discuss merely the behaviour of the impurities. It appears that to get formulæ for the electric strength in these cases both the effective and the maximum potential difference have to be taken into account.

Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Roger Adams, Editor-in-Chief. Vol. 8. Pp. vii + 141. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 10*s.* net.

THE editors direct attention to two distinct processes for making both β-chloropropionic acid (from acrolein or trimethylene chlorohydrin) and trimethylacetic acid (from *tert.*-butyl chloride or pinacolone). One of the most interesting of the preparations included in the volume is that of *l*-arabinose from mesquite gum. This material, which is collected by the natives in the south-western United States and northern Mexico, is stated to furnish from 36 to 46 per cent of its weight of crude *l*-arabinose, and a yield of 25·4 per cent of the purified sugar is mentioned in the preparation described. The raw material is said to be abundant, the process is simple, and the yields are comparatively high. A detailed description of Prof. Roger Adams's apparatus for the catalytic hydrogenation of organic compounds is another feature of this volume which merits particular mention, for a working account of a really dependable apparatus of this type has long been needed. Prof. Adams's hydrogenator is simple in construction, and the reviewer gladly avails himself of this opportunity of testifying to its effective working in actual laboratory practice. J. R.

Fluorescenz und Phosphorescenz im Lichte der neueren Atomtheorie. Von Peter Pringsheim. (Struktur der Materie in Einzeldarstellungen, herausgegeben von M. Born und J. Franck, Band 6.) Dritte Auflage. Pp. vii + 357. (Berlin: Julius Springer, 1928.) 24 gold marks.

THE first edition of Prof. Pringsheim's book appeared in 1921, and it consisted of just over two hundred pages. The preface to the third edition is dated Christmas 1927, and this edition consists of more than three hundred and fifty pages. Yet it is clear that the author must have used considerable restraint in order to keep the new edition within these bounds, when we remember the large amount of important work which has been published during the interval between 1921 and 1927. For example, we have the important work of Cario and his collaborators on the phenomena produced by collisions of the second kind, and researches, such as those of Wood and Ellett, on the polarisation of resonance radiation.

Prof. Pringsheim carefully describes all these new advances, and his book is a very useful guide to the whole subject of fluorescence and phosphorescence. The subject is a very large one, which is continually growing at a rapid rate, and it is interesting to remember that the recent work on the newly discovered Raman effect must already have provided sufficient material to encourage Prof. Pringsheim to look forward to the appearance of a fourth edition of his book.

Manuel de photographie. Par H. Vial. (Bibliothèque professionnelle). Pp. viii + 276. (Paris: J.-B. Baillière et fils, 1928.) 16 francs.

THE pages are not very large, nor are they exceedingly numerous, but M. Vial has justified the title of "Manual of Photography" by giving the essence of each subject described, and avoiding such matter as belongs more properly to trade lists and circulars. The treatment is quite modern, including desensitising, sensitometry, enlarging, bromoil, ozobrome, photography of coloured objects, photography in colours (autochrome), and stereoscopic work. The subject is divided into four parts: (1) General and introductory, including elementary optics, objectives, perspective, and apparatus; (2) the negative; (3) the print; and (4) sundry matters mentioned above, and the use of artificial light. The illustrations are all helpful and nearly all are original, and the practical directions are sufficient in the more important sections.

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.*]

The Cameroon Gorilla.

IN NATURE of Dec. 24, 1927, Sir Arthur Keith discussed a collection of gorilla skulls which I made in the Mamfe district of the Cameroon. German authorities had long separated this western race from the better-known Congo gorilla and had given the Cameroon gorilla the title of *Gorilla gorilla diehli*. Yet no skin of this new species has yet been described, and so great an authority as the director of the Berlin Zoological Museum has even doubted if the species still exists.

Two skins have recently come into my possession from the heart of the Mamfe area, one of which is a mature female, while the other is alleged to be her offspring and is a female of two or three years. In each case the skull was tied to the skin.

The coat of the infant is entirely black except for a patch of brown hair between the ears stretching five inches back from the forehead. There are, however, a few sparse white hairs on the back, but not enough to render it in any sense grey. It differs from the chimpanzee of the same age in this neighbourhood, in that the hair is shorter and coarser. The older female, which is probably the mother, has a coat which is quite black on the flanks and belly, but quite grey on the back except for a patch of brown six inches long above the forehead.

The hirsute appearance is, therefore, in no respect different from the gorilla of the Ubangie district of the Congo, several fresh specimens of which I was privileged to see last year in Major Powell Cotton's magnificent collection. Nor is there any single feature of the skull which is peculiar to this new species.

It is, therefore, open to question whether it is proper to erect a new species or even subspecies on such slender grounds, since such differences as can be shown to exist may well be racial.

The really striking differences between the Cameroon gorilla and his fellow at the eastern extremity of the gorilla belt are those of habit and behaviour. For whereas Carl Akeley and others have described the eastern gorilla as timid and retiring, the Mamfe gorilla is excessively ferocious and neither timid nor shy. Alone among wild animals with which I am acquainted, the adult male gorilla will *always* attack man on sight. This profound alteration in his behaviour as he approaches the western limits of his range might perhaps justify the creation of a new subspecies which could not be justified on anatomical grounds alone.

Akeley's gorilla differed in another important respect from his western prototype, in that he always slept with his female belongings in trees. So far as I am aware, and I have slept among them several times, and as lately as last week, this is never the case with the Cameroon gorilla, among whom the great male will invariably make his bed on the ground at the base of the tree in full view of his females and offspring in their tree beds.

This observation of mine has been held to be original and scarcely authentic, but on reference to the literature on the subject I find that H. von Koppenfels more than fifty years ago made the same observation in reference to gorilla inhabiting the country that lies between the mouth of the Muni River and that of the Congo.

The point I am anxious to emphasise is this: that if wide differences in habits and behaviour can give grounds for the creation of a separate species, then the Cameroon gorilla may fairly claim that distinction. If, however, a new species must show some definite and constant physical variation either in the bones or the hirsute appearance, it is impossible to separate the most easterly gorilla, that from Kivu, from those I have studied in the extreme west in the Cameroon and Nigeria. Such differences as exist are racial and not specific.

N. A. DYCE SHARP.

Ogoja, Nigeria,
Jan. 21.

Line Absorption Spectra in Solids at Low Temperatures in the Visible and Ultra-violet Regions of the Spectrum.

FROM extrapolation of X-ray data, it is known that the electrons in the N_1 (and N_2) shell of the ions of the rare earths possess *less* energy than those in the 0 shells. Expressed in terms of the Bohr-Stoner scheme, the electrons in the 4_4 shell are held less tightly than those of the 5_1 or 5_2, etc., shells. According to that scheme the electrons are arranged in the following manner:

Atomic Number of the Neutral Atom.	Symbol of Ion.	$1_1 \longleftrightarrow 4_3$.	4_4.	5_1.	5_2.
57	La^{+++}	closed shells	0	2	6
58	Ce^{+++}	,,	1	2	6
59	Pr^{+++}	,,	2	2	6
71	Lu^{+++}	,,	14	2	6

The proof that the 4_4 shell is gradually filled in this way was completely established by Hund (*Zeit. für Physik*, **33**, p. 855; 1926). By assuming the above arrangement and the presence of *normal* multiplet coupling between the orbital and spin moments of the electrons, he calculated the character of the most stable energy level for each ion and its corresponding magnetic moment just as if the ion were in the gaseous state. His results were in beautiful accord with the magnetic data on the solids and on their solutions—with but two exceptions.

Similar calculations for the ions of the iron group failed of agreement as might have been expected, since chromic ion, for example, in solution, is the molecular ion $Cr(H_2O)_6^{+++}$ due to the water of *co-ordination* and not the atomic ion Cr^{+++} (*Jour. Amer. Chem. Soc.*, **49**, p. 2456; 1927).

Such extraordinary immunity from external coupling as is exhibited by the ions of the rare earths in their magnetic behaviour suggested that their absorption spectra might resemble the line spectra of ions in the gaseous state. The basic electronic level in each case would be, then, the one confirmed by Hund from its magnetic moment.

X-ray data lead to the conclusion that the energy necessary to remove a 4_4 electron completely from its ion is probably within the range of a quartz spectrograph. Indeed, most of the salts are coloured, so that the energies required for electronic activation may be measured through glass. We used a large quartz spectrograph from Hilger and a three-prism 'Uviol' glass spectrograph from Steinheil.

Of previous investigations which concern us here, those of Becquerel alone in 1906, in collaboration with Kamerlingh Onnes in 1908, and finally with Kamerlingh Onnes and de Haas in 1925, are the most important. (See the remarkable summary by J. Becquerel in "Gedenkboek aan H. Kamerlingh Onnes," 1922, p. 288.) They studied the absorption spectra of minerals principally, which contained mixtures of rare earth salts, and found that upon lowering the temperature the narrow bands appearing at room temperature

became much narrower, and in some instances attained a sharpness comparable with the line spectra of gases. However, they made no recorded attempt to identify their spectra or to evaluate them. Their measurements were limited on the short wave-length side of the spectrum by the glass (Dewar tubes) which enclosed their crystals.

We have begun a systematic study of the absorption spectra of the individual rare earths from room temperature to that of liquid hydrogen, both in the visible and in the ultra-violet. At present we wish to report the general features of the spectra already obtained, those of gadolinium, samarium, and erbium.

GADOLINIUM.—The uniaxial crystal of $GdCl_3 . 6H_2O$ was made from $Gd_2(SO_4)_3 . 8H_2O$ of atomic weight purity prepared under the direction of Prof. B. S. Hopkins of the University of Illinois, to whom we are extremely grateful. The spectra were practically identical with that obtained from a crystal from another source. The spectrum consisted of about sixty lines similar in sharpness even at room temperature to the emission lines of iron which were used for comparison. At room temperature the entire spectrum was in the ultra-violet extending to about 2350 A. Upon lowering the temperature new faint lines appeared in the visible, and most of the old lines shifted slightly toward the red. There was but little change in the spectrum between the temperature of liquid air and that of liquid hydrogen.

The substitution of bromide for chloride did not affect the general appearance of the spectrum, but it separated the components of the multiplets a little, displacing some components toward the short and some toward the long wave-lengths.

From the magnetic moment of gadolinium ion we know that the level lowest in energy is an ^8S term, and by the Hund theory the other basic levels belong to systems of lower and even multiplicity. Groups of lines allow themselves easily to be arranged as multiplets in energy diagrams. Many of the closely spaced lines appear to have originated by the splitting-up of a 'normal' energy level because of the influence of the electrostatic fields of the neighbours of the gadolinium ions, principally by the water molecules. We are led to this conclusion by the small change induced by the bromide ion. The fact that it displaces the lines in particular groups both toward the short and toward the long wave-length regions practically decides that the Stark levels are shifted above and below the 'original undisplaced' energy level.

SAMARIUM.—$SmCl_3 . 6H_2O$ was prepared from a salt of samarium of unusual purity kindly furnished us by the late Prof. C. James, of New Hampshire College. At room temperature its spectrum consisted of diffuse lines and bands mostly in the region between 3000 A. and 5000 A. Upon lowering the temperature the lines sharpened and the bands became narrower. At the temperature of liquid hydrogen the lines were exceedingly fine, and the uneven intensity of the few remaining bands suggested a complete resolution into lines if the temperature were further reduced. At the low temperatures some lines disappeared and new lines, all extremely sharp, made their appearance. The appearance of a new spectrum and its increasing prominence, at the lower temperatures, confirmed the expectations derived from magnetic measurements about to be published by one of us. They show that samarium ion in the solid state is a mixture of electronic isomers. A considerable proportion of the samarium ion (the ratio varying with the temperature) is present in each of two distinct electronic levels differing very little in energy.

The spectrum which disappears as the temperature is lowered is due to the thermally excited state, and the new sharp lines which become more intense as the temperature is reduced reveal the presence of the ion that is more stable at the lowest temperatures.

ERBIUM.—$ErCl_3 . 6H_2O$ was recrystallised several times from an erbium salt marked pure by the Welsbach Company. Its spectrum at room temperature consisted of very diffuse bands, but at the temperature of liquid air, and especially at that of liquid hydrogen, the bands became resolved into lines of extraordinary sharpness. These lines clustered in groups, and the latter were separated by rather large intervals. The structure of the groups did not suggest band spectra of gaseous molecules, but rather the multiplets of gaseous atoms under the influence of external fields. Very few lines were found below 3000 A.

We are extending this work to include the other rare earths and are studying especially the influence of other negative ions and of water of crystallisation on the various spectra. This work promises quantitative information concerning such influences of far greater sensitivity and accuracy than can possibly be obtained by the use of the double X-ray spectrometer with which many similar investigations are being undertaken.

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Knock Ratings of Pure Hydrocarbons.

MESSRS. BIRCH and Stansfield have been good enough to send us a copy of their letter in reply to our communication which appeared in NATURE of Feb. 23. Our remarks on the knock rating of pseudo-cumene are taken from the Aeronautical Research Committee Report and Memorandum No. 1013 (1925), in which it is stated that the addition of 5 per cent by volume of this hydrocarbon to a common No. 1 petrol lowers the H.U.C.R. of the latter to the extent of 0·4 per cent, whereas the addition of the same amount of benzene raises the H.U.C.R. by 1·0 per cent.

With regard to the figures quoted by Mr. Birch and Mr. Stansfield for trimethyl-ethylene and diamylene which do not agree with our own, it will be observed that our figures refer to concentrations by volume, whereas theirs refer to concentrations by weight. Therefore, the two sets of figures do not allow of strict comparison, because relations between concentration and anti-knock value are often not linear and because of the comparatively large difference in the specific gravities of the two hydrocarbons concerned.

The observation that an acid refined unsaturated spirit has a lower anti-knock value than the original is readily explained by the fact that quantitative conversion of olefines to polymers is never attained in ordinary refining practice. Especially is this the case with the butylenes, amylenes, and hexenes, the hydrocarbons in question; in fact these substances are largely removed by the acid in the form of sulphuric esters. Many references have been made of late in the American scientific press to the relative merits of the various methods of anti-knock engine testing commonly used, and it has often been observed that exact correlation of the results obtained by different methods is frequently difficult to obtain (Edgar, *J. Soc. Aut. Eng.*, **22**, 1, 41; 1928: MacCoull, *Oil and Gas J.*, May 10, 1928, p. 208). Edgar has pointed out that the apparent discrepancies are probably due to the different fuel-air ratios employed. It will be apparent that the addition of 20 per cent of such a volatile substance as trimethyl-ethylene (B.P.

38·42° C.) will raise the volatility of any spirit in which it is dissolved to a quite appreciable extent, and, because of this, the strength of the explosive mixture reaching the engine cylinder will be considerably altered unless precautions are taken to prevent this or unless the air-fuel ratio is standardised in some way.

It is highly probable that the difference between our figures for trimethyl-ethylene and diamylene and those quoted by Mr. Birch and Mr. Stansfield is due to such an effect. Suffice it to say that in our determinations with the Delco testing unit fitted with the Midgley and Boyd bouncing pin the technique adopted was the same as that used by the Anglo-American Oil Co. and its associated American interests, and embodied the important recommendations on mixture strength recently made by Campbell, Lovell, and Boyd (*J.I.E.C.* **20**, 1045; 1928). The samples of trimethylene and diamylene we used for the engine tests possessed the following properties, which show good agreement with those recorded in the literature.

Diamylene. B.P. 150-156° C.
$D.\frac{20°}{4°}$·8112.

Trimethyl-ethylene. B.P. 38·3–38·5° C.
$D.\frac{15°}{4°}$·6669.
$N.\frac{15°}{D.}$1·3910.

We agree with the necessity of ensuring that all hydrocarbons are free from peroxides before conducting engine tests owing to their extreme action in promoting detonation. (Callendar, *Engineering*, pp. 147, 182, 210; 1927; Mardles., *J.C.S.*, p. 872; April 1928.)

We are very interested in the observations of Mr. Birch and Mr. Stansfield on the auto-oxidation of cyclohexene. We have observed that cyclohexene possesses a greater affinity for gaseous oxygen than the straight chain olefines (cf. Stephens, *J.A.C.S.*, **50**, 568; 1928); nevertheless pentene-2 and trimethyl-ethylene as well as cyclohexene both decolorise indigo solution and liberate iodine from aqueous hydriodic acid and feebly acidified potassium iodide after exposure to ordinary light and air for a few days. Refluxing the hydrocarbons over sodium for some hours destroyed this action, but products of auto-oxidation were again detected after a short exposure to ultra-violet light. Oxidation products such as peroxides and aldehydes have been detected in a cracked spirit long before any formation of gum or any discoloration has been apparent.

We have also observed that the two olefines di-isobutylene and diamylene react with gaseous oxygen under the action of light much more slowly than do the simple olefines such as the pentenes, while pseudo-cumene and m-xylene, aromatic hydrocarbons which have not the anti-knock properties of toluene, suffer auto-oxidation very quickly. It therefore appears that in the olefine series, and perhaps in the aromatic series also, ease of oxidation is intimately connected with anti-knock action; and in this connexion the phenomenon of auto-oxidation is especially interesting, having in mind the results of experiments recorded by Callendar (loc. cit.). This investigator has shown that peroxides and aldehydes are products of incipient oxidation during the compression stroke of an internal combustion engine, and that the extent of such oxidation is an important factor in the knock rating of any fuel. Messrs. Birch and Stansfield's views about the compactness of the molecule among isomerides on knock-rating are clearly complicated by their remarks on the behaviour of certain members of the aromatic series. We feel that insufficient work on this subject has yet been published upon which to base such a generalisation which will apply to hydrocarbons of all types.

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The Boundary of the Solar Chromosphere.

IN connexion with the theoretical side of the question discussed by Mr. R. W. Gurney (NATURE, Feb. 16, p. 240) and further by Prof. F. J. M. Stratton and Mr. C. R. Davidson (NATURE, Mar. 2, p. 318) the following points may be of interest.

In a paper shortly to appear (*Monthly Notices, Roy. Astr. Soc.*, March) I have tried to interpret the recent published measurements of the hydrogen chromosphere. At present it is only possible to give orders of magnitude. However, putting together the observations of Davidson and Stratton (*Mem. Roy. Astr. Soc.*, **64**, 105; 1927) and Davidson, Minnaert, Ornstein, and Stratton (*Monthly Notices, Roy. Astr. Soc.*, **88**, 536; 1928), on the Balmer series and associated continuous spectrum, with those of Pannekoek and Minnaert (*Verh. d. Kon. Akad. Amsterdam*, **13**, No. 5; 1928) on the absolute intensity of the H_γ line, one concludes that at the base of the chromosphere there are about $2{\cdot}2 \times 10^{10}$ ionised atoms of hydrogen and about 6200 atoms in the Balmer state, per cm.^{3}. (Stress is not to be laid on the precise number 2·2, which is only an estimate of the order so far as it can be derived from the present state of observation and theory.) Now, *were* there thermodynamic equilibrium, these two numbers would be characteristic of ionisation at almost exactly 5000° K.

The chromosphere is not in thermodynamic equilibrium, but I give reasons (loc. cit. and *Proc. Camb. Phil. Soc.*, **24**, 506; 1928) which I believe show that the various properties, atomic motion, distribution among stationary states, degree of ionisation, all define temperature parameters of the same order, say, to give rather wide limits, 4000° to 6000°, which is also the order of the temperature of the incident solar radiation. This agrees with the above numbers.

I venture to suggest that these considerations explain why chromospheric Ca^+ at the low pressures given by Prof. Milne's theory is not largely ionised to Ca^{++}. Milne explains it by the removal by gravity of the Ca^{++} ions as soon as they are formed; but I believe it is due to the fact that the large excess of hydrogen ions and electrons gives the Ca^{++} ion a vastly increased chance of recapturing an electron. I find that if the Ca^+ were in equilibrium at 5000° with these $2{\cdot}2 \times 10^{10}$ free electrons per cm.^{3} it would be only 4·7 per cent ionised, and I conclude that the order of ionisation must be the same in actual chromospheric conditions.

