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Technical and Intellectual Values.

VERY frequently we hear the complaint that, in connexion with certain of our activities, there are too many conferences and too little achievement. Specialists gather to discuss their own aspirations and grievances; they deliver their criticisms and indicate how society is refusing the positive reconstruction which would result from the realisation of the aspirations, the removal of the grievances, and the careful examination of the criticisms: but definite suggestions which shall be understood by the plain man are said to be rare. The complaint may be justified particularly where the specialists are concerned with teaching and with the implications of scientific developments. In both cases, results, so far as they affect the life of the plain man, are not immediately apparent, and he is therefore apt to glance at conference reports with some impatience and hasten back to his more 'practical' pursuits.

It is to be expected, therefore, that he will pass over certain resolutions passed by the Conference of Teachers in Technical Institutions which was held in London on May 22–25. He may not be alarmed by the statement that, just as the results of the Board of Education's Circular 1371 and Memo. 44 would have been a reduction of the standard of educational efficiency, so will be the result of the introduction of the same underlying principles in the Economy Act. He will not be moved by the opinion of the Conference that courses in junior technical schools should be as wide as, though differing in character from, those in secondary schools, since his general acquiescence to "secondary education for all" is usually accompanied by a happy ignorance of the multitudinous definitions and of the varying branches of education to which so many labels are being attached. It is certainly very doubtful whether he would be very enthusiastic concerning the Conference's declaration in favour of the principle of internal examinations in all grouped courses, or share the Conference's alarm at the increasing number of external examinations which are being organised by various unions of education authorities—an alarm great enough to spur the Conference to call for a representative meeting of local education authorities and teachers in technical institutions in order to consider the best method of obtaining a system of examinations for those groups of subjects in which National Certificates are not in being or in process of formation.

Arising out of the Conference (if not, in each case, specifically indicated on its public programme), however, were three matters which will commend themselves both to the plain man and the specialists concerned

The new president of the Association, Mr. A. E. Evans, of the Battersea Polytechnic, delivered an address which has already received considerable comment in the general press. "It is high time," he said, "that we abolished the intellectual snobbery and make-believe that regards Art, Literature, Music and the Classics as members of an aristocratic family with Science as a sort of distant cousin, whilst Technology and Commerce are spurned as illegitimates." Whether or not the image be overdrawn matters very little if its presentation will do something towards speeding up the great family reconciliation which, doubtless as a result of the efforts of Mr. Evans's Association and its allied bodies, is slowly taking place. Mr. Evans's purpose was to remind those who pay the ideas much lip-service (but do little towards their practical realisation) that one might as well try to separate the two poles of a magnet as try to divide education into two parts—cultural and vocational; that the good citizen is not one who avoids breaking laws, but one who deliberately *does* something for his day and generation; that engineering, chemistry, commerce, and the like have as great a humanitarian value if taught in the right way as any of those branches of learning beloved by the pedants, since subjects taught on the 'vocational' side of technical institutions teem with examples of how service to humanity has been rendered by their help.

The second important matter was raised by the Mayor of Marylebone, who accorded the Association a civic welcome. On entering public life, he said, men who have been used to one aspect of industry or commerce are faced with entirely new conditions. They have to deal with all sorts of matters from education to electricity proposals and the removal of refuse. They have not merely, as in their business, to be convinced themselves as to the value and necessity of administrative measures, but also to accumulate sufficient knowledge and persuasion to convince their colleagues. The growth and ramifications of public administration are continually increasing. A technical education vitally linked to immediate human needs is therefore imperative for public men. There are large fields of research and study connected with public administration which should be explored by *young* men who will later have the destiny of their fellows in their hands.

The Mayor's point is one of great interest, especially if one reflect on the position occupied by a Medical Officer of Health who, supported by a definite science, presents proposals to his committees, and that of the Director of Education, who has also to formulate proposals for his committees. Both contribute to public welfare, but the Director, lacking a recognised science, sometimes occupies an unenviable position when he is faced by contrary 'opinions' gathered frequently without close examination and research.