So long, therefore, as the hydrogen provides enough electrons to keep the ionisation of the Ca^+ fairly low, I conclude the type of equilibrium of the calcium is that given by Milne's theory. But as we ascend in the chromosphere and the number of electrons decreases we expect a departure from this type to set in until, at sufficient heights, the increased ionisation prevents it holding any longer. The radiation pressure on the calcium presumably then becomes negligible.

These considerations support Mr. Gurney's view that there must be a sharper upper boundary to the calcium atmosphere than former theory predicted. They show, however, that ionisation, and not, as he tentatively suggests, the 'coefficient of partial support,' is probably the determining factor.

Unfortunately, one cannot discuss the height of the

Ca^+ layer, since one does not yet know the density law of the ionised hydrogen. Pannekoek and Minnaert's work indicates it only so far as 3000 km. approximately, and precludes extrapolation by suggesting that their empirical law for H_γ ceases to be valid at that height.

This work, too, it may be mentioned, gives a fairly rapid falling off of the hydrogen line intensities with increasing height in agreement with Mr. Gurney.

I attempt a discussion of the equilibrium of the hydrogen in my paper, but reach no positive conclusion.

W. H. McCREA.

Göttingen, Mar. 5.

Insects Flying to Ships.

ALL those who have travelled about the world in recent years must have noticed the insects which fly to ships at anchor, attracted by the bright electric lights. Some years ago I secured a most interesting series (including a new species of moth) off the coasts of Chile and Peru, and in many other places have made collections where I could not go ashore. The most remarkable occasion of this sort was perhaps at Diamond Harbour, on the Hooghly River, near Calcutta, in December 1927. Going up, we waited some time, and again going down (on the way to Rangoon). The latter delay was caused by a railway accident in France, which prevented the through mails from arriving in time, so we had to wait until they were brought out in a tender some time in the night. Thus the deplorable accident brought good fortune to an entomologist travelling in India—a curious example of the interdependence of things. Diamond Harbour is not really a harbour, but merely a station on the river where ships anchor to await favourable conditions, with the shore distant perhaps half a mile.

The insects which came on board at Diamond Harbour were of various orders, but I will now only enumerate the remarkable series of Carabidæ or ground beetles, and a few beetles of other families, all identified for me through the kindness of the Imperial Bureau of Entomology. The Carabidæ were determined by Mr. H. E. Andrewes, the well-known authority on this group.

CARABIDÆ.

Casnoidea cyanocephala Fb.
**Clivina tranquebarica* Bon.
**Tachys impressipennis* Mots.
Tachys unistriatus Putz.
Apotomus hirsutus Bates.
**Oodes westermanni* Laf.
**Diplocheila impressa* Fb.
**Diplocheila polita* Fb.
Liodaphus birmanus Bates.
**Anoplogenius microgonus* Bates.
Anoplogenius new species.
**Stenolophus smaragdulus* var. *quinquepustulatus* Wied.

Andrewes has just published a long list of the Carabidæ of Ceylon, which includes, of the above list, those marked by an asterisk. Will some of the others presently reach there on ship-board, and is it possible that some already noted in both lists were carried to one or the other place on ships? Three of the above genera are at present apparently absent from Ceylon.

Some other beetles represented at Diamond Harbour were:

Cicindelidæ: *Cicindela sexpunctata* Fb.
Staphylinidæ: *Pœderus fuscipes* Curtis; *Philonthus quisquiliarius* var. *inquinatus* Steph.
Mycetophagidæ: *Litargus varius* Grouv.
Donaciidæ: *Donacia delesserti* Guér.
Halticidæ: *Chætocnema concinnipennis* Baly.
Hispidæ: *Hispa armigera* Ol.

It is a remarkable fact that both the species of Staphylinidæ cited also occur in Britain, and *Pœderus fuscipes* also flew on to the ship when we were anchored off Sourabaya, Java, on Mar. 7. Who can doubt that these have been spread by shipping?

We have in recent years heard a great deal about the spread of insects by automobiles, but perhaps we have not always appreciated the important part which must be played by ships, now that the vessels are so large, and carry so many electric lights. I suggest that travellers, even if not entomologists, might frequently do a good service by collecting the insects coming on board; especially the beetles, which need only to be put in a small bottle of alcohol. A more ambitious but interesting project would be to take out a small vessel with a bright light and determine just how far from the shore insects of different kinds can be attracted.

T. D. A. COCKERELL.

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Boulder, Jan. 29.

Fine Structure Absorption Edges in Metals.

IT is well known from the experiments of Lindh and others that when pure metals are examined, in general no fine structure edges (as distinguished from the secondary absorption edges) are observed. If, as is generally believed after Kossel, the fine structure edges originate in the removal of the electron from the K shell to the various optical levels in the atom in question, it is difficult to understand why these edges should be absent in them. The non-appearance of the fine structure edges when metallic plates or metallic crystals (in the form of powders) are used as absorption screens can be explained on the hypothesis of the existence of free electrons in metals. The primary absorption edge originates from the removal of an electron from one stationary orbit inside the atom to another optical orbit, both these orbits possessing definite energy value.

In metallic plates the outermost electron or electrons may be supposed to be free, and as such the optical levels of definite energy values, as are usually observed in the vapours of these metals, can have no real existence. The removal of an electron by the absorption of radiation from the K shell to the periphery of the atom simply sets the electron free from the atom, and unless the former has sufficient energy it will be confined to the metal itself. The extra energy necessary to take the electron out of the metal depends on the nature of the material and the crystal lattice, and is generally of the order of 4-5 volts. Thus not only the fine structure according to Kossel will be absent in metals, but also the most intense position of the white absorption will be confined to a range (of about 4-5 volts) smaller than the ionisation potential of the atom in question.

This statement is supported by the works of Fricke (aluminium and magnesium), Lindh (potassium, titanium, vanadium, chromium, manganese, and iron), and Chamberlain (titanium, vanadium, and chromium) in metals. Though we may not have fine structure edges of metal as predicted by Kossel, which should appear only in vapours of these elements, one can surely expect secondary absorption edges of these metals caused by the multiple absorption of the incident radiation by two or more electrons occupying different energy levels of the atom under consideration (see Ray, NATURE, Nov. 17, 1928, p. 771; Lindsay and Voorhees, *Phil. Mag.*, November 1928).

In vanadium metal, Lindh has observed a secondary absorption edge with a separation of 8·7 volts from the primary. Evidently this edge cannot be included under the category of Kossel's fine structure edge,

as the ionisation potential of vanadium is only 6·5 volts. A rough calculation shows that this edge originates from the double absorption of the radiation by the electrons in the K and M shells, the energy value of the latter being of the order of 8-9 volts.

The case of non-metals and solids from this point of view will be discussed separately.

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Origin of the Ultra-violet Beryllium Hydride Band Spectrum.

THE beryllium arc in a hydrogen atmosphere emits two band systems—one in the green region at 4800-5120 A., and the other one in the ultra-violet from λ3700 and extending as far as can be reached by quartz optics. Very recently both band systems have been measured and analysed by W. W. Watson (*Phys. Rev.*, **32**, 600; 1928), and independently of this, M. Petersen (*Phys. Rev.*, **31**, 1130; 1928) has given a short account of the green system. Both investigators state that this system belongs to an electronic transition $^2P \longrightarrow {}^2S$ of beryllium hydride, thus apparently corresponding to the long set of well-known band systems emitted by hydrides of magnesium, calcium, zinc, cadmium, and mercury. The ultra-violet system was analysed by Watson only in the region λ3700-2700 and thus permits no definite statements regarding the pure electronic transition, $n' = n'' = 0$, which falls below λ2700. However, as pointed out by Watson, the investigation of the band $n' = n'' = 0$ is necessary for information regarding the origin of the ultra-violet system. Watson hesitates between two alternatives: the ultra-violet system emitted by beryllium hydride having a common final state with the green system $^2S \longrightarrow {}^2S$, or belonging to an ionised BeH^+ molecule, the transition being of the type $^1S \longrightarrow {}^1S$.

More than a year ago I was engaged upon an investigation of the band spectrum of beryllium oxide (*Arkiv för Mat.* etc., Bd. 20 A, 1928), and in the course of work was led to study the spectrum of beryllium hydride. From this point of view I was interested in the two alternatives mentioned above. The ultra-violet system was photographed by a Hilger quartz spectrograph E_1 which gives the spectrum completely resolved down to λ2200. A large number of bands belonging to the final vibrational state $n'' = 0$ [$0 \longrightarrow 0$, $1 \longrightarrow 0$, $2 \longrightarrow 0$, $3 \longrightarrow 0$, $4 \longrightarrow 0$], were measured and analysed. The values of their final rotational term differences $2\Delta F''$ definitely rule out the first alternative given by Watson. Both $2\Delta F'$ and $2\Delta F''$ can be represented by the ordinary formula $2\Delta F = 4Bj + 8Dj$.

The $B^{(n)}$ values so obtained are here given:

$$2B'_n = 14{\cdot}45 - 0{\cdot}31n'\ ;\quad 2B''_n = 21{\cdot}7 - 0{\cdot}62n''\ ;$$
$$(n = \tfrac{1}{2}, \tfrac{3}{2}, \ldots).$$

For the green system the values obtained from the measurements by Watson and myself are:

$$2B'_n = 20{\cdot}9 - 0{\cdot}65n'\ ;\quad 2B''_n = 20{\cdot}5 - 0{\cdot}55n''.$$

The differences in the final states of both systems, though small, are very distinct. The 0-lines ($\nu_0 = P\frac{1}{2}$) best fit the formula:

$$\nu_0 = 39417{\cdot}1 + [1476{\cdot}6n' - 14{\cdot}9n'^2 - 0{\cdot}42n'^3] -$$
$$[2221{\cdot}9n'' - 41{\cdot}3n''^2] (n = \tfrac{1}{2}, \tfrac{3}{2}, \ldots).$$

The nuclear separation of the molecule as calculated from B_0'' is $r_0'' = 1{\cdot}31 \times 10^{-8}$ cm.

From what is mentioned above I think no objections can be raised to the statement that the known systems are emitted by two different molecules. As the only possible origin for the ultra-violet bands there remains the ionised BeH^+ molecule. This is also in agreement with the fact that the bands are formed by singlet series, the transition being of the type $^1\Sigma - {}^1\Sigma$.

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An Optical Method for Analysing Photographs of α-Ray Tracks.

FOLLOWING a suggestion from Dr. A. v. Hippel, of the University of Jena, I have tested the following optical method of analysing the right-angle views of α-ray forks. The double camera for photographing α-ray tracks is represented diagrammatically in Fig. 1.

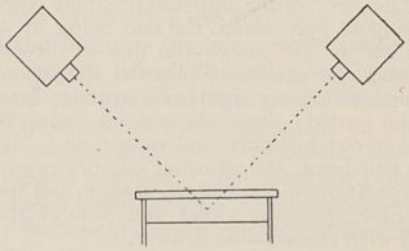
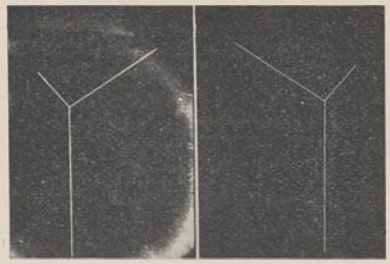


FIG. 1.

These cameras take two views simultaneously on separate negatives. In order to secure a full-sized image of the α-ray track in the plane in which it occurred, it is only necessary to replace the developed negatives in the camera and project them on the focal plane. By adjusting and rotating a thin translucent screen, a position is found where no part of the composite image appears double. The screen is then in the proper plane. This adjustment is very sensitive, even slight displacements of the screen from the correct position affecting some part of the image.

It is very easy to secure a permanent record of the projected image of the α-ray track by replacing the screen by a photographic plate. A photograph thus obtained is of course actual size and should correctly reproduce all angles of the track in the plane in which they occurred. Fig. 2 (*a*) shows a photograph of a



(*a*) (*b*)

FIG. 2.

model track which was secured as outlined above, the plane of the model being inclined at 30° to the horizontal when the original negatives were made. Fig. 2 (*b*) is a direct photograph of the track itself taken actual size in the ordinary way. Within usual limits of error the two are identical.

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Solar Diffraction Spectrum from a Single Strand of Cobweb.

THE following account of an unusual observation of the solar spectrum seems worthy of record in the pages of NATURE: Recently, in brilliant sunshine, I was taking a country walk, and after walking northwards for a mile or so I turned towards the sun. The dark shadow-side of a hedge-bank was close in front, and at once I saw—through my spectacles, clearly projected against the dark bank—a brilliant vertical strip of the solar spectrum. Naturally thinking this to be due either to scratches or dust on the glass, I took off my spectacles and was surprised to see a single strand of cobweb stretched horizontally across one lens between the two frame-attachments, not touching the glass. On replacing the spectacles and raising and lowering the head through a range of about 70° or 80° it was easy to see the first and second orders of the diffraction spectrum, and part of the third. The first order appeared, violet uppermost, when the head was raised, the sun being at an angle of about 20° or 30° above the line of direct vision. As the head was gradually lowered the second order commenced as a hazy light overlapping the red end of the first order; then the second order blue and green shone out brilliant and pure; and, on further lowering the head, the unusual colours produced by the superposition of the yellow, orange, and red of the second order upon the violet and blue of the third, appeared with remarkable beauty.

So far, there is nothing new, for one has often seen diffraction spectra produced by scratches on a window pane, for example in a railway carriage; but the succeeding part of my observation is new to me: A sudden brief period of dead stillness allowed the stretched cobweb to stop vibrating in the breeze, and then appeared brightly and definitely (though somewhat out of focus, because, though myopic, my minimum distance of clear vision is 4 or 5 inches) the familiar lines of the solar spectrum, or rather the bright spaces between the lines. The strip of spectrum, which had appeared as a rectangle about ten times as long as its breadth, with clean-cut edges, now appeared widened by irradiation at every bright space.

Being a spectroscopist of some experience I could definitely recognise the 'pattern,' especially in the bright yellow-green and in the strongly marked portion of the blue; and, as the observation was several times carefully repeated whenever a dead-calm interval occurred, there can be no doubt of its reality. On moving the head slightly from side to side I found that the cobweb was evidently finer and more polished in certain parts, and these parts gave a very bright spectrum with very marked alternations of light and dark. WALTER SCUTT.

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Pollination of Species of *Primula*.

DARWIN (1862) showed that in some species of *Primula*, which are dimorphic (heterostyled), a cross between like forms was less fertile than that between the two forms. In other species the heteromorphic and homomorphic crosses are equally fertile.

Primula obconica is of the first type; a short-styled plant crossed with another short-styled plant or a long-styled with a long-styled produces no seed, while long-styled by short-styled and the reciprocal is fully fertile.

The following facts suggest that the physiology of the relationship of male gametophyte and style is the key to the situation.

Pollen of a long-styled plant will not germinate upon a long style of *P. obconica*. Pollen of a short-styled plant will germinate, but the pollen-tubes will not penetrate far into the stigmatic tissue of a short style. Pollen of either short or long-styled plants will produce excellent tubes in the styles of opposite type. Upon agar-agar and 12 per cent cane sugar medium, pollen of long-styled plants only germinates to the extent of 15 per cent, while pollen from short-styled plants germinates to the extent of 75 per cent. The succeeding growth of pollen tubes of the two types is in accordance with the germination percentages.

In *P. sinensis*, in which the homomorphic and heteromorphic crosses are equally fertile, the pollen tubes of short and long-styled plants grow equally well on both types of style. In media there is no observable difference in the behaviour of the two types of pollen.

Similar work on other species is proceeding.

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The Electronic Charge *e*.

IN a letter to NATURE of March 2, Dr. R. T. Birge has pointed out the difficulty of reconciling the experimental value of 137·2 of $hc/2\pi e^2$ with Prof. Eddington's theoretical value of 136. He concludes that it is highly improbable that any of the measurements of the three physical quantities involved could be so much in error. The only other possibility seems to be that the value of π we calculate for practically zero field is not the value that should be inserted in obtaining the value of $hc/2\pi e^2$.

It is, of course, well known that in a radial gravitational field, the value of π is less than the ordinary value. Unfortunately, however, if we imagine that owing to the gravitational attraction of an electron we should use a smaller value of π in calculating $hc/2\pi e^2$ it will only make the discrepancy between experiment and theory worse. In any event, the mass of an electron is so small that its effect on the value of π would be completely negligible. Is it possible that the intense electric field near the electron could have the reverse effect on the value of π, and thus bring the two values into agreement? This idea may appear rather fantastic, but is perhaps worth some consideration. J. H. J. POOLE.

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The British Museum (Natural History).

MANY biologists will be grateful for the two weighty leading articles in NATURE of Mar. 16 and 23, on the British Museum of Natural History and on the Museums of South Kensington. This letter does not purpose to discuss the important questions therein raised nor the conclusions drawn, but merely to dispel a possible confusion, which may arise in the mind of the reader of the earlier article, between editorial opinion and the unanimous resolution of the meeting of British zoologists.

At that meeting, as the article in NATURE of Mar. 16 indicates, it was shown clearly that it is the strong and unanimous desire of zoologists that the British Museum of Natural History shall be independent of the British Museum of books and antiquities and on completely equal footing.

On the desirability or otherwise of (1) changing the Trustees, (2) coming under a government department, or (3) being ruled by a council of experts, zoological opinion was shown not to be unanimous. On these points no resolution was passed. GEO. P. BIDDER.

Cambridge, Mar. 24.

Co-operation in Science and Industry.[1]

By Prof. J. F. THORPE, C.B.E., F.R.S.

THE past ten years have witnessed a wonderful development of organised industry and organised science in Great Britain, and although conditions are still rapidly changing it is nevertheless possible to look forward and in some measure to determine the position in which we stand and the prospects for the future. The War, although one of the greatest economic disasters the world has yet experienced, gave without question a stimulus to discovery and production which no other event could have occasioned. Especially was this the case in the engineering and chemical industries, for the need of new appliances and methods, and the necessity for producing in large quantities and in the shortest possible time, caused the keenest intellects to be brought to bear on the problems at hand, and led to the discovery of new and important processes many of which have now been introduced into industry.

It is a principle conceded now even by the enlightened leaders of labour that the universal demand for a higher standard of living necessitates a general increase in the national productive capacity, the term 'productive capacity' being used to mean the capacity to render available the potential wealth of the nation in a suitable form. It is chiefly to the chemical and allied industries, mining, metallurgy, etc., that Great Britain turns, because it is their peculiar function, aided by the engineer, to make available its mineral, vegetable, animal, and atmospheric wealth. Provided chemical and allied industries are properly organised, they should be in a particularly strong position not only to increase the availability of wealth, but also to guide national policy in questions strongly affecting material prosperity. The age is at hand, if it is not already here, in which the changing majorities of governments will no longer be able to determine major policies as of war, financial and fiscal, except in directions approved by organised industry. Control by those who hold the keys of national prosperity, that is, of organised industry, is one of the alternatives to class control and is not only a desirable but also an eminently practicable ideal. To achieve it science and industry must organise so that they may become strong politically and financially.

Four kinds of co-operation are essential to strength: (1) internal co-operation, (2) co-operation with pure science, (3) co-operation with Government, (4) co-operation with labour. The last, that is co-operation with labour, is a human question rather than one of science or of policy dependent on science and need not be further discussed, especially since enlightened opinion on the part of employers now realises that labour relations are as vital to prosperity as any other factor.

[1] From the presidential address delivered at the annual general meeting of the Chemical Society on Mar. 21.

INTERNAL CO-OPERATION.

Apart from more purely chemical or scientific factors, there are two immediate advantages to be gained by the formation of big combines, in the pooling of capital and the pooling of engineering resources; the establishment of a balance in commodities produced and in the method used for their production being determined mainly by chemical and engineering conditions.

The standardisation of methods and the co-ordination of interests as regards production and distribution, the question of price and the prevention of over-production are problems which mainly concern the business organisation of industry, and do not directly affect the relations between industry and science. Yet their importance is manifest, and in some instances, especially in connexion with the standardisation of methods, the help of the chemist is essential. The need for obtaining a balance in all these factors, a consummation which can only be reached by a pooling of like interests, is obvious.

Probably the best example of the common use of a chemical substance by a number of different manufacturers is that of hydrogen, which is at the present time used in vast quantities for the production of (*a*) methyl alcohol, (*b*) liquid fuels from coal, (*c*) ammonia, to mention three of its most recent applications. In pre-War days it was used in large quantities, and still is so used, for the hardening of fat. Nevertheless, the three industrial operations mentioned also represent in a remarkable degree examples of progress and development that have taken place within the last ten years.

At the present time we know nothing of the reasons which determine the action of a catalyst, and although we have to hand a vast number of reactions which may be regarded as reasonable and likely to occur should the right conditions be discovered, the search for a catalyst is always attended with difficulty and often ends in disappointment. Prior to the original German patent for the production of methyl alcohol from carbon monoxide and hydrogen, many attempts had been made to realise this very simple reaction even on the laboratory scale.

Other reactions readily suggest themselves, such as, for example, the formation of acetic acid from methane and carbon dioxide. As a matter of fact, this, and other reactions of a similar type, forms the subject of patent specifications, but whether they have been actually realised experimentally must remain an open question in the absence of definite evidence. Our patent system unfortunately lends itself admirably to the production of 'blocking' patents, and there is no subject so suitable as organic chemistry as a medium for such patents.

CO-OPERATION WITH PURE SCIENCE.

Training.—Chemical trade is at present in the midst of the most rapid expansion it has ever known and nowhere is the development more noticeable than on the research side. This is as it should be, for the researchers are the scouts and it is essential that they should be far ahead of the army (the working process). It is necessary also that the scouts should operate on a broad front in order that no channel of advance should be overlooked merely because it does not lie in the expected direction. The realisation of this principle by the greater manufacturers has led to a strong demand for university-trained men, and the number of research chemists in industry in Great Britain has been estimated at twenty times the number before the War; the demand is still increasing. The universities have had and are having difficulty in supplying this larger number of adequately trained men, for they have to fulfil the majority if not all the demands made by chemical industry. Manufacturers have come to realise that training should be essentially fundamental and that a wide knowledge of the principles of chemical science is a necessity. The vexed question in what manner is this to be attained is being answered by the gradual adoption of at least a four years' course, although the still more important one—that of the post-graduate course—is not yet settled.

A long experience of university teaching has shown me that it is exceedingly difficult to determine whether any particular individual is more fitted to succeed as a process chemist or whether he has that peculiar aptitude which will enable him to carry out effective work in the research laboratory. Unfortunately, the positions are not interchangeable. A student who has shown aptitude for research may, if occasion demands, make an excellent process chemist; indeed it often happens that he will have to elaborate a laboratory method so as to place it, with the help of the engineer, on the unit factory scale. But it is very doubtful if the individual who has shown that he possesses no aptitude for research can be usefully employed in that connexion excepting under control. The only manner in which the presence of the research aptitude can be discovered is by direct trial, and therefore it is always desirable to subject a student to one year's training in research after graduation in order to discover if he possesses this characteristic.

The term 'research training' must be interpreted in its widest sense to include training in special branches of chemistry related to the industries as well as more general training in the higher branches of chemical technology.

Industrial Research in Universities.—At no far distant period in the past the great potentiality for research residing in our university laboratories, and in the personnel controlling them, was not available for industrial purposes. The reasons for this were many. For example, industrial research was not regarded as of sufficiently 'pure' character to allow of its inclusion in the academic curriculum. There was considered to be something essentially different between 'applied' and 'pure' chemistry, and this was emphasised in the 'eighties by the formation of the Society of Chemical Industry as a distinct body from the Chemical Society. The Americans knew better than this. They have kept their chemists together as a homogeneous body, and the American Chemical Society with its membership of 17,000 represents in no uncertain manner the considered opinion of the whole body of chemists of that country.

The fault lay mainly with the universities of Great Britain, which were loath to introduce science other than 'pure' into their courses of instruction. Hence there arose the multitude of technical schools which were originally intended to supply the need for a vocational training without undue reference to the science upon which the training was based. The establishment of new universities in industrial centres, a period of reform ushered in by the breaking up of the old Federated Victoria University, soon produced a marked change, and research and instruction in the fundamental principles underlying industrial science gradually passed into the hands most competent to deal with them.

Industrial research both of the fundamental kind as well as that which arises as the daily outcome of works practice should be and now is carried out for the most part by the firms themselves in their works laboratories. But there are a number of problems, mainly of a 'long-sighted' character, which are intimately related to industry. The personnel on the scientific staffs of the universities of Great Britain are people who have throughout their lives specialised in some particular branch of research, and are therefore eminently fitted to solve problems in their special field. This is now recognised by many leading firms who supply grants to enable post-graduate research workers to investigate specific problems under the guidance of professors of chemistry and other directors of research laboratories, and in this connexion must be mentioned the far-sighted policy of Imperial Chemical Industries, Ltd., which gives yearly substantial grants to research laboratories in order to enable them to obtain special types of apparatus and appliances which it would otherwise be difficult to procure.

Great advances in the development of scientific industry have been made in Great Britain since the War, and every effort must be made to maintain and strengthen the causes which have led to this condition. From the point of view of national prosperity it is essential that active research centres should be maintained and still further developed in our universities, not only to supply the scientific ability to foster and improve the industries of our own generation, but also to pave the way by discoveries in science for future commercial prosperity.

Team Work.—During the War very valuable work was accomplished by means of team work, by which is meant the solution of some problem by the united efforts of a team of workers under a directing head. There can be no question that this

method of attack is usually most effective, especially in a works laboratory where some specific problem may require rapid solution. Its application to the university laboratory is subject to the difficulty that under team conditions the intellectual stimulus which attaches to the individual attack on specific problems is sometimes lacking, and it is in the highest degree desirable that this stimulus should be developed and maintained. Nevertheless, it is always possible so to divide a major problem as to make each section in itself a self-contained research and thus to give each investigator what is essentially a definite subject on which he can work in his own way and according to his own mentality.

Co-operation with Government.

The Government of Great Britain has already discovered the two most valuable ways in which it can co-operate to the benefit of present and future chemical industry, namely, (*a*) by protecting young and struggling industries against competition from similar but established industries abroad and against competition arising from deflated foreign currency, and (*b*) by promoting research in pure and applied chemistry by financial assistance. Another way in which it has helped the application of science is by the provision of a free chemical advisory service in the interests of agriculture.

Research Associations.—There can be no question that the value of co-operative research in industry has been established. The Department of Scientific and Industrial Research has, therefore, rendered a valuable service to the industrial community and its initial policy has been fully justified. Nevertheless, the time has arrived when the varying appeal which the necessity for scientific investigation makes to different industries has made itself manifest, and the Department feels that any further support on general lines would no longer be justified. It proposes, therefore, to treat each case on its merits.

Research Studentships and Fellowships.—The call for adequately trained research workers in science, and especially in chemistry, is increasing. It is therefore very disquieting to realise that the policy of the Department in connexion with the provision of maintenance grants for students in training appears to be changing. The outlook is serious, because it is quite impossible for the universities to provide funds for post-graduate training in any way commensurate with the present-day requirements of industry, and as the average science student is usually drawn from a comparatively poor class, it is not likely that the necessary money for an extended course will always be obtainable from parental sources.

Every director of a research school has had to tell some promising student who wishes to undergo post-graduate training and is, without question, likely to profit by such training, that no funds are available to enable him to extend his course and that he must, therefore, seek any minor post that may be open to him. The loss of such a man is a national loss, because his training is broken off at the stage where even one extra year would have enabled him to become a useful member of a research organisation, whereas, in the circumstances, he has to take up some position, probably one involving merely routine work, where the value of his early training will be lost and his initiative and enthusiasm destroyed. It is therefore to be hoped that the diminution in the number of research grants is merely a temporary expedient and that it does not indicate a reversal of a policy which has proved so fruitful during the past twelve years and has shown itself to be an essential part of research development in Great Britain.

The Functions of the Human Skull.[1]

By Wilfred Trotter.

THE development of science involves the two processes of collecting facts and of elucidating their relations. In the early days common experience so abounded with unrelated facts that an alert and contemplative mind was an adequate equipment for the man of science and could readily find material for generalisation. Knowledge was like an unexploited gold-field, in which the mere attentive wanderer might pick up nuggets of the metal. So were made the earliest discoveries in mathematics, astronomy, and physics. When the surface of the field no longer yielded such finds, the digger with his simple and homely outfit could still from easily accessible deposits gather with his own hand gold dust by the ounce and pound. This was the Golden Age of science; it lasted somewhere about two hundred years, and was nobly marked near its beginning by the "Principia" and near its end by the "Origin of Species." It was the day of the individual digger, of simple apparatus and the still obvious predominance of the worker's mental quality over every accessory circumstance. It was a time in which relatively simple efforts in the collection of facts might have great results. Looking back at it we discern as a characteristic object Wollaston with his laboratory on a tea-tray, and as a characteristic incident Hans Christian Oersted noticing in 1819 the deflection of the magnetic needle by an electric current—an experiment it would not be very extravagant to call the most important event of the nineteenth century; or as not less characteristic Joseph Fraunhofer in 1814 observing and thinking it worth while to map out the dark lines in the solar spectrum—a dull-looking task that was, however, ultimately to yield a veritable measuring rod for the universe and a most effective probe of even its stupendous depths.

At the present day what we may call the surface

[1] Lecture delivered before the Anthropological Society of University College, London, on Jan. 25.

deposits of truth seem almost everywhere to have been worked over, and ours is the time of the thousand-yard shaft, the mile-long gallery, the battery of stamps, and the pennyweight yield to the ton. The mere collection of facts has become a difficult and elaborate enterprise, to which the solitary worker is rarely equal. In almost every branch of science complex equipments are necessary, the mere use of which may need years of training. Even genius itself is no longer inspired by the falling apples and spouting kettles of the Golden Age; the powers of Einstein are called out by the quintessential zero of the Michelson-Morley experiment, or those of Bohr by the incredible vacancies of the atom.

Since the merely observational half of the scientific act has become so formidable, it is natural that the other half that comes of the speculative, contemplative, and relating turn of mind should as such have sunk somewhat in general esteem. It is perhaps correct to say that, among scientific people, work of any general speculative kind is a little under suspicion unless it is closely associated with actual observation as well, and that anyone who tries to correlate large groups of facts is unlikely to be listened to with great attention unless he has been concerned at any rate to some extent in the collection of the facts themselves. This attitude of the mind is on the whole sound and practical, but it should perhaps be qualified by two small reservations. In the first place, the justified predominance of observation may lead to a certain frigidity towards ideas as such, and even some risk of the automatic rejection of them.

In the second place, it must be remembered that there are still some few 'alluvial' deposits left unexhausted in the gold-field of truth. Here the observational side of scientific work may seem when judged by modern standards primitive and 'uneconomic,' and yet it may be capable of yielding appreciable finds. One such deposit is the great range of human behaviour, in which we all can be adequately skilled observers and need no more than the critically selective and relating turn of mind. Other such opportunities are apt to occur along the line where two fields of observation meet. Medicine has many such lines of meeting with the sciences, and its contact with anthropology is one of the most obvious. Medical men are interested in the same animal as are anthropologists and have to study it with some intensity.

When we study the boundary zone of two adjoining departments of knowledge, we may expect to find what instruction we are to get not so much in learning strictly ordered and documented facts as in getting fresh points of view; we may hope that the well-established and matter-of-course fact or principle from one side of the line may prove new and illuminating when viewed from the other side.

In such a study, then, we shall do well not to be too exacting in proof or too systematic in method. We must be willing to accept new light where we can find it, and to remember the old paradox that in science the primary duty of ideas is to be useful and interesting even more than to be 'true.' We must be ready to entertain ideas freely and fairly, and no less ready to discard them without regret, glad enough when we gain an unexpected glint from "the blank face of familiar things." It will be with very limited pretensions, therefore, that certain considerations derived from surgical experience will be set out here. Nothing could be less dogmatic than the spirit in which they are put forward or more submissive to the principle of the aphorism, "Do not believe new ideas; use them."

While the essential object of all biological knowledge is the elucidation of function, the work of the surgeon is actually engaged in the direct study of function in a very special degree. He is concerned with the human body solely as a going concern and his unique object is to keep it going. In regard to the cranium, he has no direct interest in its size, its form, its types, its indices; he limits himself, with what for the anthropologist must seem a certain crudity, to the question what does it do? In the briefest possible terms, the cranium is to the surgeon the *capsule* and *the skeleton of the brain*.

The Capsule of the Brain.

It is not usual to regard the brain as among the encapsuled organs, but to do so brings out an interesting aspect of its functional relations with the skull. If we consider encapsuled organs in general we at once see that the rigidity of the capsule is an important character. In regard to it, organs may be divided into three groups. In the first, which may be called the normal type and is represented by the kidney and spleen, the capsule is fully extensible; in the second, represented by the testis, only very slightly extensible; and in the third, represented by the brain and skull, it is absolutely rigid to all physiological forces. Such conditions have necessary and very important effects on the mechanics of the circulation in the various organs. There is of course a primary need for the flow of blood through any tissue to be continuous; this is effected in organs of the first group by the extensibility of the capsule permitting pulsation and elastic recoil to occur. In the case of the brain, however, a different mechanism is necessary. The brain itself expands with each arterial pulse, but, as the skull is unyielding, room must be made at each pulsation by the expulsion of a corresponding volume of the low pressure intracranial fluids. This is why the veins leaving the skull and the cerebro-spinal fluid in the subarachnoid space of the spinal cord show arterial pulsation.

The mechanism is adequate, but the margin by which it is so is not very large. After violent exertion, when the range of pulsation of the brain is at its widest, we are apt to be conscious of an unpleasant thudding in the head, which shows that the brain can only just find room for its circulatory excursions. Again, if one has a slight headache it is at once aggravated by exertion.

This circulatory peculiarity is fundamental in cerebral pathology and makes it possible to say

that, apart from purely destructive processes, all cerebral symptoms are of circulatory origin.

We may briefly inquire into how this comes about. The low pressure outflow that must accompany each arterial pulsation is chiefly in the form of venous blood. For it to occur the flow of blood in the veins must be quite free. But the pressure in the veins is very low, so that the least abnormal swelling of the brain or part of it causes collapse and obstruction of a greater or less venous territory. Thereupon further swelling from venous congestion occurs and the disturbance of function becomes progressive.

The brain is thus uniquely sensitive to any pathological change in its bulk. When an organ like the kidney is bruised and swells, it matters very little how soon or if ever it gets back to its normal size. When the brain has been bruised, it must get back to its normal size or its circulation will remain permanently disturbed. A simple bruise of no ultimate importance to an organ with a yielding capsule, is thus a relatively serious matter with the brain. The great difficulty with which the brain recovers from even simple injuries that cause swelling is one of the most important functional consequences of its rigid encapsulation by the skull.[2]

The Defensive Function of the Skull.

It is still a widespread opinion, even to some extent among medical men, that fracture of the skull is the most important feature of head injury, and that if the skull is not fractured not much harm can have been done. There is no more complete delusion. Fracture of the skull is usually an insignificant element in a head injury, and nothing has done more to limit the knowledge of trustworthy principle than the traditional reverence for it.

A fracture means that the skull has been distorted until the limit of its elasticity has been passed. It is the distortion, and not the crack that may or may not ensue, that is important.

Now surgical experience in Great Britain shows that the skull is susceptible to considerable degrees of distortion by even only moderately severe external violence. Because immediate and dramatic effects are not always produced, and because of the superstition about the significance of fracture, it is apt to be assumed that the average European cranium is on the whole very successful in preserving the brain within it from the effects of quite severe violence. Since the nature of what are called the minor injuries of the brain has been better understood, this faith in the beneficent fortitude of the skull has been considerably shaken. We now know that the skull in its protective function is only moderately effective. It is liable to bend under local violence and to permit of a localised bruising of the brain beneath ; it is also liable in appropriate circumstances, especially such as falls on the head, to a far more serious general distortion. This general distortion causes the very interesting instantaneous and transient paralysis known as concussion of the brain, and is also apt to produce a widespread bruising of the brain substance that is of great practical importance. It is important to note that all the evidence points to actual distortion of the skull being the immediate cause of most if not all injuries of the brain. There is no reason to suppose that injury is commonly if ever produced by the brain being thrown about inside an undistorted skull. It is probably true to say in so many words, no distortion of skull, no injury of the brain.[3]

This liability to relatively easy distortion seems to be in some special degree a character of the modern European skull. It appears to be fairly clear that in some races the resistiveness is decidedly higher. For example, the negro, judged by purely clinical, that is functional considerations, is little liable to receive cerebral contusions from the moderate degrees of violence that an Englishman could not endure with impunity. The willingness of the negro to use his head as a battering-ram has often been described, and it is said that an experienced policeman will use his truncheon on the head of a negro less hopefully than he would use it on an English head.

We arrive then at the position that the modern European skull is demonstrably far from completely effective in its protective function, and that this defect is not shared by all other races.

It will be noticed that we are not at all concerned so far with the anatomy of skulls. It may or may not be possible to show a difference in the thickness or rigidity of European and negro skulls. The test of function is far more delicate and trustworthy than that of structure, and it seems to show that a clear difference exists.

We have already seen that the bony capsule of the brain is a serious hindrance to recovery from minor injuries, so that the skull and brain mechanism is satisfactory only when the former is highly effective as a protective covering. Once the protective function is impaired the physiological disadvantages of the arrangement become fully manifest. It seems clear, then, that the present functional relation of brain and skull—plainly disadvantageous as it is—must be the result of some strong evolutionary tendency or must be accounted for by some advantage that compensates for it.

In a very broad and general way, it does appear to be the fact that there has been an evolutionary tendency towards a reduction in the massiveness of the human cranium ; there can be no doubt that the modern European cranium is in comparison with many of its predecessors remarkably light and thin. It is not improbable, therefore, that a tendency towards the lightening of the cranium is an inherent character of the race and progressive. It is natural, therefore, to ask how far such a process could conceivably go. The European skull has already discarded a good deal of its protective rigidity ; is a rigid cranium a necessary structure ?

[2] It is interesting to notice that the testis—the only other organ in the body that approaches the brain in the rigidity of its capsule—shows the same susceptibility to minor injuries. As is well known, it may undergo complete atrophy after a simple bruise.

[3] A contrary opinion is perhaps encouraged by the use of the time-honoured and now ineradicable phrases 'concussion of the brain' in English and 'Hirnerschütterung' in German.

THE SKELETAL FUNCTION OF THE SKULL.

Without considering any other matter but function, this question can be given a perfectly definite answer. However much more of its protective massiveness the skull may lose, it must always maintain enough rigidity to preserve its form. This is because it is a function of the skull, not the less important for being usually overlooked, to support the brain. If we make in the treatment of injury or disease a considerable hole in the skull, and after healing of the scalp is complete the intra-cranial tension is normal, we find a tendency for the soft parts to sink into the cranial opening. This depression is most marked when the subject is standing and usually quite filled up when he is lying down. With an opening 3 or 4 in. across, the depression may perhaps reach a depth of as much as $1\frac{1}{2}$ in. at its centre. The larger the opening the greater the depression ; and it is clear, therefore, that the exposed brain, when the intra-cranial tension is at its lowest, cannot support the atmospheric pressure and actually collapses under it. In certain cases the subjects of openings in the skull suffer severely from the exaggerated movements of the brain that in them accompany changes of posture. Such symptoms are always abolished when the opening is closed by restoration of the skull.