The final matter discussed at the Conference may ultimately be proved to be one of the most important of its activities. It was foreshadowed in a speech at the Association's annual dinner. There can be no doubt that some voluntary (and other) educational bodies have tended to regard technical education as concerned almost wholly with the quick preparation of shorthand-writers, plumbers, etc., and it is not to be wondered at that the plain and earnest man may distrust that which he thinks does little more than flood the labour market at public expense. On the other hand, the Association denies this and insists not only on the vital need of its work, but also on its humanitarian value. The position should be made clear not only to teachers but also to the plain man. Technical education has a philosophy which, it is claimed, will commend itself to all. Has it yet been written and published in clear terms? It is not a matter which can be left entirely to university professors of education. Will the Association of Teachers in Technical Institutions supply the deficiency? If it will do so, the reconciliation of the educational family to which Mr. Evans referred will be greatly hastened, and the family itself will discover friends of which, hitherto, it has been quite unaware.

The Centenary of the Athenæum.

History of the Athenæum, 1824–1925. By Humphry Ward. Pp. xii + 370 + 32 plates. (London: Printed for the Club, 1926.)

NO other Club vies with the Athenæum in its interest to scientific men. Faraday was its first secretary, Humphry Davy and Thomas Young were on its first committee; Darwin and Huxley have their portraits on its walls. To four generations of men of science it has been almost a matter of course to belong to it; the young and ambitious have peeped in at its door, and the old have found consolation in looking out of the window. Moreover, scientific men neither monopolise it nor even predominate in it; they share the Club, vastly to their own advantage, with men of letters and affairs, with statesmen, bishops, judges, artists, scholars; with most of those who, for better or for worse, represent the learning of our time and country.

The Athenæum has reached and passed its hundredth birthday, and an old and distinguished member has written the history of its hundred years. A hundred years seems a great while ago, especially to the young; but looked at properly, as the old regard it, it is not much after all. When we add to the years which

we ourselves remember those penumbral (or half-shadowy) years of which our fathers and grandfathers have told us, we seem to carry our recollections easily back across a hundred years, and perhaps a trifle more. Waterloo seems ever so much the nearer because of the beribboned coach which brought the news to my grandfather's village; I seem to have known Sir Astley Cooper and Mr. Brande pretty well, even the great Sir Humphry in the days when he let Mr. Faraday lecture for him now and then. It is not difficult to keep in touch with a short century ago.

Some time before these hundred years began a great house stood at the foot of Regent Street; the First Gentleman in Europe lived in it, and Nash's great white street (which has lately dissolved away before our eyes, after we had found out its beauty) stretched from the Great Personage's doorstep to the Park on which he had graciously bestowed his name. The critics of the day found fault with Prince and street and everything; "we had hoped," says one, "that that tissue of cast iron and whitewash which reaches from Pall Mall to Portland Place would, at one end at least, have had a redeeming spot to balance the absurdity standing at the other." The house was so big that when they pulled it down the United Service Club was built on one wing of it and ours upon the other, and its doorstep stretched far across the space between. The billiard-room of the Athenæum is said to stand where the Prince Regent had his dining-room; where Herbert Spencer played his game was possibly, nay more was probably, the dreadful spot where the bell had once been rung for Mr. Brummel's carriage.

The Great War (as our grandfathers called it) had left a deal of money in England, and it was spent freely; travel had enlarged men's ideas, and the First Gentleman set no example of economy. He had recently become a greater personage than ever, and Carlton House was no longer big enough for him; but when he moved into Buckingham Palace his old house was too big for anybody else, and they pulled it down with as little concern as they had shown to the foul alleys round St. James's Market. What had contented and delighted the eighteenth century did not satisfy the nineteenth; taverns and coffee-houses were good enough for Dryden and for Addison, and Dr. Johnson found nothing so productive of happiness among all the contrivances of men; but the Waterloo generation outgrew the Mitre and the King's Head. The Guards had their Club after Waterloo; after the Peace, Castlereagh founded the Travellers', for visitors from abroad and for noblemen and gentlemen who had made the Grand Tour, travelling not less than five hundred miles from London; the Oriental (Jos Sedley's Club and Jan Bahawder's) followed soon afterwards. In short, a movement had begun which soon turned the sweet shady side of Pall Mall into a street of palaces, and utterly transformed the social life of London. About the same time a hospitable person called Crockford entertained very handsomely in St. James's, and built a big house at the top of the street at the very time the Athenæum was a-building. White's and Boodle's and Arthur's belonged to a much older lot; they had grown out of the chocolate houses where country gentlemen and men of fashion met, and made it worth the landlord's while to keep out the common people. But apart from these, clubland as we know it to-day came into being a hundred years ago, as near as may be—in a time of great expansion and prosperity.

The idea is said to have first started in John Murray's house in Albemarle Street (see how near we keep to the present day!) that "literary men and artists required a place of rendezvous," now that the old coffee-houses were superseded and many of them destroyed; and a remarkable man was the first to make the suggestion. John Wilson Croker was the Mr. Pepys of his time; he was Secretary to the Admiralty, like Pepys; he was a fellow of the Royal Society, like Pepys again; he knew everything and everybody; his correspondence was immense, and his diary has helped to keep him famous. Macaulay detested him; Disraeli and Thackeray drew him in ugly colours and unpleasant company. But Disraeli, who was elected to the Athenæum in 1866, might have got in thirty years before had the omnipotent 'Rigby' shown him a helping hand; and the other two had grievances of their own. After all, if Croker did not find in young Disraeli the sort of man he wanted for his club, one need scarcely wonder; it is easier to admire the old Dizzy than the young. Croker had his faults as he had his enemies; but we now think of him as a shrewd, an honourable and a sociable man.

Croker was a bosom friend of Sir Humphry Davy's, who was president of the Royal Society at the time; and in letters to Davy he discussed the character and the constitution of his proposed Club in great detail:

"In order to keep our Club what it is intended to be, a club of literary men and artists, we must lay down clearly and positively, as our first rule, that no one shall be eligible into it except Gentlemen who have either published some literary or professional work, or a paper in the Philosophical Transactions—Members of the Royal Academy—Trustees (not officials) of the British Museum—Hereditary and Life Governors of the British Institution. The latter will open our doors to the Patrons of the Arts; I do not see any other classes which could be admitted, unless Bishops and Judges, who are *par état* literary men although they have not published any literary work."

There are subtle points in this letter; there is a

liberal spirit not entirely emancipated from the social prejudice of the times. I like the notion of "literary men *par état*"—who have written nothing.

The first list of "persons of acknowledged eminence" was filled up easily and handsomely. Sir Walter Scott and Tom Moore, Campbell and Samuel Rogers, represented the literary men of the day. Sir Thomas Lawrence and Chantrey stood for art, together with Robert Smirke the younger, architect of the British Museum and the College of Physicians, a man remembered with respect and praise when he is remembered at all. In science there were the great names of Davy and Thomas Young, to which Faraday's was presently to be added in the humbler rôle of secretary. Among the noble patrons of the arts were Lord Palmerston and Lord Aberdeen, the Lord Lansdowne who filled Bowood with its greatest treasures, Lord Ashburnham the picture-collector, and Lord Spenser of the Althorp Library. There were so many other notable names on the original committee that one may begin by admiring the skill with which Croker and Davy chose their men, and end by wondering at the numerous crowd of distinguished personalities in George IV.'s London.

There was Sir Henry Halford, the Court Physician, a great figure in society; Richard Heber, greatest of bookhunters, who needed three copies of every book, and left eight houses full; Sir George Beaumont, an old man, a friend of Sir Joshua's and a benefactor of Wordsworth—a true patron of the arts; Davies Giddy or Gilbert, the Cornishman, another elderly man, who had discovered young Humphry Davy and (together with his friend Dr. Beddoes) had helped to start him on his illustrious career. There was Thomas Linton Parker, a county magnate in Lancashire, intimate friend of Gainsborough's and learned antiquary; also another scholarly squire, Aylmer Lambert of Boyton in Wiltshire, whose treasures of art were famous in his day and who wrote and published a "Description of the genus *Pinus*," a beautiful and costly book; Henry Thomas Colebrooke, the first Englishman to study Sanskrit; William Stewart Rose, a friend of Sir Walter's and translator of Ariosto; Edward Locker, father of Frederick Locker-Lampson, Secretary to Greenwich Hospital and founder of the gallery of naval portraits in the Painted Hall,—these and two or three more completed the committee. The list is a remarkable one; there is a fine, friendly, gentlemanly air about it; it gives us a glimpse of conditions different from our own, under which the men of professional eminence were fewer, the dilettanti much more numerous and distinguished, and whole classes of men, important and influential to-day, are conspicuous by their absence.