In the cranium, in fact, the vertebrate has rediscovered the principle of the external skeleton and exploited it in a remarkably interesting way that may be worth a moment's consideration. What may be called the constructional problems of such an immense mass of neural tissue as the brain are very complex. The obvious way of supporting a large mass of soft consistence would be the provision of a stiff stroma of ordinary connective tissue. Such a solution is inadmissible for very definite reasons. In the first place, direct contact between mesoblastic and neural tissues is a physiological impossibility, so that every strand of the hypothetical connective tissue stroma would have to be clothed, as is every cerebral vessel, with a so-called ' perivascular lymphatic ' to its finest ramifications. At a moderate estimate this might double the bulk of the whole organ. Again, the presence of an elaborate and alien fibrous network would immensely complicate the system of intercommunication, which is the very essence of the brain as it is. How neat a solution of the problem does the exo-skeleton provide. With it, it is possible for the brain to be made up almost entirely of actual functional elements, and for the utmost complexity of communication to exist while the bulk of the whole organ is kept within bounds.

THE MEANING OF THE VULNERABLE SKULL.

We have seen that the low strength of the modern European skull is shown by actual experience to be producing serious effects in the way of a high susceptibility to disabling injuries of the brain. To discuss the meaning of this remarkable and perhaps a little disturbing state of affairs it is necessary to enter into some rather general considerations.

There can be no doubt that in the growth side by side of the cranium and the brain, the latter is the predominant partner, and what it needs the former must on the whole provide. If the skull had no other function whatever but to be the capsule and skeleton of the brain, the correspondence would be absolute and every least developmental variation of the brain would be accurately accommodated by the skull. Now the skull or even the cranium does have other functions to fulfil than those concerned with the brain. It is involved with the muscles of the trunk, with the apparatus of mastication, with the respiratory tract. The provision for these accessory needs must, it seems reasonable to suppose, have some influence however minor on the growth of the cranium, and act as some restraint however minute on the control of it by the brain, and therefore on the freedom of variation of the latter. When, therefore, the skull is very massive and deeply involved with accessory functions, when it gives attachment to large neck muscles, when it is ridged and fortified for a heavy masticatory apparatus, the freedom of the brain to develop minor variations is perhaps less complete than when the cranium is stripped to the condition of a mere cerebral capsule.

Since it is possible that free variability of the brain through a very small range is of value in fitting man for a complex civilisation, it seems not a very extravagant supposition that the freeing of the skull from accessory functions has been a factor in human evolution.

EVOLUTION OF THE BRAIN AND SKULL.

In considering the evolutionary process in general, then, we have to think not merely of a progressive expansion of the cranium to accommodate the increasing brain, but also of a growing independence of the cranium.

It seems obvious that the anterior end of the segmental animal was the inevitable site for the chief nucleus of a centralised nervous system. The same region was equally inevitably annexed for the entry to the respiratory and the digestive tracts. An interesting series of complications has ensued from this necessary crowding of function into one extremity. It does not seem too fantastic to see two tendencies constantly at work and in conflict—the tendency on one hand to make use of the brain skeleton for functions connected with other systems, and on the other the struggle of the brain for autonomy and freedom from these burdens. Wherever the former tendency has been definitely the stronger, the progress of the brain has been arrested and the animal has found itself in an evolutionary blind alley. The most striking illustration of this process has been in connexion with apparatus of defence and attack. Such apparatus has a natural and inevitable localisation near the digestive inlet and at the anterior end of the animal. Nature in her experiments with horns, antlers, fangs, and tusks has found the skull waiting as a

convenient foundation for these useful but enslaving structures. The ancestors of man, with the steady avoidance of specialisation to which he so largely owes his zoological position, kept their craniums free from such encumbrances.

It was, however, probably the beginning of the upright posture that was the decisive change in favour of the independent skull. It has not, so far as I know, been much remarked upon that the upright posture changes the whole mechanics of attack and defence from that of the quadruped. The head is withdrawn from the front of the animal, and thus being no longer available as a foundation for offensive or defensive structures, the cranium is at last and finally safe from them. Another and more familiar way in which the cranium was helped by the upright posture to free itself from accessory functions was in the limitation in the movements of the mandible that necessarily ensued. With a poised instead of a slung skull, the mouth can no longer be opened freely enough for the aggressive use of fangs. Thereupon the cranium is no longer called upon to find attachment for the correspondingly massive muscles.

When we see an evolutionary tendency so strong as that seems to be which has stripped and lightened the cranium until it has reached the degree of fragility and simplification seen in the modern European, we are inclined to ask whether even yet its force is exhausted. There are perhaps signs that even now the cranium is, so to say, intolerant even of the light burden of accessory function it still has to bear. It is scarcely possible to be familiar with the lower jaw of the modern English without wondering whether the unexhausted tendency we have been considering is not at work to free the cranium even of the temporal muscle. It is clear that the molar region of the mandible is shrinking, and experience already suggests that 8 fully erupted molar teeth are nearer the actual normal than 12. Since the temporal muscle is especially concerned with the use of the molars, it is perhaps permissible to wonder whether it, rather than the jaw, is not the real object of evolutionary attack.

The tenuity of much of the foregoing speculation must be obvious. The argument, however, makes no attempt to be rigorous, and is intended to be illustrative rather than demonstrative. The object of it has been to find out whether the old-fashioned method of general qualitative survey might not in so favourable a situation as the frontier between two branches of knowledge, present the familiar facts of one side of the line in a way that would have freshness and perhaps interest on the other.

News and Views.

The Postmaster-General has written an excellent letter, dated Mar. 27, to the Baird Television Development Company. He states that he has seen a demonstration of the Baird system and that he could recognise with sufficient clearness the features and movements of persons posed for the purpose in the transmitting studio. He is a little doubtful whether it is at present practicable to reproduce simultaneously more than two or three individuals, and they must be staged in very close proximity to the transmitting apparatus. In his opinion the Baird system represents a noteworthy scientific achievement. Taking into consideration the present limited scope of the objects which can be reproduced, he does not consider that it is at present practicable to include television in the broadcasting programme in broadcasting hours. He is anxious, however, to give facilities so far as practicable without impairing the broadcasting service for continued and progressive experiments to be made with the Baird apparatus. He consents to a station of the British Broadcasting Corporation being utilised for this purpose outside broadcasting hours. The Company would probably have little difficulty in negotiating satisfactory terms with the Corporation. It is very desirable that experimental demonstrations of television should be accompanied by the broadcasting of speech. Consequently, two wave-lengths and two transmitters are required. It would be very difficult to provide a second transmitter in a suitable locality which would not interfere seriously with important radio services in central London, until the new station of the B.B.C. at Brookmans Park be opened next July. In the meantime, the engineers could jointly discuss the best methods. In order to get a television service during broadcasting hours, wave-lengths outside the bands now being used for speech broadcasting must be used. Unfortunately, these bands are much congested. It is important, therefore, that the Company should press on with experiments on as low a band as possible. Purchasers of receiving apparatus are warned that they buy them at their own risk, as the system is not yet sufficiently advanced to warrant giving it a permanent place in the broadcasting programmes.

It is interesting to learn from a *Daily Science News Bulletin*, dated Feb. 26, issued by Science Service, Washington, D.C., of the paternal attitude adopted by the Federal Radio Commission towards the many applicants who are anxious to start television broadcasting in the United States. Eleven licences for television broadcasting have already been granted, but in all cases precautions have been taken that such activity is for a limited period and is purely experimental. The licences are only for six months. The broadcasters have to give monthly reports of their activities and of the scientific work they are doing to advance the art. The Commission apparently is not yet convinced that radiovision can render real service comparable, for example, with that of sound broadcasting. They are naturally anxious to prevent anyone broadcasting radiovision with the main purpose of selling radiovision receivers. The Commission has allotted to radiovision, or, as they call it, 'visual broadcasting,' which includes still pictures, 'radiomovies,' and pictures of living actors, four bands of frequencies.

The first two bands are between 2000 and 2200 kilocycles (136-150 metres) and the other two bands are from 2750-2950 kilocycles. A further band between 2200 and 2300 kilocycles for radiovision may also be used in the future provided that it does not interfere with Canadian stations. The present radiovision broadcasting stations are situated in New York, New Jersey, Washington, East Pittsburgh and Springfield, Mass., Schenectady and Oakland in California. Many applications are still pending, and hearings will be held to determine "whether or not public interest, convenience, or necessity would be fulfilled by granting their applications." No television broadcasting (that is, by wire) will be allowed on any frequency in the broadcast band, except between 1 A.M. and 6 A.M.

AT a recent meeting of the Royal Statistical Society, Dr. E. C. Snow, who read a paper on "The Limits of Industrial Employment," said that before the War the population of Britain was increasing by about 350,000 a year, but now the annual increase is not much more than half this figure. In ten years time it is estimated that the increase will not be much more than 100,000 per annum. Important changes have taken place in the age distribution of the population. In the decade before the War, 130,000 of the annual increase occurred in the age-group 30-45 (probably the most important period of life as regards the demand for goods for consumption) and only 50,000 in the group above 60. At the present time the former group is increasing by only 30,000 per annum, while those over 60 are increasing by more than 100,000 per annum. These changes, Dr. Snow said, are of importance in the study of the unemployment problem. Modern industry requires a continuously expanding market since many workers are engaged in manufacturing machinery and other capital goods which will help to increase future production. But if population does not increase correspondingly, a state of over-production will arise and this will react on the employment capacity of industries which produce capital goods or their raw materials. The effect on employment is cumulative, because those who manufacture capital goods are themselves consumers, and their demand as consumers will be reduced. The effect is the more severe in Britain because this country is far more dependent upon industrial activity for employment than any other.

ON April 6 occurs the centenary of the death of Niels Henrick Abel, the brilliant young mathematician who died at the early age of twenty-six. Born at Findoë, Norway, on Aug. 5, 1802, the son of a minister, Abel was educated at the Cathedral school and University of the capital, and from the age of sixteen gave evidence of striking mathematical powers. After the death of his father he was supported by the professors, and later by a pension from the government. He travelled into Germany, Italy, Switzerland, and France, became intimate with Crelle, but it is said that his visit to Paris proved disappointing. After his return to Norway, however, Legendre, Poisson, and Lacroix wrote to the King of Sweden on his behalf, but no notice was taken of the letter, and a few months later Abel died of consumption at Arendel. "The great point," said De Morgan, "to which Abel turned his attention was the theory of elliptic functions. Legendre, who had devoted a large portion of his life to the development of these functions and the formation of tables by which to use them, found himself, when his toil was just finished, completely outdistanced by the young Norwegian of whom no one had ever heard." The centenary of Abel's birth was celebrated with great enthusiasm at Oslo in September 1902, when honorary degrees were conferred on many men of science, among whom were Kelvin, Rayleigh, Salmon, and Stokes, while in 1908 a striking monument to him was erected close to the University building.

THE differences of opinion which have arisen on the subject of the management of the New Forest have already been alluded to in NATURE. The Forestry Commission, on taking over the Crown Forests from the Woods and Forests branch, commenced certain sylvicultural operations in the Forest without reference to local opinion—operations which were viewed with alarm by a certain section of the public. The ideas of this section were powerfully voiced by the New Forest Association, which represents, amongst others, the right and privilege holders (*i.e.* the commoners). In how far the New Forest Association can claim to voice the opinion of the general public is open to doubt. It is this view of the question which Mr. H. H. Haines, a well-known botanist and formerly a member of the Indian Forest Service, considers in a small pamphlet which he has prepared and circulated to the members of the Society for the Promotion of Nature Reserves, fellows of the Linnean and Royal Societies, and others. Although we are not in agreement with all Mr. Haines's contentions, he presents the case for a correct management of the New Forest in a perfectly straightforward and fair manner. If the absence of all efficient management which has persisted for many years is maintained, the most beautiful parts of the Forest are doomed to disappear. Professional opinion is at one on this matter. Since Mr. Haines can speak on the sound professional side, whilst being at the same time a botanist and a Nature lover, his small brochure, which unfortunately bears no title, should be read by all lovers of the New Forest.

IN the Final Report of the Committee on Industry and Trade, which has recently been issued (Cmd. 3282. London: H.M. Stationery Office, 1929. 5*s.* 6*d.* net), considerable stress is laid upon the benefits which would accrue to industry in Great Britain from the greater recognition of the value of scientific research. In certain other countries, notably Germany and the United States, a very great amount of research is carried out by various industrial associations, corporations, and combines, and even by large individual concerns, though in Britain the importance of scientific research is imperfectly realised by the leaders of industry. In the opinion of the Committee, a change in this attitude would open up prospects to British industry which at present are beyond the

range of possibility. It is true that certain large works in Britain carry out much research work, but for the most part this consists of mere routine testing, or what has been called 'tactical' as distinguished from 'strategical' research; that is, the improvement of results obtained from a given process or the investigation of fundamental laws. The latter has to be undertaken by the State or by co-operative research associations which represent a joint effort of the industries themselves and the Department of Scientific and Industrial Research. The Committee suggests that the most hopeful direction of future development is to define more and more clearly the line of demarcation between the kind of research which is the special function of the State, namely, that concerned with fundamental scientific problems and their application to industry as a whole or to great groups of industries, and that which is the proper function of industrial undertakings either singly or in co-operation.

THE Committee finds most cause for disquietude in the relations between the research associations and the industries themselves, since the response to the propagandist efforts of these associations is frequently most disheartening, even when full allowance is made for difficulties such as trade depression and the expense of installing new plant and processes. It recommends that every important trade association should take into consideration the existing means of disseminating technical and scientific information and, where these are inadequate, should take steps to establish suitable machinery for the purpose. The research associations on their part should engage in a campaign of publicity and explanation in order to popularise their results. There should be some responsible suitably qualified officer on the staff of each firm, whose duty it would be to follow the progress of scientific research as summarised in the bulletins received. It is also essential that at least an adequate proportion of the responsible heads of industry should have the scientific habit of mind, though it is not necessary that they should themselves be trained researchers. "Before British industries, taken as a whole, can hope to reap from scientific research the full advantage which it appears to yield to some of their most formidable trade rivals, nothing less than a revolution is needed in their general outlook on science: and in the case of some industries at least, this change of attitude is bound to be slow and difficult, in view of our deeply rooted industrial traditions."

THE wireless organisation for the air mail service to India, which opened on Mar. 30, is such that the aircraft engaged will be in touch with aerodrome ground stations throughout the 4700 air miles of the journey. On the London to Basle section, the present wireless organisation for continental aviation will be employed. The aircraft are fitted with Marconi sets of 150 watts power (Type AD6), adapted for communication over distances of 200 to 300 miles either by telephony or telegraphy. From Basle the night train to Genoa makes the connexion with the second section of the air route, from Genoa to Alexandria, operated by three 'Calcutta' flying boats fitted with the more powerful Marconi Type AD8 sets. These sets are also adaptable for telegraphy or telephony, enabling the pilots to keep in touch with Italian and British Air Ministry wireless stations until arrival at Alexandria. In addition, Imperial Airways, Ltd., which is conducting the London-Karachi service, has stationed a depot ship in the Greek Archipelago. This has been fitted with a Marconi valve transmitter of ½ kilowatt power (Type U) and suitable receiving equipment (Marconi Type RG19 Receiver), and will be capable of communicating with Malta, Alexandria, and other stations concerned with the service. At Alexandria a change is made to aeroplanes again for the final section of the route, through Basrah and over the Persian Gulf to Karachi. Part of this section has been in operation for some time, employing De Havilland aircraft fitted with Marconi AD6 apparatus and communicating with R.A.F. stations and a ½ kilowatt station at Rutbah Wells. During the flight from Basrah to Karachi, the machines will be in touch with two Marconi stations in Persia, at Chabar and Bunda Abbas. The terminal wireless station at Karachi is one of the most powerful aerodrome stations installed at any air port, consisting of a 6-kilowatt Marconi transmitter with direction finder receiving apparatus. Many features of the Marconi apparatus for this service have been specially designed to meet the conditions existing on this new route.

AT the meeting of the Illuminating Engineering Society on Mar. 19 a paper on architectural lighting was read by Mr. Waldo Maitland. The author defined this term as implying that the lighting becomes an essential part of the architectural scheme, and in some cases the major element. Amongst the devices adopted, luminous panels in the ceiling and walls, lighted columns and lintels, and cornice lighting were mentioned, but in the examples shown by Mr. Maitland, which included a number of original lighting schemes adopted in Paris, many other novel methods were illustrated. This mode of lighting has been adopted at present mainly in the case of large stores, restaurants, and places of entertainment, but it has evident possibilities in modern buildings of architectural distinction. Naturally these methods, which involve the reflection of light from diffusing surfaces (concealed lighting) or its transmission through more or less dense translucent glass, may require a higher consumption of energy than do conventional methods. But in many cases a sacrifice in efficiency might be tolerated in order to obtain the desired picturesque effect. Complete success, however, can only be obtained when the co-operation of the lighting expert and the architect can be secured in the early stages of the design of the building. At the conclusion of the meeting a series of demonstrations were given in the architectural lighting room of the E.L.M.A. Lighting Service Bureau, various pleasing combinations of lighting from artificial skylights, cornices, luminous bands encircling the room, and luminous lintels and doorways being shown. The underlying idea is based on the recognition that whereas the buildings of the past were designed solely with a view to appearance by daylight, appearance by artificial light is now

frequently of equal importance. This consideration may materially influence the architecture of the future.

ALTHOUGH little is now heard of Tutankhamen in the daily Press, the tomb continues to provide from its store a wealth of objects both of intrinsic beauty and of interest to the student of Egyptian culture. In the *Times* of Mar. 30 is given a long list of articles from it which have recently been added to the Cairo Museum. Some of these are unique and many of unusual type. Among these is the only existing example of the well-known sickle-sword known as 'Khepeth' with which the King slew his enemies. A model sickle of wood inlaid with gold in the shape of the jaw-bone of an ass has red, blue, and purple glass in place of the more usual serrated edge of flint. Especially interesting are head-rests of an entirely new form. One is of blue faience with gold and polychrome glass, another of light blue glass, and a third is made like a three-legged stool with legs ending in goose feet and with a grotesque figure of the god Bes with its tongue out on top. Boomerangs include some apparently of the returning Australian type and unlike the Egyptian throwing-stick type. Another object which is unique is the King's game board. It is made of polished ebony marked off into 30 squares, of which some are marked with hieroglyphs. The pawns are of faience, and in a drawer in the board were two ivory knuckle bones and dice in the form of sticks, black on the one side and white on the other. Miniature boards of the same kind were also found. Of special interest to technologists were a wicker basket covered with linen on which were a design in yellow, blue, red, and white beads, and a pattern of beads representing captives on top, and a bow fire drill with which was a piece of wood bored with twelve holes and marked with charring, which had apparently been used with the drill for producing fire.

A NOTABLE extension of the Manchester Museum is recorded in the *Report* for the year 1927–28. The Haworth Extension Building, which now becomes the centre and main entrance of the Museum as a whole, was erected at a cost of approximately £29,000, and £5000 has been spent upon cases and fittings. The Haworth benefaction, a handsome gift, to which the extension was due, provides a further £1100 for additional cases, and a sum of £15,000 as a permanent endowment. Formally opened by Mrs. Jesse Haworth on Nov. 28, 1927, the building has been devoted to the exhibition of ethnological collections in a series of alcoves, which serve to emphasise the geographical and racial human groups, while room has also been found for comparative series of weapons and utensils. Of the six floors of the building, the top and the basement, more than a third of the available area, have been allotted to work-rooms and the storage of study collections—a welcome indication that the needs of the student as well as of the ordinary museum visitor are being kept well in view. The removal of the ethnographical collections has permitted an expansion of the natural history collections, and the rearrangements thus made necessary are now in progress. It is an excellent sign of the place taken by the Museum in the education of the city that the Education Authority has delegated five teachers to conduct school classes in the galleries, to the extent of a hundred classes weekly, and the rearrangement of the collections will now enable these teachers to be provided with special rooms for their class-work.