The Club opened its doors in February 1824, in the house in Waterloo Palce now occupied by the Italian State Railways. Croker saw to everything; he engaged the servants, seven men, five women, and three boys, at a total wage of 550*l.* a year; he ordered the coals, he bought the liveries (at 4*l.* 15*s.* per suit, or 10*s.* additional if the committee should prefer plush to velveteen), and the beds and bedsteads, "those for the three upper servants of rather a better kind." He purchased some 500 ounces of beautiful table-silver (still as good as ever) at 7*s.* 6*d.* an ounce; and he laid in "a Pipe of Port, another of Madeira, and a Butt of Sherry, and twenty dozen of Claret for present use." The port cost from about 50*s.* to 64*s.* a dozen, the claret from 80*s.* or 90*s.* to 120*s.*; as in Mr. Spectator's day, "the plaguy French claret cost more money, and did less good."

By midsummer the Club had more than five hundred members. The Prime Minister, Lord Liverpool, and seven future Prime Ministers—Canning, Goderich, Wellington, Peel, Russell, Aberdeen, and Palmerston—were all in the first list. Five of these five hundred, including the celebrated Captain (Sir Edward) Sabine and Decimus Burton, the architect of the Club, were still members fifty-four years after; and the last survivor, Mr. John Lettsom Elliot, died in 1898, after seventy-four years of membership. The limit of numbers was very soon increased to 1000, and the rush of would-be members grew beyond all anticipation. The ballot became a severe ordeal, black-balls being so common that Mr. Humphry Ward finds it "difficult to understand how the Club managed to survive and prosper when such a nipping wind was prevalent in the years of its infancy." Men canvassed openly on their friends' behalf—a thing undreamed of now! We find Southey, for example, begging a fellow-member's vote and influence for "an old friend of mine—Kenyon is his name—one of the best and pleasantest men whom I have ever known." This was Mr. John Kenyon, who looked like Mr. Pickwick according to some, or like a Benedictine monk according to others; and was immensely popular "both in life and death," leaving a great fortune to a large number of friends, among whom Robert Browning's share came to 10,000*l.* In 1831, very soon after the Club came into its own house, the celebrated Rule II. was passed, giving the committee power to elect nine eminent persons annually without ballot. The first object of the rule was merely to save a certain number of meritorious candidates from the risk and anxiety of the ballot; but it became an honourable distinction, and has given the bulk of its most distinguished members to the Club.

Decimus Burton, son of a prosperous London builder (a rival of Cubitt's), was the remarkable man chosen, of course by Croker, to be the architect of the new Club.

He was only twenty-four years old in 1824; but helped and protected by Nash he had already built the 'Colosseum' in Albany Street and several of the large houses in Regent's Park; and before he began to build the Athenæum (in 1827) he had built the Archway at Hyde Park Corner, the Wellington Arch on Constitution Hill, and other severely classical structures. Within three years, that is to say by 1830, the Club was built, at a total cost of about 43,000*l.*; it is vastly less than it would cost to-day, it is scarcely as much as the Club is obliged to spend on structural improvements on the renewal of its lease; but it seems a deal of money for men of science and letters and the arts to have spent upon their house a hundred years ago. The building looked just as it does to-day (and long may it remain so), save that it lacked the upper story, which was added some seventy years later. Croker conceived the idea of adorning the Club with its frieze from the Elgin Marbles; and he is said to have spent money on this embellishment which had been ear-marked for an ice-house. "I'm John Wilson Croker, I do as I please. . . . You ask for an ice-house, I give you a *Frieze*," is a well-known epigram by Joseph Jekyll, the wit of the first committee.

Mr. Humphry Ward's book falls into two parts. In the first part he describes the Club and sketches its history in a very charming fashion, with plenty of anecdotes and gossip and reminiscence, such as the theme invites and suggests abundantly; acknowledging his debt for much historical material, and repaying it handsomely, to the late secretary of the Club, Henry Richard Tedder. Tedder, who by the way had been a close friend and an executor of Herbert Spencer's, served the Club for more than forty years; the Club held him in the greatest possible respect, and a life-like portrait on the wall keeps him in its remembrance.