THE generally admitted superiority of American monthly journalism is challenged by a new monthly, entitled *The Realist*, the first number of which was published by Messrs. Macmillan and Co., Ltd., at the end of March. This journal is to be devoted to science, industry, art, and economics, and the general editor is Major Archibald Church. An editorial board has been appointed, on which the interests of science are represented by such names as Prof. F. G. Donnan, Sir Richard Gregory, Mr. J. B. S. Haldane, and Prof. Julian Huxley. The new magazine stands for scientific humanism, and we are invited editorially to test its scope by an examination of the subjects and writers of the articles published in this first issue. Literature is represented by Arnold Bennett, who writes on the progress of the novel, and by Aldous Huxley, who writes on Pascal. Among the subjects of articles of scientific interest are "Rejuvenation" by Norman Haire, "Science and the Farmer" by Sir Daniel Hall, "Scientific Humanism" by Dr. Charles Singer; and other articles deal with architecture, music, and the 'movies.' *The Realist* is excellently printed and produced, and if the high standard set by the first number is maintained the journal will soon secure wide recognition.

THE non-magnetic yacht *Carnegie* arrived at Papeete, Tahiti, on Mar. 13. Conditions throughout the passage from Callao, Peru, were excellent. On Feb. 16 the soundings obtained showed depths from 2700 metres to 5400 metres and back to 4100 metres over a distance of 50 miles; the ocean-deep thus revealed was named 'Bauer Deep.' Two uncharted submarine ridges were also discovered and rapid slopes off Tatakoto and Amanu Islands were determined. On Mar. 8 five hours were spent ashore on Amanu Island. The bottle-sample obtained at 2100 metres on Mar. 10 (latitude 17°·6 south, longitude 141°·9 west) contained a few fragments of black lava with no trace of ooze, indicating recent volcanic origin. The work done on this passage included 63 determinations of magnetic declination and 17 of magnetic intensity and inclination; 17 ocean-stations, at 15 of which bottom samples were obtained; 206 soundings; 35 pilot-balloon flights, one of which was followed to a height of more than 6 miles; 8 determinations of evaporation; 4 series of atmospheric-electric observations by eye-readings, each throughout 24 hours; and 23 complete 24-hour photographic electrograms of potential gradient. The vessel left Papeete on Mar. 20 for Apia, Western Samoa; she will also make a short stop at Pago Pago, American Samoa.

HIS Royal Highness the Prince of Wales has consented to become patron of the Society for the Preservation of the Fauna of the Empire, which was founded in 1903 by a group of animal lovers with the object of awakening public interest in the great heritage of wild life existing all over the British

Empire. It has a very energetic president in the Earl of Onslow, and has helped in the formation of the many sanctuaries and national parks which are now to be found throughout the Empire. There is, however, much more work to be done in this direction, and the Society needs further support in order that it may continue to carry out its objects efficiently. The Society's secretary is Col. J. Stevenson-Hamilton, well known for his work in the formation of the Kruger National Park recently opened in South Africa. Further information about the Society can be obtained from the secretary, S.P.F.E., c/o Zoological Society, Regent's Park, London.

HIS Royal Highness the Prince of Wales has consented to become an honorary member of the Linnean Society of London.

WE much regret to announce the deaths of the Right Hon. Lord Avebury, on Mar. 26 at the age of seventy years, and of Lord Montagu of Beaulieu, K.C.I.E., C.S.I., on Mar. 30 at the age of sixty-two years. Lord Avebury was a trustee and also the honorary treasurer of the British Science Guild, and Lord Montagu was president of the Guild in 1920–22.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A government chemist in Fiji—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (April 10). A lecturer in metallurgy at the Technical College, Bradford—The Principal, Technical College, Bradford (April 12). An assistant lecturer in preparing, combing, and spinning and yarn manufacture at the Bradford Technical College—The Principal, Technical College, Bradford (April 12). An established analytical chemist, Class II., in the Royal Naval Cordite Factory, Holton Heath, of the Scientific Research and Experimental Department of the Admiralty—The Secretary to the Admiralty (C.E. Branch), Whitehall, S.W.1 (April 13). A fellowship in the department of Coal Gas and Fuel Industries of the University of Leeds for post-graduate research in gas chemistry—The Clerk to the Senate, The University, Leeds (April 19). A senior chemist under the Northern Coke Research Committee, Armstrong College—Prof. H. V. A. Briscoe, Armstrong College, Newcastle-upon-Tyne (April 22). A director of the Dental Prosthetic Laboratory, Guy's Hospital Dental School—The Dean, Guy's Hospital Dental School, London Bridge, S.E.1 (April 30). A professor of imperial economic relations, tenable at the London School of Economics—The Academic Registrar, University of London, South Kensington, S.W.7 (April 30). A head of the Navigation Department of the L.C.C. School of Engineering and Navigation, Poplar—The Education Officer (T.1a), County Hall, Westminster Bridge, S.E.1 (May 13). A government analyst, Cyprus—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1. An assistant editor of *Science Abstracts*—The Secretary, Institution of Electrical Engineers, Savoy Place, W.C.2.

Our Astronomical Column.

STUDIES OF PROPER MOTION.—Prof. J. Comas Sola, of Fabra Observatory, Barcelona, contributes an article on this subject to *Scientia* for March. It begins with a historical review of the subject, and goes on to describe the modern methods of picking out stars with sensible motions by means of the stereocomparator. This is essentially a stereoscope in which plates taken at an interval of a few years are viewed simultaneously by the two eyes. Prof. Sola has devised an improved form in which the plates can be rotated so that the displacement due to proper motion of the two images of any star is parallel to the line joining the eyes. He states that an interval of 20 days between the exposures suffices to give a sensible displacement in the case of 61 Cygni, the motion of which is 5·2″ per annum. The focal length of the camera employed is only 80 cm. He makes a comparison with the 'blink' micrometer, but considers his instrument superior. Work of this kind is very useful for detecting faint stars with appreciable proper motion.

WOLF'S PERIODIC COMET.—Prof. M. Kamiensky, Director of Warsaw Observatory, has been engaged for many years in a detailed study of the perturbations of this comet from the date of its discovery in 1884 to the present time. At the aphelion passage between 1918 and 1925, it approached very closely to Jupiter and suffered large perturbations that increased its perihelion distance from the sun by nearly a unit. These enormous perturbations were so accurately computed that the comet was found close to the predicted position.

Acta Astronomica for January 1929 contains a careful recomputation by Prof. Kamiensky of the perturbations between 1891 and 1898. He had previously used A. Thraen's results for this revolution, but finding that he did not use the latest values for the planetary masses, Prof. Kamiensky has repeated the work with the greatest care, carrying the work to units of 0·001″. The differences from Thraen, after allowance has been made for the different masses employed, are very small. But it was necessary to repeat the work to obtain the degree of accuracy necessary to link together all the apparitions of the comet in a rigorous manner.

CLUSTERS OF UNIVERSES.—It has been long known that there is a rich nebulous region in Virgo and Coma Berenices, close to the north pole of the galaxy. The nebulæ in this region are of the type which Dr. Hubble's researches marked out as external galaxies, so that we have evidence that these objects are not scattered uniformly but are aggregated more densely in some directions than in others. In *Harvard Bulletin*, No. 864, Prof. Harlow Shapley and Miss A. Ames show that, in addition to the main assemblage, the distance of which is given as about 10 million light years, there are three other adjacent 'clouds of galaxies'; these are fainter and smaller, so are probably much more remote. The correlation between magnitude and angular diameter indicates the relation $m = 24{\cdot}15 - 5 \log d$, where m is the apparent magnitude and d the diameter in seconds. This equation would indicate the perfect transparency of space: the departure from it is so small that it is estimated that the loss of light through absorption in space does not exceed one-fifth of a magnitude in a hundred million light years. This of course is not true in the special regions in our galaxy where there is strong evidence of local absorption by dark matter; as, for example, in the 'Coal Sacks.'

Research Items.

WITCHCRAFT IN SOUTHERN INDIA.—In *Man* for March, Mr. F. J. Richards publishes photographs of houses in Arantängi, Tanjore, which have been demolished by their owners in their fear of 'black magic.' On the occasion of a visit to the village in 1900 he found the Brahmins in a panic, stripping the thatch from the roofs of their houses and removing their belongings into the street. On the previous night no less than seven houses had been set on fire by supernatural agency, and the whole Brahmin quarter had been pelted with stones thrown by invisible hands. Stone-throwing continued in broad daylight, and when another fire broke out the householder brought to the author a rag ball a little bigger than a tennis ball which had been found under the eaves. Tow and rag had been rolled tightly together. It was damp and was said to smell of phosphorous, though this was not perceptible. In the centre was a small fruit stone —held by the villagers to be conclusive evidence of sorcery. The kitchens were desecrated with blobs of boiled rice, coloured yellow or magenta, and mixed with clippings of human hair and nail parings. These were found secreted in and about the cooking places. This defilement of places of which the ceremonial cleanliness is of the utmost importance, was especially to be noted. The Brahmin quarter was the residence of the most intelligent and prosperous section of the village. It was suggested that blackmail was the origin of the visitation. Some professed expert in sorcery had demanded a contribution from each household and had been refused. This was his retaliation.

A PILE-DWELLING AT BRENTFORD.—In *Antiquity* for March, Dr. R. E. M. Wheeler describes some investigations recently carried out on the foreshore and in the bed of the Thames at Brentford. In 1928 public attention was attracted by the frequency with which bronze weapons and implements were found in the neighbourhood, and especially near the meadow "Old England" just above the junction of the Thames and the Brent, particularly through the collections made by Mr. G. F. I. Lawrence. Mr. O. G. S. Crawford has suggested that this may be the site of one of a number of settlements of lake-dwelling peoples from Switzerland of the late Hallstadt Iron Age. A fund was raised for excavation through the *Daily Express*. The result was the discovery of a Romano-British pile-dwelling—the first of the period recorded in the British Isles. As the excavations were below tide level, they were carried out under great difficulty and only part of the site was uncovered. This, however, was sufficient to indicate the existence of a rectangular dwelling. Piles were found in position with part of the floor of the hut. The first indication of the date of the structure was a complete Roman pot found above this floor. The structure of the floor was as follows: A pile was driven more than three feet into the gravel—how much more it is impossible to say; a horizontal beam was laid on the pile on the level of the gravel; then a layer of green clay was laid on the gravel to the height of the beam—6-7 inches. Upon this was laid a longitudinal layer of wattle. Upon this was a second horizontal timber and then a further layer of clay. A double layer of wattle formed the final floor, nearly 2 feet above the gravel. The timbers were unsquared. A Roman roofing tile beneath the wattle floor in the upper layer indicated the period. Roman pottery and roofing tiles were found around the hut. In the surface of the gravel, fragments of coarse pottery were found which can with confidence be assigned to the half millennium 1000–500 B.C., known in Central Europe as 'Hallstadt.'

PHOTOSYNTHESIS IN THE SEA.—The Annual Report for 1927–28, drawn up by the executive to the council of the Scottish Marine Biological Association, shows a satisfactory financial situation, the greater part of the expenses of the marine research being defrayed by the Development Fund of H.M. Treasury, together with an amount contributed from local sources. Miss S. Marshall and Mr. A. P. Orr having been granted leave of absence in order to join the Great Barrier Reef Expedition, temporary appointments have been made to fill their places. Before leaving, their researches on photosynthesis in the sea had been continued, including further experiments on diatom cultures enclosed in glass bottles suspended at different depths in the sea, the oxygen produced being measured. From the results it was concluded that the light intensity at which photosynthesis just balances respiration in these inshore waters is never deeper than 20-30 metres even in summer. As the surface is approached the increasing light enables more photosynthesis to take place, but this increase only goes up to a certain depth, above which the light is too strong. During the spring maximum the diatoms are so numerous that they shut off a considerable amount of light and the compensation point rises. Different species behave in different ways. The members of the genus *Chætoceros*, summer forms in these regions, were found to be more sensitive to sunshine than those of *Coscinodiscus*, which are chiefly spring forms, both in cultures and naturally in the sea. Two papers have been published by these authors in the *Journal of the Marine Biological Association* in 1927 and 1928, "The Relation of the Plankton to some Chemical and Physical Factors in the Clyde Sea Area" and "The Photosynthesis of Diatom-Cultures in the Sea."

DECAPODA OF THE *SIBOGA* EXPEDITION.—Dr. J. G. De Man has continued his studies of the rich material of the *Siboga* expedition, his latest report dealing with the Thalassinidæ and Callianassidæ (*Siboga* Expeditie. Monog. 39 a6, Leyden, December 1928). This report, which amounts to a partial monograph of the group, gains particular value from the list of species known in each genus and the tables for their identification. The *Siboga* material includes 10 species of *Upogebia*, of which 5 are new, and 15 of *Callianassa*, of which 12 are new. This large proportion of new species shows how little these burrowing forms are known. Dr. De Man illustrates this point by saying that, out of 76 species of *Callianassa* described, 46 have not been seen since their description. No one to this day knows the manner of life of *Jaxea nocturna*, which has been known since 1818. Its larva is commonly met with on the coasts of Britain, but the adult has been taken only twice. There is one omission from this report which is difficult to understand—*Naushonia crangonoides*. In one of his earlier reports, Dr. De Man includes it among the Crangonidæ, but he does not mention it here at all. There is no doubt whatever that it is not a crangonid but a thalassinid, and it is almost certain that it is closely related to *Jaxea*. The author does not enter into the question of the phylogeny and systematic position of these remarkable and probably very ancient Decapoda; but his extraordinarily detailed description of the species will be valuable material with which to build. The last word has certainly not been said as to the position of the Thalassinidea among the decapods or their relation to one another.

A JAPANESE OLIGOCHÆTE.—Mr. Hironori Yoshizawa gives an interesting and detailed description of

the freshwater oligochæte *Stylaria lacustris* which is very common in the pond of the Biological Laboratory, Tôhoku Imperial University ("On the Aquatic Oligochæte *Stylaria lacustris* L." *Science Reports of the Tôhoku Imperial University*, 4th Series (Biology), Sendai, Japan, vol. 3, No. 4, Fasc. 1, 1928). The worm is remarkable in having an elongated prostomium. It was cultured in the laboratory, the cultured specimens being used for the present work. These all attained sexual maturity in early autumn, September and October being the natural time for the sexual form in the pond. The food consists of diatoms, other algæ and vegetable debris. One of its enemies is *Hydra*, which swallows the worm, helping it down with its tentacles (body length of the worm 8-11 mm.). This reminds one of *Protohydra*, which can swallow oligochætes much longer than itself, and in that case with no tentacles at all. Asexual forms are found in spring. These are rather shorter and thinner than the sexual worms, and fission may take place in three or even in four places. The front portion forms a new tail by adding a number of posterior segments, and the hind portion adds five new segments anteriorly to form a new head. As a rule, fission proceeds from the ventral plane, midway between the anterior and posterior septa of the segment. There are usually twenty-five segments, 16, 17, 18, 19, and 20 being the segments which most frequently undergo fission.

LIVING FORAMINIFERA IN THE TRANSCASPIAN KARA-KUM.—Up to now only a few marine Foraminifera have been found in fresh waters or in continental waters generally. Some marine genera (such as *Polystomella*, *Rotalia*) come up to river estuaries and small freshwater lakes by the sea. In the spring of 1927, A. L. Brodskii (*Priroda*, No. 11, 1928) found a numerous fauna of Foraminifera in the wells of the Kara-Kum desert. These wells lie north-east of Askhabad, their depth is 18-20 m., temperature of the water in spring is 17°-20° C., and in some cases the water contains as much as 10 gm. of salt per litre. The Foraminifera found in the wells belong to the genera *Spiroculina* (a new species *turcomanica*), *Biloculina* (*B. elongata* and a new species *turcomanica*), *Textularia*, *Nodosaria*, and *Lagena*. They all contained protoplasm, and in some a nucleus or nuclei were found; thus there can be no doubt that they were alive. All the Kara-Kum Foraminifera are very small in size; whilst the marine *Spiroloculina* and *Biloculina* reach 2-3 mm. in length, the Kara-Kum representatives of the genera scarcely exceed 0·16 mm. Their shells are fragile, transparent, flattened, and smoothed. They evidently inhabit salty ground-waters of the sands of Kara-Kum desert, whence they fall into the wells. They are probably relics of the Upper Tertiary seas which once covered the Kara-Kum desert. Waters of the Sarmatian and the Akchaghyl seas may also have stretched up to there. It should be noted that *Polystomella*, *Rotalia*, *Textularia* are still found in the Caspian Sea. Masses of valves of *Polystomella* and *Discorbina* are found in the Aral Sea, and it is probable that Foraminifera live there now.

REVISION OF THE GENUS *TRIGONELLA*.—In his monograph on the genus *Trigonella*, G. Sirjaev proposes a new division of the genus into three subgenera, fifteen sections and numerous subsections. The first published part (*Publications de la Faculté des Sciences de l'Université Masaryk*, No. 102, 1928) deals with the taxonomy and distribution of twenty-one species of the chief subgenus *Trigonella*, one new species from Bokhara and several new varieties being described.

WATER METABOLISM IN DUSTY LEAVES.—With most plants the transpiration of dust-covered leaves is considerably lower than that of leaves which have been recently cleaned, so that after a few hours the former leaves will contain appreciably more water than the latter. An exception to this general rule, noted by Luigi Montemartini in the *Rendiconti* of the Royal Lombardy Scientific and Literary Institute (vol. 61, parts 11-15), is observed in the case of *Ceratonia siliqua* (L.). Here the cleansed leaves, although exhibiting a markedly more active transpiration, yet accumulate more water than those covered with a layer of road-dust. To explain this exceptional behaviour, reference is made to the fact that, as Bose showed, transpiration renders more active the circulation and ascent of water in plants, whereas diminution of the transparency and of the permeability to gases of the cuticle by the thin coating of dust determines a decreased production of substances able to retain moisture in the cells. It would seem that, with *Ceratonia* leaves, the cuticle presents peculiar features as regards this transparency and permeability and the cellular protoplasm a sensitiveness which, under the conditions employed, leads to a retardation of all the vital functions with consequent loss of water when the leaves are dust-covered.

CYTOLOGY OF *ŒNOTHERA*.—A useful summary of our knowledge of the cytology of *Œnothera* has been published by Prof. R. R. Gates in *Bibliographia Genetica*, **9**, 401 (1928). It was in this genus that important correlations between chromosome content or behaviour and genetic phenomena were first discovered. Since the original announcement of chromosome numbers in *Œnothera* was made in December 1906, an enormous amount of research has been carried out on many of the species, mutations, and hybrids of wild and cultivated evening primroses, as is indicated by the bibliography of seven and a half pages attached to this paper, which summarises work up to 1923, with some references to subsequent publications. Chromosome numbers in 30 species are now known. The improvements in cytological technique in recent years have led to the demonstration of delicate connexions between the ends of the chromosomes, and these determine the peculiar alinement observed in the heterotypic metaphase. The meiotic process is certainly telosynaptic. The mutant *Œ. gigas* was the first investigated tetraploid mutation. The first examples of non-disjunction were also studied in this genus, and double non-disjunction is now known to occur. Trisomic mutations, with 15 chromosomes, are the most characteristic of all the mutations of *Œnothera* and include the well-known *Œ. lata*, *Œ. scintillans*, *Œ. oblonga*, and *Œ. albida*. The view that *Œ. lamarckiana* is, in spite of the numerous mutations it has thrown, a persistent species of equal value to *Œ. biennis* and others of the *Onagra* group, is maintained, though it is suggested that the whole group may be ultimately hybrid in origin. Indeed, it is accepted that hybridisation followed by new chromosome linkages and accompanied by mutations, some of them cytoplasmic and some arising in the chromatin, have been largely responsible for the evolution of the genus *Œnothera* as we now know it.