The second part of the book, which is all Mr. Humphry Ward's own, contains a list, with brief but telling annotations, of the members elected under Rule II. from the year 1831 until last year. It seems a little hard to exclude from commemoration *all* those who came in by the broad road of the ballot, who cannot all deserve neglect and oblivion; but the limitation set is at least a soundly conservative one, and the list as it stands is a wonderful catalogue of well-known names. The book opens in my hand, at random, at the year 1878. In that year came in Lister, and Rayleigh, and Frederick Harrison, and James Bryce; two great Anglo-Indians, Sir Alfred Lyall and Sir William Muir, both of them scholars and one of them a wit; Sir Robert Morier, "le grand ambassadeur qui a roulé Bismarck"; and last, but by no means least, Allen Thomson, the eldest of them all, a great anatomist and famous teacher, whose son still reminds us of him in the Club. Next year brought in Burne-Jones and Henry Sidgwick, and Stubbs the historian, and Stanley Jevons, and Huggins the great astronomer; also Lord Crawford, who succeeded Sir William in the chair of the Astronomical Society and was a true patron, if ever there was one, of science and of art; his son too is a member of the Club. In the following year we have Michael Foster and John Addington Symonds, and Salmon the Provost of Trinity, theologian, mathematician, and chess-player; also Lewis Morris and Orchardson, and Aldis Wright the great Shakespearian and learned Hebraist. Opening the book at another page we find that just fifty years before, Charles Darwin and Charles Dickens, Macready the actor, George Cattermole the painter, George Grote and Arthur Stanley, all entered the Club together in one special election by the committee. Mr. Humphry Ward's catalogue is well-nigh 250 pages long; the names cannot all be illustrious, but they are all more than respectable; they are the familiar names of the men who have made the world we live in, among whom have been our teachers and our friends.

Let us take a look within the Club, following, but not following too closely, Mr. Humphry Ward's description. The house is planned quite differently from the big house over the way. In the 'Senior' you look and look again for the stairs; but the great staircase of the Athenæum is the feature of the house. The pillars of the entrance-hall are copied from those of the Temple of the Winds; they are golden-yellow, on bronze bases, and the very sofas between them are of classical design. The floor is of a mosaic pattern; the recessed and panelled ceiling is enriched with delicate Pompeiian designs. The design and colouring are Alma Tadema's, who, together with Sir E. J. Poynter and Mr. A. Lucas, undertook the re-decoration of the Club in the early 'nineties. It is not in the taste of to-day, but it suits the architecture of the house to perfection; and it helps usefully to remind us that some things in Victorian art were exceedingly beautiful. On the Pall Mall side of the Hall is a pleasant morning-room. Time has ripened and softened a somewhat gorgeous ceiling, a rich Japanese wall-paper, and woodwork of a peculiar brown, of which last the club's earthenware teapots are said to have suggested the *motif*. There were some interesting pictures here until they were moved elsewhere not long ago. A portrait of Dr. Johnson by Opie was the gift (if I remember rightly) of Mr. Humphry Ward himself; it is as fine a thing as Opie ever painted, it reminds one of what he mixed his colours with, it shows Johnson as we would keep him in our mind's eye for evermore. Alas, it now hangs neglected on an unlighted wall; and its own place is filled by things incomparably inferior to it.