THE PARKGATE SEAM IN SOUTH YORKSHIRE.—The Department of Scientific and Industrial Research has issued the thirteenth of its physical and chemical surveys of the coal resources of Great Britain (London: H.M.S.O., 1929), being an investigation of the Parkgate Seam, which occurs over an extensive area in South Yorkshire and the adjoining parts of Nottinghamshire and Derbyshire. The seam is an exceedingly

important one and extensively worked throughout the whole area in question. In Derbyshire and Nottinghamshire it is spoken of as the Deep Hard, whilst in Yorkshire to the north of Barnsley it is known as Old Hards. The seam is generally considered as capable of being divided into three main sections, namely, the tops, the hards or middle coal, and the bottoms. Of these, the middle coal may be considered the most important; it consists very largely of durain. The method of investigation in the present report has been to cut some sixteen samples from the Parkgate seam as it occurs in South Yorkshire in the exposed portion of the coalfield, ranging from a little north of Barnsley to just south of Sheffield. These samples have then been fully examined, and the results of the examination are reported in detail; the determinations include approximate analysis, ultimate analysis, calorific value, melting point of ash, carbonisation assay, and ultimate and proximate analyses of the four constituents, vitrain, clarain, durain, and fusain. The work has been done not only on the whole sample, but also upon the various sections into which each sample could be divided, the sample consisting in every case of a vertical prism of the coal cut from the roof to the floor. When, as is sometimes the case, a certain portion of the top coal is left standing to form a roof, such portion has not been included in the sample. The report gives evidence of very thorough and careful investigation, and the results should be of value to those engaged in working this particular seam, that is to say, to practically all the collieries working in the area above indicated.

A NEW WARM STAGE.—An electrically heated warm stage and compressor for use with high-power objectives is described by Messrs. J. E. Barnard and F. V. Welch in the January issue of the *Journal of the Royal Microscopical Society*. The apparatus consists of a small box which encloses the heating system, the microscope stage and object holder, and also the objective and substage illuminator. The box is in two parts, one of which slides off the other and permits access to the object without disturbing the microscope or its adjustments. The two electrical heating elements are clamped on the under-side of the stage, one on each side of the condenser, and the leads to them connected to the mains in series with a suitable variable resistance. The temperature of the air inside the box is raised, and the stage and compressor can therefore be maintained at a constant temperature. As the compressor is a relatively large mass of metal, its temperature once raised changes little, and hence the two cover-glasses between which the material is placed for observation are also maintained at a constant temperature. The apparatus was designed for use in an investigation on bacteriophagic action involving observations of living bacteria for long periods, and for this purpose has proved entirely satisfactory.

ULTRA-VIOLET LIGHT TRANSMITTING GLASSES.—An interesting paper by Starkie and Turner on the composition and properties of ultra-violet light transmitting glasses has appeared in the *Journal of the Society of Glass Technology*, vol. 12, No. 48. An account of the development of these glasses is given, together with some analyses. The limits of transmission in the ultra-violet and the percentage transmission have been studied for eight commercial ultra-violet glasses, and the results show a wide divergence for the different samples. The ageing effect of sunlight, known as solarisation, was examined, and an exposure of several months in summer was found to reduce the transmission by more than 10 per cent in some cases. Exposure to the light of a powerful arc for several hours brought about much more rapid ageing. This ageing is usually accompanied by a colour change from a greenish to a brownish tint, which supports the theory of Starkie and Turner, that the dominating factor in solarisation is the conversion of ferrous to ferric oxide in the glass.

THE MECHANISM OF ARCS.—It seems now to be generally agreed that it is not necessary for the cathode of an arc to be hot for the discharge to pass. The problem therefore arises as to how the current is maintained, if it is not primarily due to thermions from the metal, and to meet this difficulty the suggestion has been made by Prof. Seeliger and by Dr. Langmuir that there is an 'autoelectronic' liberation of electrons from the surface of the cathode in the high electric fields that are present in the localised region of the cathode fall in potential. These fields can be of the order of a million volts per centimetre, and are ample to pull electrons out of a cold metal under appropriate conditions, such as those employed, for example, in the recently revived Lilienfeld type of X-ray bulbs. Unfortunately, this theory requires that the current density in the cathode spot should not fall below about 1000 amperes per sq. cm., whereas some arcs in gases at reduced pressure have been described by J. Slepian and E. J. Haverstick in the January issue of the *Physical Review* in which the current density was only about one per cent of this. It appears, then, that the field theory is not tenable, if its interpretation by these authors is correct, and they have again directed attention in the same paper to a theory proposed by one of them (J. Slepian) three years ago, which referred the maintenance of the arc not to any emission of electrons from the cathode at all, but to the thermal ionisation of a layer of gas in its immediate vicinity.

RAMAN OPTICAL EFFECT.—In spite of the attention that the quantised scattering of light discovered by Prof. Raman has already received, there are a number of points connected with it that are still obscure. Perhaps the most significant of these is the difference in intensity between the Raman satellites and the corresponding infra-red absorption bands and maxima of selective reflection. Quartz, for example, gives rise to Raman satellites equivalent to natural vibrations at 38 μ, 48 μ, and 78 μ, all of which were, until recently, unknown in the infra-red spectra. M. Czerny has now recorded the pair at 38 μ and 78 μ as absorption bands of crystalline quartz, using a grating apparatus (*Zeitschrift für Physik*, Feb. 19); he has, however, found not the slightest trace of a band at 48 μ in this way, although there is an intense Raman satellite corresponding to this wave-length. The origin of these discrepancies can only be surmised at present, but it may be, as the author suggests, that they arise from the fact that for a body to show the phenomena of selective reflection and absorption, the oscillators in it must have other properties than the mere possession of a definite period, whereas possibly the last condition alone suffices to produce a Raman satellite in scattered light.

DETERMINATION OF TRACES OF IODINE IN VEGETABLES.—McClendon and Remington, in the February number of the *Journal of the American Chemical Society*, describe a method for the estimation of small quantities of iodine in vegetables, depending on combustion in oxygen, the material being fed into a silica combustion tube by a special arrangement so as to avoid soot and tar formation. Chlorides and iodides volatilise and are condensed by electrostatic precipitation. Low temperature burning in open dishes requires about fifteen hours for 100 grams of dry sample, and does not lead to large losses of iodides if the ash is alkaline and the temperature never exceeds 450°. Calcium lactate must be added to vegetables with an acid ash (cereals) in order to make the ash alkaline and to prevent its fusion. Combustion is never complete if the ash fuses.

Weather and Wireless.

MR. R. A. WATSON WATT delivered the G. J. Symons Memorial Lecture of the Royal Meteorological Society in the rooms of the Society on Mar. 20. The lecture was illustrated by the first public demonstration, in Great Britain, of the reception by wireless picture telegraphy of current weather charts and forecasts, and also by the first public demonstration of the cathode ray direction finder. Figs. 1 and 2 are reproductions of the

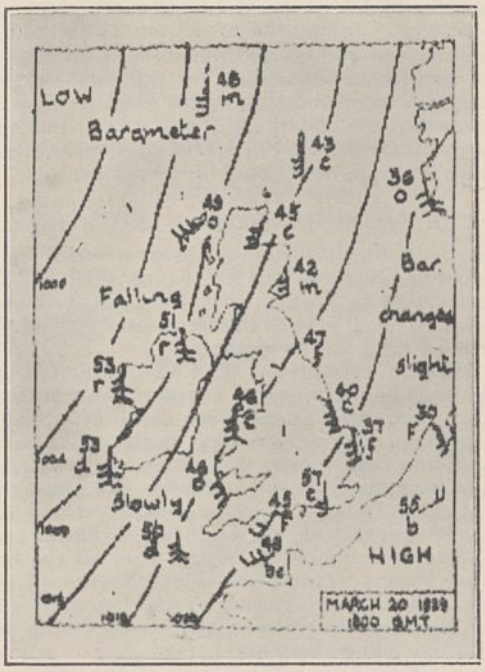


FIG. 1.—Synoptic chart transmitted and received by wireless on Mar. 20 by the Fultograph method.

synoptic chart for 6 P.M. on the evening of the lecture and of a general inference and forecast based on the same data which were prepared in the Meteorological Office at the Royal Airship Works, Cardington, transmitted by the Fultograph method from the wireless station at Royal Airship Works, and received by wireless in the rooms of the Society before 8.15 P.M. The reproductions are from photographs of the actual Fultograms received by wireless.

Subjoined is a summary of Mr. Watson Watt's lecture :

Wireless and Weather Warnings.

Wireless communication is of vital service to the forecaster, particularly in Great Britain, because of five special facts affecting synoptic meteorology, namely, that :

(1) Data from very wide areas must be utilised in the preparation of forecasts.

(2) British weather comes mainly from the west.

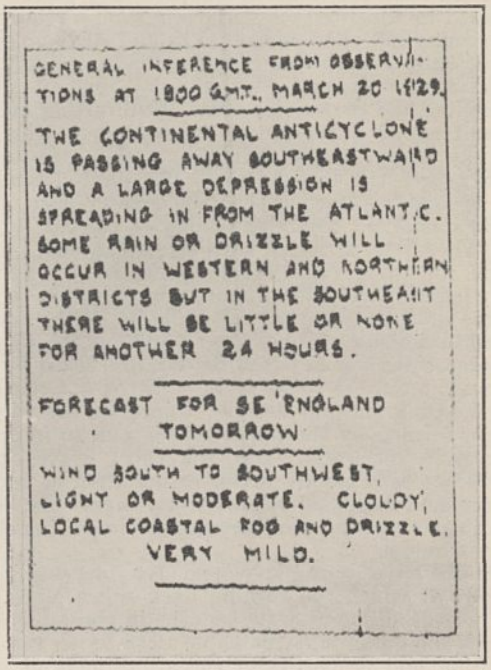
(3) The shortness of the periods for which we can at present forecast makes it imperative that the exchange of data should be extremely rapid.

(4) The importance, in navigation, of meteorological data more recent than that available at the time of departure increases rapidly with the mobility, speed, and range of action of the craft concerned.

(5) Aircraft require the most detailed meteorological information attainable, on account of the extreme seriousness of the results of meteorological interference with normal flying.

The present state of organisation is such that the data for the whole of Great Britain is collected within an hour, sufficient data for Europe as a whole within an hour and a half, while a chart containing data for the whole northern hemisphere at 7 A.M. is issued before noon. Data from the Atlantic shipping routes is of special importance to the British forecaster, and transmission by wireless alone can put it in his hands sufficiently quickly.

The broadcasting of weather reports and forecasts is forming a public opinion which will react beneficially on the science by increasing the attention paid to meteorology in education. The broadcasting of synoptic charts by picture telegraphy will enhance the value and facilitate the interpretation of the


GENERAL INFERENCE FROM OBSERVATIONS AT 1800 G.M.T., MARCH 20 1929.

THE CONTINENTAL ANTICYCLONE IS PASSING AWAY SOUTHEASTWARD AND A LARGE DEPRESSION IS SPREADING IN FROM THE ATLANTIC. SOME RAIN OR DRIZZLE WILL OCCUR IN WESTERN AND NORTHERN DISTRICTS BUT IN THE SOUTHEAST THERE WILL BE LITTLE OR NONE FOR ANOTHER 24 HOURS.

FORECAST FOR SE ENGLAND TOMORROW

WIND SOUTH TO SOUTHWEST, LIGHT OR MODERATE. CLOUDY, LOCAL COASTAL FOG AND DRIZZLE. VERY MILD.

FIG. 2.—Written weather forecast transmitted and received by wireless on Mar. 20 by the Fultograph method.

broadcast reports. An experimental period of transmission of current synoptic charts will begin at a very early date, the transmissions being made from Daventry on the Fultograph system. Such transmission of charts by one of the wireless methods now available is likely to be of extreme value to the airship navigator, who must be put in possession of sufficient data for the intelligent application of the forecasts sent him. The demonstration given showed the transmission and reception of current weather charts and written forecasts, and in particular the reception by wireless picture telegraphy of a synoptic chart for

6 P.M. of the same evening, together with a written forecast, prepared in the Meteorological Office at the Royal Airship Works, Cardington, and transmitted by wireless from Cardington.

THE WEATHER OF WIRELESS.

Wireless has a climate and a weather of its own. The weakening of signals over different kinds of country, depending on time of day and season, the dependence of atmospherics on latitude, place, and time, are climatological in scope. The quick-period variations, erratic fading phenomena, and the like, are of the nature of weather, and atmospherics are the rainfall of wireless. The history of civilisation is in the main the story of man's progress towards independence of the weather. The history of wireless telegraphy is that of progress in the mitigation of these disturbing factors.

The study of fading and signal variations is simplified by considering separately the energy which travels along the earth's surface and the energy which, after reaching high levels in the atmosphere, is returned to the ground level by reflection or mirage effects occurring at heights of 50 to 150 miles. The ground ray is heavily absorbed, but is not subject to random variations. It can therefore be depended upon to give a reliable 'service area' of limited extent around the transmitter. Outside this area the ray returned from the upper levels (the 'sky wave' as it is called in America) may arrive in such a relation to the ground ray as to neutralise it, and leave no signal at all, while a slight change in the conditions aloft will cause reinforcement. This gives a zone of severe fading outside the service area. Still farther out the ground ray is so weak that it can never wipe out the sky wave, and so fading is actually less severe than nearer the transmitter. The limited range of the ground ray means that the greater part of the world's wireless communications is carried by the sky wave. It is as if stations which are out of range for direct vision communicated by lighting up a cloud layer the illumination of which is then visible at the distant receiver. Most of the foreign broadcasting stations heard at night on the average broadcast receiver in Great Britian are heard by this process.

Increasing sunspot activity improves the wireless mirror formed by the upper layers, and so improves long-wave reception. But for short waves these layers act as a cloudy prism rather than as a dirty mirror, and increased solar activity makes the layers absorb short waves more strongly, so impairing short-wave wireless.

Means have been developed for measuring the heights at which the turning back takes place, and the use of different wave-lengths in these measurements should provide valuable data as to the constitution and properties of the atmosphere at great heights.

Conditions for the travel of short waves in the upper air are often so favourable that a signal is received directly, and again after it has been once or several times round the world. Moreover, it would appear that 'echoes' of this kind have been received owing to waves penetrating the upper layers, and being sent back from a reflecting surface, far beyond the moon's orbit, formed of electrons which have been emitted from the sun.

Atmospherics, of which as many as three or four thousand per second can be counted in a tropical night, are found to be capable of disturbing broadcast reception at stations up to four thousand miles from the place at which they originated. The average atmospheric applies to the receiving aerial an electric force a hundred thousand times as great as is needed to give a readable signal.

THE EFFECT OF WEATHER ON WIRELESS.

Atmospherics are found to originate in thunderstorms, and the predominant source of the world's supply of atmospherics at any given hour lies in a land where it is summer afternoon. The strength of atmospherics radiated from thunderstorms at known distances agrees with that computed from other data about lightning, and the average atmospheric received in England is of such strength as would be radiated from a lightning flash 2000 miles away. By means of visual direction finders, of the type demonstrated in operation, thunderstorms can be located by observations at stations one or two thousand miles away.

The surfaces of discontinuity between cold and warm air masses, which form the principal features in the modern interpretation of the weather map, produce marked modifications in the strength of signals in the path of which they lie. These discontinuities also produce errors in directional observations.

THE EFFECT OF WIRELESS ON WEATHER.

Dr. Johnson has immortalised a brief chapter "Concerning Snakes," the full text of which is "There are no snakes to be met with throughout the whole island." Thus it is with the frequently alleged effects of broadcasting on the weather.

It is to be remembered that all the rainfall of the world must be produced by evaporation, and that the average rainfall of England requires for its evaporation the expenditure of energy at the rate of a third of a million horse-power per square mile, night and day, throughout the year. This is the approximate power of the Barking super-power station, the largest electricity generating station in Great Britain. The total rate of emission of energy from all the broadcasting stations of Great Britain and Northern Ireland, in the limited periods during which they are working, is less than 55 horse-power, the corresponding figure for Europe being about 400 horse-power. Any effect of broadcasting on rainfall would, therefore, mean the exercise of control by the expenditure of energy amounting to less than one part in a thousand million, a reaction so sensitive that it could not have escaped detection in the laboratory. The scale may be represented in another way by remarking that the annual rainfall for a single tennis court, if the energy required for evaporation were purchased at a favourable rate as electrical energy, would cost about £800, while the London listener pays only $\frac{1}{8}d.$ per annum, in his 10*s.* licence fee, for transmitter power. The expenditure on transmitter power for all the B.B.C. stations amounts to only $\frac{3}{4}d.$ per licence.

WIRELESS AND WEATHER WARNINGS.

Extensions of the application of wireless telegraphy in meteorological communications may well include the transmission of three-colour charts, in which the fronts are indicated in distinctive colours. The detection and location of thunderstorms by wireless direction finding on atmospherics has been tested, and further experimental work is likely to lead to applications of this method in the meteorology of air-routes. It is possible that some of the other measurements of the effects of weather on wireless, as described, may be of use as aids to the forecaster in the identification and location of fronts. It may also be possible to trace a relation between measured ionisation gradients at considerable heights and the convective processes in the troposphere.

The Stereochemistry of Tellurium.

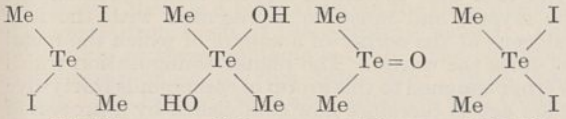
By Prof. T. M. LOWRY, F.R.S.

NEARLY ten years ago the late Mr. R. H. Vernon made a remarkable series of observations on the occurrence of isomerism in the alkyl derivatives of tellurium.[1] The initial compound can be prepared by the direct action of metallic tellurium on methyl iodide, $Te + 2CH_3I \rightarrow Te(CH_3)_2I_2$. Silver oxide then liberates from the iodide a weak 'α' base, $TeMe_2(OH)_2$, which when dehydrated undergoes a molecular rearrangement, and is converted into a rather stronger 'β' base. From this 'β' base a series of 'β' salts can be obtained, which have the same composition as the 'α' salts derived from the 'α' base. Measurements of boiling-points of solutions in acetone, and of freezing-points of solutions in benzene and in nitrobenzene, indicated that the two chlorides had the same normal molecular weight, but that, whilst the α-dibromide and the α-di-iodide were also normal, the β-compounds were partially polymerised thus :

MOLECULAR WEIGHTS.

	α (Obs.).	β (Obs.).	Calc.
Chlorides in acetone .	229	226 230 223	228
Bromides in acetone .	335	430 459 525	317
Bromides in nitrobenzene	..	400 445 370	
Iodide in benzene . .	401	..	411
Iodide in acetone . .	..	509 707	

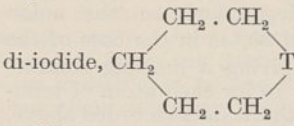
In view of the equality of molecular weights of the chlorides, and of the methods by which the α and β salts were produced, Vernon supposed that they represented the *trans* and *cis* forms of molecules having a square configuration, like that which Werner assigned in 1893 to the isomeric platinous compounds of the type $Pt(NH_3)_2Cl_2$, thus :



α-Di-iodide (*trans.*). α-Base (*trans.*). Anhydrous β-Base. β-Di-iodide (*cis.*).

The thorough character of the work, the simplicity of the explanation, and the obvious analogy with platinum, won for this scheme an immediate and universal acceptance, and it was a source of pleasure to me, in view of my intimate association with Vernon's earlier activities, to be able to record in December last [2] the fulfilment of Vernon's prediction in reference to the diethyl base that " If this base does not decompose when its solution is evaporated to dryness, but gives diethyltelluronium oxide, the existence of two haloid series would be highly probable." A detailed physico-chemical study with Mr. Gilbert [3] of Vernon's own compounds had also confirmed the equality of molecular weights of the α- and β-compounds, since measurements of the freezing-points of aqueous solutions gave almost identical values for van't Hoff's i-factor, namely, 1·1 for the α- and β-bases, and about 1·8 for the α- and β-hydroxychlorides $TeMe_2(OH)Cl$.

Although, however, Vernon's experiments were impregnable, and the evidence for identity of molecular weight appeared to be ample, the writer concluded [4] that " The striking difference in colour of the α- and β-dihalides shows that the isomerism of the α- and β-compounds must include some factor which is not expressed completely by merely putting two halogen atoms and two alkyl radicals at adjacent or at opposite corners of a square." Serious reasons for doubting the validity of the whole scheme were found for the first time, however, when further experiments showed [5] that a *cyclo*-telluropentane



di-iodide, , prepared by Morgan, and Burgess,[6] and the bases and salts derived from it, behaved in five different points like the corresponding α-compounds of Vernon's series, to which he had assigned a *trans*-configuration. Examination of models showed that, whilst it was easy to form a strainless ring in the case of a *cis*-compound, the formation of a *trans*-ring involved as usual an intolerable strain, which produced a corresponding strain on the theory and made it desirable to look round for possible alternatives. An analysis of the facts which were then available, showed that a larger number of them could be covered by assigning to quadrivalent tellurium a tetrahedral instead of a planar configuration ;[7] but, in order to explain the formation of α- and β-isomerides, it was necessary to distort the regular tetrahedron, which is accepted universally in the case of sulphur, by making one valency different from the other three.

A new series of experiments, described by Dr. H. D. K. Drew before the Chemical Society on Jan. 17 (*Jour. Chem. Soc.*, p. 560, 1929), has removed the last obstacle to a complete analogy between sulphur and tellurium, by showing that the changes recorded by Vernon involve an alteration of structure which goes beyond the limits of stereoisomerism. This change of structure was actually observed by Vernon, who showed, while the α-di-iodide and potassium carbonate gave a basic salt,

$$2\ \alpha\text{-}TeMe_2I_2 + K_2CO_3 \rightarrow I\ .\ TeMe_2\ .\ O\ .\ TeMe_2\ .\ I + 2KI + CO_2,$$

the β-di-iodide and potassium carbonate gave trimethyltelluronium idodide, by the wandering of a methyl group,

$$2\ \beta\text{-}TeMe_2I_2 \rightarrow TeMe_3I + \ ?$$

Vernon supposed that this wandering took place under the influence of the alkali, but Drew's experiments show that it had already taken place in the preparation of the β-base, since the β-di-iodide is itself a complex salt, which can be synthesised readily from the *mono*- and *tri*-methyltelluronium iodides,

$$TeMe_3I + TeMeI_3 \rightarrow TeMe_3I,\ TeMeI_3 \text{ or } [TeMe_3]^+\ [TeMeI_4]^-.$$

The structure of these compounds was confirmed by a corresponding synthesis of the " β-dibromide " $TeMe_3Br$, $TeMeBr_3$, and of mixed halides of the composition $TeMe_3Br$, $TeMeI_3$ and $TeMe_3I$, $TeMeBr_3$.

The simple salts from which the more complex β-compounds were synthesised are obviously derivatives of trimethyltelluronium hydroxide, $TeMe_3OH$, and of the monomethyl compound Me . TeO . OH, which Drew describes as telluracetic acid. He there-

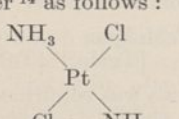
[1] *J. Chem. Soc.*, **117**, 86, 889 ; 1920 : **119**, 105, 687 ; 1921.
[2] F. L. Gilbert and T. M. Lowry, *J. Chem. Soc.*, pp. 3179-3189 ; 1928.
[3] *J. Chem. Soc.*, 1997-2010 ; 1928.
[4] *J. Chem. Soc.*, p. 308 ; 1928.
[5] Gilbert and Lowry, *J. Chem. Soc.*, 2658-2667 ; 1928.
[6] *J. Chem. Soc.*, 321-329 ; 1928.
[7] *Chem. and Ind.*, **47**, 1246 ; Nov. 23, 1928.

fore assigned to the β-base the structure of an *anhydride*, $TeMe_3O . TeMeO$. Since, however, the monomethyl compound can be shown to have an acid rather than a basic reaction,[8] it is clear that the mixture of *mono-* and *tri*-methyl-hydroxides should form a *salt* $[TeMe_3]^+ [Me . TeO . \bar{O}]$. The correctness of this alternative view can be established from measurements of conductivity,[8] which show that the 'β-base' gives a curious series of values ranging from $\Lambda_{32}^{25} = 31$ to $\Lambda_{512}^{25} = 37$. These can be explained by assigning to the cation $[TeMe_3]^+$ a mobility of 50, as in the case of $[NMe_4]^+$, and to the anion $CH_3 . TeO . \bar{O}$ a mobility of 30, as in the case of the acetate ion $CH_3 . CO . \bar{O}$, giving a limiting conductivity of 80 for the salt, or 40 for each atom of tellurium, in close agreement with the data recorded above.

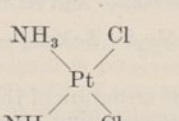
It is important to point out that whilst the *stereoisomerism* of Vernon's theory has been disproved, the *isomerism* indicated by his experiments may still be valid for some of the compounds of this series. In particular, crystallographic evidence suggests that the α-di-iodide is itself a complex compound, with a structure that is very similar to that of the β-di-iodide; there are therefore clear indications that the α-dihalides may form complex molecules of the type $[TeMe_2I]^+ [TeMe_2I_3]^-$ which would be isomeric with $[TeMe_3]^+ [TeMeI_4]^-$, although they are evidently more readily dissociated into molecules or ions containing only a single atom of tellurium.

The abrupt disappearance of the only evidence which justified the representation of quadrivalent tellurium by a planar model at once raises the question whether the analogous configurations for quadrivalent platinum and palladium are likely to survive. In a matter of this kind, prediction is dangerous, but it can at least be said that the planar formulæ for palladium and platinum are supported by a greater variety of evidence and are therefore much less likely to collapse under a single blow. The evidence cited by Werner in 1893 [9] corresponds closely with that obtained by Vernon. So long ago as 1828, Magnus,[10] by the action of ammonia on platinous chloride, obtained a compound which is still known as *Magnus' green salt*. This has the empirical composition $PtCl_2 . 2NH_3$, but behaves as a complex salt of the formula, $[Pt . 4NH_3]^{++} PtCl_4^{--}$. When boiled with ammonia it is converted into *Reiset's salt*,[3] $[Pt . 4NH_3]^{++}Cl_2^{--}$, which on heating to 250° [11], or on boiling with concentrated hydrochloric acid,[12] is converted into two isomeric forms of the non-valent diammine $[2NH_3 . PtCl_2]$. These two isomers, which can be prepared more readily by the action of ammonia on ammonium platino-chloride,[13] $(NH_4)_2PtCl_4$, are distinguished, for no very obvious reason, as platosammine chloride and platosemidiammine chloride.

The two compounds, which differ in colour and in solubility, were formulated somewhat arbitrarily by Werner [14] as follows:



Platosammine chloride (sulphur-yellow), β or *trans*.



Platosemidiammine chloride (orange-yellow), α or *cis*.

On account of their limited solubility, their molecular weights were not determined precisely until 1926, when Reihlen and Nestle [15] made a series of observations on the vapour pressures of solutions in liquid ammonia. These showed that the *cis* compound had a normal molecular weight, whilst that of the *trans*-compound was twice as great. On the other hand, Grünberg [16] has obtained normal values for solutions in acetone of both forms of the thiocyanate, $[2NH_3 . Pt(CNS)_2]$; Hantzsch [17] has obtained normal molecular weights for solutions in phenol of both forms of the dipyridyl-compound $[2C_5H_5N, PtCl_2]$; and Kraus and Brodkorb [18] have obtained normal values for the two forms of $[2C_5H_5N . PdCl_2]$ and $[2EtNH_2 . PdCl_2]$, as well as for one form of $[2NH_3 . PdCl_2]$, the other being hydrolysed too readily to permit of accurate measurements.

Up to this point the story is an almost exact duplicate of the recent observations on tellurium, since the mere multiplication of examples of α- and β-compounds does not rule out the possibility of an alternative explanation of the supposed isomerism in either case; and the repeated determinations of molecular weights have again provided conflicting evidence. It is also open to question whether the occurrence of the same isomerism in tetrammines of the type $[2C_5H_5N . Pt . 2NH_3]Cl_2$, might not stand or fall with that of the diammines. Fortunately, however, physical evidence is now available which appears to be decisive on the point at issue. Thus crystallographic observations have shown that the double cyanides, $K_2[Zn . 4CN]$, $K_2[Cd . 4CN]$, $K_2[Hg . 4CN]$, crystallise in the *cubic* system, and X-ray analysis [19] confirms the obvious deduction that the anion has a tetrahedral configuration, such as has already been found in the molecules of $[SnI_4]$, although the ion $[SnCl_6]^{--}$ has an octahedral configuration. On the other hand, the two pallado chlorides, $K_2[PdCl_4]$ and $Am_2[PdCl_4]$, and the platinochloride $K_2[PtCl_4]$ all crystallise in the *tetragonal* system, and X-ray analysis [20] confirms the deduction that the anion has the same symmetry as the crystal and must be represented with the four halogens at the corner of a square of which the metal occupies the centre. The planar configuration which Werner assigned to this group of compounds thirty-five years ago is therefore now established by a process of mensuration, which does not encourage any hope of its disestablishment by less direct chemical methods.

[8] Gilbert and Lowry, *J. Chem. Soc.*, 1997-2010; 1928.
[9] Werner, *Zeit. anorg. Chem.*, **3**, 310; 1893.
[10] Magnus, *Pogg. Ann.*, **14**, 204; 1828.
[11] Reiset, *Compt. rend.*, **10**, 870; 1840: **11**, 711; *Ann. Chim. Ph.* [3] **11**, 417; 1844.
[12] Peyrone, *Ann. Chim. Ph.* [3] **12**, 193; 1844: **16**, 462; 1846.
[13] Jorgensen, *Zeit. anorg. Chem.*, **24**, 181; 1900.
[14] Werner, *Zeit. anorg. Chem.*, **3**, 310; 1893.
[15] Reihlen and Nestle, *Ann.*, **447**, 211; 1926.
[16] Grünberg, *Zeit. anorg. Chem.*, **157**, 299; 1926.
[17] Hantzsch, *Ber.*, **59**, 2761; 1926.
[18] Kraus and Brodkorb, *Zeit. anorg. Chem.*, **165**, 73; 1927.
[19] Dickinson, *J. Amer. Chem. Soc.*, **44**, 774; 1922.
[20] Dickinson, *J. Amer. Chem. Soc.*, **44**, 2404; 1922.

University and Educational Intelligence.

LONDON.—Dr. Harold Raistrick has been appointed as from Aug. 1 to the University chair of biochemistry tenable at the London School of Hygiene and Tropical Medicine, where he will also hold the position of Director of the Division of Biochemistry and Chemistry as applied to Hygiene. Dr. Raistrick is a graduate of Leeds and Cambridge. From 1915 until 1920 he was engaged on research work on the biochemistry of micro-organisms for the Medical Research Committee in Sir Frederick Hopkins's laboratory at Cambridge, and since 1921 he has been on the research staff of Messrs. Nobel's Explosives Company, Ayrshire, where he organised and equipped a new Biochemical Research Department.

THE National Union of Teachers held its annual conference this year at Llandudno on Mar. 30. The

presidential address, delivered by Mr. C. W. Cowen, of Sheffield, emphasised the increasing, and increasingly necessary, solidarity of the teaching profession and the broadening of the basis of the Union since 1888 when the word 'elementary' was eliminated from its title. Referring to the Board of Education's pamphlet on "The New Prospect in Education" and the reorganisations designed to provide advanced instruction for all pupils of secondary school age, the president, while regretting that it has not been decided to enforce throughout England the raising of the age-limit of compulsory attendance, pointed out that such reorganisations involve risks of hardship in individual cases and appealed to the Board that local education authorities should not be compelled to proceed immediately with far-reaching schemes but invited to put them into operation cautiously and by stages as vacancies arise through retirement or other causes. Turning to the relationship between education and industry, and to the gap left by the decay of the apprenticeship system, he expressed the opinion that as an effective training must be based upon an adequate general education, the raising of the school leaving age to at least fifteen years is an essential preliminary to advance. He lamented the destruction, attributed to the opposition of small-scale employers, of the powerful movement towards day continuation schools. He closed with an appeal to teachers to take an even greater part than they do already in all social movements which tend to the uplift of the masses of England.

FROM the Universities Bureau of the British Empire we have received a pamphlet (pp. 36, price 1*s*.) containing lists of students from other countries in the universities and university colleges of Great Britain and Ireland in the current session. The names of the students are grouped, separately for each institution, under the names of the countries to which they belong, and there is a table showing the total number of students from each of the countries named. The grand total of these numbers is 5170. The countries contributing most to this total are: India and Burma 1575, South Africa and Rhodesia 574, United States of America 556, Egypt 382, Australia and New Zealand 336, Canada and Newfoundland 203, Germany 157, West Indies 128, Ceylon 121, China 93. Of the Indian students more than half are in the London colleges, and of the remainder Oxford and Cambridge have 181, the modern English provincial universities 288, Edinburgh 133, and Glasgow 99. Of the 574 South Africans, 222 are in the London colleges (123 in the medical schools), 163 at Oxford and Cambridge, 100 at Edinburgh. Oxford has 168 students from the United States, including 96 Rhodes Scholars, Cambridge 64, London 136, and Edinburgh 127. The Egyptian students are chiefly in the modern English provincial universities (162), especially Birmingham (55), in London (131), and also in Edinburgh (55). Australians and New Zealanders congregate chiefly in Oxford and Cambridge (157), London medical schools (64), and Edinburgh (37); Canadians in the London colleges (77), Oxford and Cambridge (74), and Edinburgh (35). German students have been coming to England in rapidly increasing numbers in the past four years; they are chiefly in London (94), especially the School of Economics (40), and the modern English provincial universities. A comparison with similar pamphlets published two years and four years ago discloses some interesting increases: grand totals—4385, 4596, 5170; India, Burma, and Ceylon, 1199, 1361, 1696; Germany, 34, 93, 157; and decreases—South Africa, 747, 624, 574; Siam, 79, 62, 37.

Calendar of Patent Records.

April 6, 1852.—It was Samuel Fox who introduced the light steel frame for umbrellas and parasols. His patent for constructing the ribs and stretchers of steel formed into hollow trough-like shapes was granted on April 6, 1852, and the frames were put on the market under the well-known 'paragon' mark.

April 9, 1788.—The first beater thrashing-machine was patented on April 9, 1788, by Andrew Meikle, who was led to the invention by making experiments with a machine of a different type which did not work satisfactorily. John Rastrick, the engineer, was also trying to solve the problem at the same time, and says himself that he had made machines on Meikle's plan about ten years before the date of the patent, but though there is evidence that Meikle's rights were contested and that he obtained little benefit from his patent, nothing has so far come to light to support Rastrick's claim to be the real inventor.

April 10, 1790.—The first federal Patents Act of the United States was passed on April 10, 1790, and the first grant under it was made to Samuel Hopkins in the following July. Many patents had, however, been issued previously; by extension of English patents by the Crown to include one or more of the colonies, directly by the colonial authorities, and, after the Declaration of Independence, by Acts of the various State legislatures, especially Maryland, Connecticut, Massachusetts, and Pennsylvania.

April 10, 1811.—In the first days of the railway locomotive, it was widely held—in spite of evidence to the contrary—that the adhesion of smooth wheels on the rails would not be sufficient to enable heavy loads to be drawn along the railway, and Blenkinsop's rack locomotive was designed to overcome this objection. This was patented on April 10, 1811, and was introduced on the tramline of Middleton colliery, near Leeds.

April 11, 1807.—The modern method of igniting the powder charge in all fire-arms dates from the invention of the percussion lock by the Rev. Alexander John Forsyth, the patent for which is dated April 11, 1807. Forsyth used as his detonating powder a mixture of potassium chlorate, sulphur, and charcoal, but the specification is drawn in wide terms to include all percussion systems, and the patent was held to be good after a strenuous fight in the courts. The British government was, however, slow to adopt the new method, and Forsyth received no benefit from his patent, though his heirs were afterwards given a government grant of £1000.

April 13, 1847.—Theodore Boehm's improvements in the flute, which consisted mainly in the provision of a cylindrical instead of a tapering bore, and the adoption of a system of rings and levers in combination with the keys, whereby the fingers were given much easier control, received a Bavarian patent for five years on April 13, 1847. The introduction of the new flute raised a great controversy both as to the merits of the new construction and to Boehm's claims to be the inventor, but its use soon became general.

April 13, 1869.—George Westinghouse's first patent for a continuous air-brake for railway trains was granted in the United States on April 13, 1869. The idea did not originate with Westinghouse, but his construction embodying the three-way control cock and automatic valves in the connecting tubes, which ensured that the system would still continue to work if part of the train became disconnected, was the first practical system, and was immediately taken up. It was greatly improved in the following years, and by 1874 had been fitted to more than 2000 locomotives and 7000 coaches.

Societies and Academies.

LONDON.

Society of Public Analysts, Mar. 6.—**Christine Mary Fear**: On the alkaloid test for tannin. It has frequently been asserted that most alkaloids are precipitated by tannin, but the author's experiments show that the only alkaloids giving appreciable precipitates with tannin solutions alone are brucine, caffeine, cinchonine, cinchonidine, quinine, and strychnine. —**A. L. Andrews**: The cryoscopic method for the detection of added water in milk. The determination of the freezing-point affords a simple and trustworthy means of detecting added water in milk. Genuine milk has a freezing-point not higher than −0·550° C., when determined by the method in use in the New Zealand Dominion Laboratory. If the freezing-point rises to −0·530° C., watering may be suspected, and if to −0·520° C., the milk has certainly been adulterated with 5 per cent of added water.—**A. J. Parker** and **L. S. Spackman**: Investigations on the relations between the acidity and freezing-point of milk. The normal acidity of fresh milk is 0·14 per cent. The correction factor is 0·003° C. for each 0·01 per cent excess acidity between acidities of 0·17 and 0·60 per cent, and 0·010° C. for acidities ranging from 0·14 to 0·17 per cent lactic acid. When the cryoscopic method is used for the determination of added water in milk, it can be applied with accuracy only when the samples are quite fresh.

PARIS.

Academy of Sciences, Feb. 25.—The president announced the death of M. J. Boussinesq.—**Charles Richet**: Some statistics on the mortality and age of election of members of the Academy.—**L. Cayeux**: Typical calcispheres are Algæ.—**Henri Villat**: A problem of hydrodynamics. — Guido Castelnuovo was elected *correspondant* for the Section of Geometry in the place of the late Luigi Bianchi.—**Paul Delens**: The differential geometry of spheres and groups of torsors. —**Marcel Vasseur**: Deformable surfaces with permanent conical network.—**Bertrand Gambier**: Quadratic solutions of Moutard's equations.—**Alexandre Ghika**: The analytical prolongation of a given function by its development in Taylor's series.—**D. Pompeiu**: A geometrical form of the fundamental theorem of Cauchy.—**Alex. Froda**: The relative maxima and minima of functions of real variables.—**Z. Horák**: The conditions of validity of Hamilton's principle.—**D. Iwanenko**: Two remarks on Dirac's equation.—**G. Ribaud** and **S. Nikitine**: The realisation of the black body at the melting-point of palladium by the tube method.—**H. Pelabon**: The electronic theory of bad contacts.—**Jean Lecomte**: The elimination of diffused radiations in an infra-red spectrometer.—**Paul Bary** and **José V. Rubio**: Observations on colloidal solutions of alumina and chromium oxide and their desiccation.—**F. Bourion** and **E. Rouyer**: The determination by the boiling-point method of the molecular equilibria of resorcinol in solutions of lithium chloride. —**A. Chrétien** and **E. Cornec**: The equilibria between water, sodium nitrate, and sodium chloride.—**Albert Roux** and **Jean Cournot**: Combined influences of velocity of deformation and of temperature on the production of cold hardening.—**B. Bogitch**: The reduction of fused silicates by carbon monoxide. Silicates of copper. Metallic copper is produced when the carbon monoxide amounts to 3 per cent of the gas mixture; when the percentage reaches 26 per cent the reduction of the copper is complete.—**Mlle. M. Pernot**: The system mercuric iodide, potassium iodide, and acetone.—**Mme. Ramart-Lucas** and **Mlle. Amagat**: The comparative stability of isomers according to their absorption spectra. Allyl and isoallyl derivatives of the benzene series. The absorption curves and thermal stability of these compounds are in agreement with the rules laid down by the authors in earlier communications.—**A. Michel-Lévy** and **Gaston Grenet**: The relation between the increase of the magnetic susceptibility of certain heated rocks and the modifications which occur in certain of their mineral constituents. —**Paul Corbin** and **Nicolas Oulianoff**: Mylonitic zones with hercynian orientation in the massif of Mont Blanc.—**P. Idrac**: Some singularities of the Gulf Stream.—**H. Buisson**: Measurements of the ozone in the upper atmosphere during the year 1928.—**G. Nicolas** and **Mlle. Aggéry**: A Heterosporium parasite of *Viburnum odoratissimum*.—**Louis Rapkine**: The rôle of free oxygen in development.—**Takir Ertogroul**: The origin of the peritrophic membrane in the silkworm.—**A. Demolon** and **G. Barbier**: The conditions of formation and constitution of the argilo-humic complex of soils. The colloidal clay is a fixation factor of the humic colloids of soils. The cations absorbed by the clay, especially Ca, condition the formation of clay-humus complex. This complex can be reproduced starting with its constituents.—**Georges Lakhovsky**: Explanation of the therapeutic effects of open oscillating circuits on the organism of living beings.—**d'Arsonval**: Remarks on the preceding communication. The application of Hertzian waves in therapeutics and their bactericidal action was utilised in France nearly forty years ago.—**P. Lecomte du Noüy**: The rotatory power of serum as a function of the temperature. From a study of the rotatory power of normal horse serum for temperatures varying between 0° C. and 70° C., it is concluded that up to 50°-52° C. only very small changes occur in the chemical nature of the serum proteins for a time of heating of about two hours. At 55° C. a change is noted after twenty minutes heating, and above 59° C. change is very rapid.—**Maurice Fontaïne**: The increase in the oxygen consumed by marine animals under the influence of high pressures. Its variations as a function of the duration of the compression. The oxygen consumed by *Pleuronectes platessa* under pressures of 100 kgm. increases during the compression to a maximum, then diminishes, but remains for several hours above the normal consumption.—**P. Thomas**, **A. Gradinescu**, and **Mlle. R. Imas**: The utilisation of the pentoses in the animal organism.—**Mlle. Andrée Courtois**: The small proportion of cholesterol in the fatty matters from the chrysalids of Lepidoptera.

GENEVA.

Society of Physics and Natural History, Dec. 20.—**R. Bach** and **A. Schidlof**: The allotropic states of iron. It is generally admitted, from earlier researches, that iron has four allotropic varieties, α, β, γ, δ, and is characterised by the same crystal network for α, β, δ (centred cube), and another face-centred cube for γ. The authors find confirmation of these views from the study of the variations of the constant of the crystal network in the neighbourhood of the transformation points of the different varieties.—**L. Reverdin**: Faunistic study of the station of Sumpf (Zoug); the Bronze Age (2). The author completes the results of the excavations of 1926 by those of the years 1927 and 1928, obtained at two new places. The numerical proportions of the different species vary from one field to the other, but the sheep preponderates. Taken as a whole, the descending order is sheep, ox, dog, pig, horse. J. Favre has determined the molluscs. Those of the archæological layer are characteristic of aquatic deposits without exception. The presence of *Valvata piscinalis*, var. *antiqua*,

shows that it was a lake and not a marsh.—**F. Battelli**: The relation between the voltage and the duration of the stimulation in the production of convulsions. Continuous current and alternating current (frequency, 45), with the voltage rising from 10 to 86 volts, were applied to the frog. For the lower voltages the action of the alternating current is much more prolonged, but the durations tend to equality starting from 45 volts.

ROME.

Royal National Academy of the Lincei, Dec. 2.—Gino Fano: S. Lie's representation of the linear element of the plane on dotted space.—**L. Cambi**: Univalent iron, cobalt, and nickel, and nitrosothiosalts: reply to W. Manchot.—**A. Palatini**: Constant tensors associated with binary and ternary varieties.—**Maria Pastori**: Noteworthy identities relating to derived tensors.—**C. Burali-Forti**: A question concerning elastic films.—**E. Čech**: The asymptotic correspondence between two surfaces.—**G. Vranceanu**: The equations of the problem of two bodies of variable mass. Levi-Cività has recently considered the problem of the motion of a body, the mass of which varies as the result of the fall of meteorites on to it (astronomical case) and arrives at the conclusion that $\frac{d}{dt}(mv) = F$ should be taken as the fundamental law. The equations of the problem of two bodies of variable masses, which is of astronomical interest, are now considered.—**E. Gugino**: A new interpretation of Gauss's principle of minimum contraction.—**B. Finzi**: The singularity of dynamic actions in the problem of the plane strip.—**R. Serini**: Symmetrical deformations of an elastic strip.—**D. Graffi**: The theory of the transmission of heat by convection.—**Stefano Lodovico Straneo**: Application of the functional method to the study of the cooling of a bar.—**A. Occhialini**: The effect of resistance on a spark spectrum. A method is described which allows of the classification of the lines emitted by an element, and is based on their behaviour when a resistance is inserted in the discharge circuit. Use is made of low voltage spark spectra, and, if the resistance is sufficiently high, the spectrum lacks certain lines, whereas if the resistance is diminished these lines appear adherent to the cold electrode in groups at definite values of the resistance.—**M. Kahanovicz**: Elastic constants in relation to the periodic system of the elements. Elasticities of form, volume, and tension are progressive functions of the atomic number. The relationships are simple proportionalities, and the product of the modulus with the atomic number constitutes a constant characteristic of the group. Various conclusions are drawn concerning the mutual relationships between the different deformations.—**G. Bargellini and Lydia Monti**: 2 : 5-Dichlorophenetidine. The dichlorophenetidine obtained by Reverdin and Düring by treating phenacetin, in acetic acid solution, with nascent chlorine and hydrolysing the resulting dichlorophenacetin, is the 2 : 5-compound.—**R. Altschul**: A new procedure for staining glial cells. Weigert's method for revealing the marginal glia, the fibrous glia, and their relations to the vessels may be greatly simplified and rendered more certain in its results.—**C. Ruiz**: The fauna of the Jurassic volcanic tufas of Roccapalumba, Sicily.—**Constantino Gorino**: Thermobiosis and microbic dissociation. By thermobiotic culture is meant, not adaptation of organisms to high temperatures, but treatment to ascertain if some of the cells are more or less thermophile. This is done by subjecting the cultures, suddenly and as soon as they are inoculated, to temperatures ranging from 50° to 70°, the daily re-inoculation of each culture being made at its own special temperature. In this way a mesophile species of the *Subtilis* group has been dissociated into a strain showing transitory thermo-tolerance and another exhibiting lasting thermo-tolerance.—**G. Testi Dragone**: Fluorescence of vegetable juices in filtered ultra-violet rays. The experiments on the effects of the rays from a Hanau lamp, after passage through a uviol filter, on the latex from plants of various families, have now been extended to the resinous substances of a number of Coniferæ and to the essential oils of the pericarp of various *Citrus* species. The resins exhibit fluorescence, which is usually blue, but sometimes greenish or brownish. These substances, then, protect the parts of the organism producing them from harmful, invisible radiations by converting these latter into harmless radiations of greater wave-length. Similar results are obtained with the oleiferous glands of *Citrus*.—**N. A. Barbieri**: Physiological culture: results and applications. The author has previously shown that it is possible to separate, from vegetable tissues, the soluble and insoluble salts existing preformed therein. These salts, as a whole, constitute the physiological fertiliser, which is the saline nutriment most suitable to, and most readily assimilable by, a plant. Various crops, when fertilised on these lines, give favourable yields in comparison with similar crops to which the fertilisers commonly used are applied.—**V. Bambacioni**: Contribution to the embryology of *Lilium candidum* L. Various observations are recorded, of interest not only as regards the development of the feminile gametophyte which, perfectly identical with that of *Fritillaria persica*, follows the *Euphorbia dulcis* type and explains in the simplest manner the increase in the number of chromosomes in the nuclei of the chalazal region, but also on account of a number of anomalies, some not previously described.

Official Publications Received.

BRITISH.

The Hannah Dairy Research Institute. Bulletin No. 1: Surplus Milk and Milk Residues; being the Report of an Investigation into the Utilisation and Marketing of Surplus Milk and Milk Residues carried out for the Scottish National Milk and Health Association and the Empire Marketing Board. By Archibald Macneilage, Jr. Pp. 66. (Glasgow: The University.) 2*s*. 6*d*.

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 58, July to December 1928. Pp. xiv+305-564+17+plates 25-53. (London.) 15*s*. net.

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontein), for the Year ending December 1927. Pp. 25. (Kirstenbosch.)

Quarterly Journal of the Royal Meteorological Society. Vol. 55, No. 229, January 1929. Pp. 102. (London: Edward Stanford, Ltd.) 7*s*. 6*d*.

Department of Scientific and Industrial Research. Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 1 (New Series), No. 12, December 1928. Abstracts Nos. 2127-2293. Pp. v+379-493. (London: H.M. Stationery Office.) 9*d*. net.

British Association Reprints. No. 23: Report on Science in School Certificate Examinations. Pp. 443-532. (London.) 1*s*.

Journal of the Chemical Society: containing Papers communicated to the Society. February 1929. Pp. iii+217-360+viii. Journal of the Chemical Society. Supplementary Number, containing Title-pages, Contents and Indexes, 1928. Pp. 3309-3433+xxxvii+4. (London.)

The Indian Forest Records. Silviculture Series, Vol. 13, Part 7: Slash in Chir Pine (*Pinus longifolia*) Forests; Causes of Formation, its Influence and Treatment. By J. E. C. Turner. Pp. vii+46+25 plates. (Calcutta: Government of India Central Publication Branch.) 3.6 rupees; 5*s*. 9*d*.

British Research Association for the Woollen and Worsted Industries. Annual Report, 1928–29. Pp. 60. (Leeds.)

FOREIGN.

Human Biology: a Record of Research. Vol. 1, No. 1, January 1929. Pp. 152. (Baltimore, Md.: Warwick and York, Inc.) 1.50 dollars.

Proceedings of the Imperial Academy. Vol. 4, No. 10, December 1928. Pp. xxxiii-xxxiv+569-625. Vol. 5, No. 1, January 1929. Pp. ii+56. (Tokyo.)

United States Department of Agriculture. Technical Bulletin No. 98: Imported Parasites of the European Corn Borer in America. By D. W. Jones. Pp. 28. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 80. A Revision of Leidy's Collection of Mermithids. By G. Steiner. Pp. 547-552. A Collection of Birds from Siam. By Rodolphe Meyer de Schauensee. Pp. 553-580. Studies on West Indian Mollusks: the Genus Zachrysia. By Henry A. Pilsbry. Pp. 581-606. Notes on New Jersey Fishes. By Henry W. Fowler. Pp. 607-614. (Philadelphia.)

University of California Publications in America Archaeology and Ethnology. Vol. 25, No. 1: Lovelock Cave. By Llewellyn L. Loud and M. R. Harrington. Pp. viii+183+68 plates. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 2.50 dollars.

University of California Publications in Zoology. Vol. 31, No. 11: A Study of Physical and Chemical Conditions in San Francisco Bay, especially in relation to the Tides. By Robert C. Miller, William D. Ramage and Edgar L. Lazier. Pp. 201-267+5 charts. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 85 cents.

Ministero dell' Aeronautica, Aviazione civile e Traffico aereo. Annuario 1929 (anno 7) Pp. 211. (Roma.)

United States Department of Agriculture. Technical Bulletin No. 83: The Pacific Flathead Borer. By H. E. Burke and A. G. Böving. Pp. 36. (Washington, D.C.: Government Printing Office.)

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1928. Pp. 18+5 maps. (København: G.E.C. Gad.)

Marx-Engels Archiv: Zeitschrift des Marx-Engels-Instituts in Moskau. Herausgegeben von D. Riazanov. Band 2. Pp. viii+613. (Frankfurt a.M.: Marx-Engels-Archiv Verlagsgesellschaft m.b.H.) 12 gold marks.

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 12, No. 1, January. Pp. 80. Series B, Vol. 4, No. 2, February. Pp. 81-163. (Tokyo and Kyoto: Maruzen Co., Ltd.)

CATALOGUES.

Law, Crime and the Criminal. (Catalogue No. 515.) Pp. 40. (London: Francis Edwards, Ltd.)

Eighteenth Century England: a Catalogue of Books and Autographs. (New Series, No. 1.) Pp 92. (London: Francis Edwards, Ltd.)

The Bureau of Information on Nickel, Ltd. Series B: Nickel Cast Iron. No. 4: Nickel Cast Iron in Theory and Practice. Pp. 8. Series H: General. No. 2: The Bureau; What it Is and What it Does. Pp. 12. (London.)

Diffraction Gratings ruled on the Dividing Engines of the Johns Hopkins University, Baltimore, Md., U.S.A., under the supervision of Professor R. W. Wood. (Rooster 28.) Pp. 4. (Delft: P. J. Kipp en Zonen.)

West Africa: Books, Maps and Views relating to the Gold, Ivory and Slave Coasts, Sierra Leone, Nigeria, Dahomey, Liberia, Benin, etc. Pp. 18. (London: Francis Edwards, Ltd.)

Diary of Societies.

FRIDAY, APRIL 5.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (Annual Meeting) (at College of Technology, Manchester), at 4.—J. Yates: Foundry Organisation.

ROYAL SANITARY INSTITUTE (at Council House, Birmingham), at 5.30.—H. H. Humphries: Some Drainage Problems in Birmingham.

INSTITUTE OF TRANSPORT (Manchester, Liverpool, and District Section) (at Manchester), at 6.30.—D. R. Lamb: Sidelights on the Transport Problem.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—E. W. Hill: Some Technical Considerations concerning Power Factor in Relation to Tariffs.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—Technical Film showing the Production of Graham-Paige Cars in America.

INSTITUTION OF MECHANICAL ENGINEERS (Midland Graduates' Section) (at Chamber of Commerce, Birmingham), at 7.30.—Wing-Comm. T. R. Cave-Brown-Cave: Aircraft Engineering in its Relation to Mechanical Engineering (Annual Lecture).

SATURDAY, APRIL 6.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (at Town Hall, Leeds), at 2.30.—Resumed Discussion on the Address by W. J. Hadfield on The Local Government Bill and the Municipal Engineer, with Particular Reference to the Compensation Clauses.

HULL ASSOCIATION OF ENGINEERS (at Technical College, Hull), at 7.15.—H. E. Copp: The Carbonisation of Coal.

MONDAY, APRIL 8.

ROYAL SOCIETY OF MEDICINE (War Section) (Annual General Meeting), at 4.30.—Col. J. C. Kennedy, Surg. Rear-Admi. E. T. Meagher, Squad. Leader M. L. Burton: Discussion on Functional Diseases of the Nervous System.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Lt.-Col. L. M. Davies: The Philosophic Basis of Modernism.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.—W. H. Ogilvie: A Review of Recent Work on Bone Tumours.—R. Watson-Jones: Wrist Dislocation with Associated Nerve Lesions.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—G. H. Gardner: Notes on the Inspection of Public Works.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (Annual General Meeting) (at Armstrong College, Newcastle-upon-Tyne), at 7.—B. L. Goodlet: The Testing of Porcelain Insulators.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (Annual General Meeting) (at Hotel Metropole, Leeds), at 7.15.—Dr. E. G. Ritchie: The Storage of Steam in Industrial Plants.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Major-General Sir Fabian Ware: The Work of the Imperial War Graves Commission.

SURVEYORS' INSTITUTION, at 8.—B. W. Adkin: The Education of a Young Surveyor.

TUESDAY, APRIL 9.

SOCIETY FOR THE STUDY OF INEBRIETY (at 11 Chandos Street, W.), at 4.—Dr. J. D. Rolleston and others: Discussion on Alcohol in Therapeutics.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Dr. L. Dudley Stamp: The Oil and Gas Fields of Burma.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—S. R. Douglas: Further Results of Dr. Wilfrid Ashley's Experiment on marking Woodcocks breeding in the West of Ireland.—J. W. Winterbottom: Studies in Sexual Phenomena—Continual Display in Birds.—W. S. Bristowe: (*a*) The Mating Habits of Spiders, with Special Reference to the Problems surrounding Sex Dimorphism; (*b*) (1) The Spiders of the Scilly Islands; (2) The Spiders of Lundy Island; (3) A Contribution to the Knowledge of the Spiders of the Channel Islands.—C. J. Conolly: A New Copepod Parasite representing a New Genus and its Larval Development.

INSTITUTION OF CIVIL ENGINEERS, at 6.—H. Hall: The New Piccadilly Circus Station.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, Old Broad Street), at 6.30.—J. E. S. Dallas: Summer in Switzerland.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—W. E. Woodeson, jun., and J. S. Gander: The Relative Merits of Pulverised Fuel and Mechanical Stoking and their Application for Marine Purposes.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (Annual General Meeting) (at Engineers' Club, Manchester), at 7.—Hon. Sir Charles A. Parsons and J. Rosen: Direct Generation of Alternating Current at High Voltages.—J. A. Kuyser: Recent Developments in Turbo-Generators.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Section) (Annual General Meeting) (at Royal Technical College, Glasgow), at 7.—E. B. Wedmore, Dr. W. B. Whitney, and C. E. R. Bruce: An Introduction to Researches on Circuit Breaking.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—S. H. Horgan: Bringing Photography to the Printing Press.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch), at 7.30.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—Dr.-Ing. F. Sass: Experiences with and Investigations on Double-acting Airless-injection Diesel Engines.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—H. S. Rowell and C. G. Williams: Automatic Spark Advance.

ROYAL SOCIETY OF MEDICINE (Psychiatry Section) (jointly with British Psychological Society, Medical Section), at 8.—Dr. E. Jones, Dr. H. Yellowlees, Dr. R. D. Gillespie, and others: Discussion on The Rôle of Anxiety in the Psychoses and Psycho-neuroses.

TELEVISION SOCIETY (at Engineers' Club, Coventry Street), at 8.—J. C. Rennie: Some Notes on Exploring.

WEDNESDAY, APRIL 10.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—T. L. Eckersley: Short Waves.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.

ROYAL SOCIETY OF ARTS, at 8.—G. H. Nash: Some Modern Aspects of Electrical Communication.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.30.—B. Clark: Effect of Organic Addition Agents in the Electro-deposition of Copper.

THURSDAY, APRIL 11.

TEXTILE INSTITUTE (at Midland Hotel, Bradford), at 2.30.—H. T. Tizard: Science and the New Industrial Revolution (Mather Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—B. L. Goodlet: The Testing of Porcelain Insulators.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—M. Lapresle: Wind Tunnel Methods of the Eiffel Laboratory.

INSTITUTE OF METALS (London Local Section) (Annual General Meeting) (at 83 Pall Mall), at 7.30.—Dr. Hankins and others: Discussion on Hardness Testing.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Discussion on Disseminated Encephalo-myelitis.

NELSON TEXTILE SOCIETY (at Nelson).—F. Hughes: Sley Construction and Traverse of Shuttle.

FRIDAY, APRIL 12.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—A. T. Cooper: Recent Electrical Developments in India.

ROYAL ASTRONOMICAL SOCIETY, at 5.—L. Rosenhead: The Annual Variation of Latitude.—E. A. Kreiken: On the Dwarf Nature of the Spectroscopic Binaries.—H. Horrocks: The Longitude of the Royal Observatory, Cape of Good Hope, from Wireless Signals, Oct.-Nov. 1926.—S. A. Mitchell: Atlas Stellarum Variabilium, Series VII.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual General Meeting) (at Engineers' Club, Manchester), at 7.—T. R. Woolaston: Suggestions in Steam Raising.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—F. E. F. Durham: Pumping Plant.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—E. J. Wayland: The Later Geological History of the Equatorial Lakes in Uganda.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.30.—Annual General Meeting.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (jointly with Chemical Engineering Group) (at Engineers' Club, Birmingham).—Dr. C. M. Walter: The Design and Operation of Gas Heated Furnaces.

SATURDAY, APRIL 13.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (jointly with Yorkshire and North-Western Districts) (in College of Technology, Manchester), at 2.30.—W. J. Hadfield: The Local Government Bill, with Particular Reference to the Road Clauses.