On the other side of the hall is the long dining-room, with a row of windows looking out upon the garden. The ceiling and mural decorations, by Sir E. J. Poynter, are curious but withal beautiful, and it seems an æsthetic solecism to hang modern portraits on the Pompeiian panelling of its walls. One knows where among the many tables one's friends are likely to be found—where men of science mostly sit, or where the artists or the critics; or the august corner where statesmen consort together, and eat and drink like common men. There are nooks and corners still associated by tradition with certain famous clubmen. Abraham Hayward, more than fifty years a member, friend of Sydney Smith and of Macaulay, translator of "Faust," story-teller, whist player and bon-vivant, sat in the corner by the door; was it not called "Abraham's bosom" even unto yesterday? In the same corner before Hayward's day sat Theodore Hook, drinking what (belittling it) he called 'toast-and-water,' and making up stories about bishops; and in the corner opposite, far off in the south-west, J. M. W. Turner used to dine, and dine alone, and drink his bottle of port in semi-darkness after bidding the candles to be taken away. Charles Dickens is said to have used the same corner-table in after years. To go back for a moment to Hayward, he has very little to say about the Club in his published "Letters"; but curiously enough, it is from him we learn that Thackeray was blackballed in 1850, to be elected by the committee as soon after as possible, in the following year. Can it have been some old friend, or friends, of "Wenham" who did this thing?

As we turn to go upstairs we shall, perhaps, be shown just where Dickens and Thackeray made it up, after a long and bitter quarrel; Edmund Yates had satirised the satirist, and Dickens had taken sides with Yates. We shall be shown also where poor Dicky Doyle lay down and died—Dicky, who drew the immortal title-page of *Punch*, and signed it with his dicky-bird effigy. The great drawing-room, a Library (to the southward) and a Writing-room, all full of books, occupy the first floor. A fine bust of Croker, by Chantrey, is one of the ornaments of the drawing-room; Lord Rosebery and Mr. John Murray are said to have discovered it, and the committee had the good fortune to buy it for a small sum. In the South Library there is a big table in the middle of the room where Thackeray dictated Esmond (or parts thereof) to his friend Eyre Crowe; and Richard Burton sat afterwards at the same table, with his snuff-box beside him, translating the "Thousand and One Nights." In a corner of the same room was a favourite seat of Macaulay's, used afterwards by a line of scholars, by Hallam and Matthew Arnold, by Mark Pattison and by Lord Acton.

The Library (which Mr. Humphry Ward lingers over with obvious predilection) has been a feature of the Club from the beginning; books are here, there, and everywhere—in gloomy store-rooms, in basement passages, in dizzy galleries where few members are young or bold enough to venture life and limb. For sheer want of space accessions to the Library have been comparatively few in recent years; but books which no gentleman's library should be without are very plentiful, the older editions of the classics are all there, and there is a famous lot of the great illustrated folios once vastly admired by all persons of taste and fashion. Splendidly bound and enshrined in fine cabinets we find here such things as that monument of the Naples Bourbons, the great "Case e monumenti di Pompeii," or Graevius' "Thesaurus," or Hoare's "Wiltshire," or Gould's bird-books, or Temminck's still more beautiful "Planches coloriées"; or Brockedon's "Passes of the Alps," or Rossellini, or Stuart and Revett, and very many more. It was one of the chief objects and ambitions of the Library Committee when Henry Hallam was a member of it, about the middle of last century, to "purchase such works in the fine arts, in natural history and antiquities, as, though eminently instructive or interesting, are too costly or bulky for the majority of private persons." Many of us are old enough to remember the days when men (when we ourselves) loved and coveted such books as these, of which this strenuous, anxious generation takes no account at all; and are there not one or two (such as Sibthorp's "Flora Graeca") which we desire and covet still?

We might pass on from room to room finding associations everywhere and memories without end. We have not yet seen Faraday's wheeled chair, still standing as he left it; nor yet another and more famous 'Empty Chair'; nor Thackeray's terra-cotta statuette, nor the Owls of Athene (several of them); nor the stone horse-block outside which was put there on purpose for the Duke of Wellington to mount at the door. But it is high time we took our leave of the Club, and of Mr. Humphry Ward's book. In doing so we may heartily declare that the book could not have been better done; it is light in touch, copious in anecdote, sympathetic in allusion, gentle in criticism. The Athenæum may well be proud of this history, and of the fellow-member who has put his heart into the writing of it.

And now what has been said in praise of the book becomes all of a sudden a tribute to its author's memory; for since these last words were written, Humphry Ward's long life has drawn gently to its close.

D. W. T.

Popular Astronomy.

The Earth and the Stars. By Dr. C. G. Abbot. Pp. xi + 264 + 33 plates. (New York: D. Van Nostrand Co.; London: Chapman and Hall, Ltd., 1925.) 15*s.* net.

THE appearance of a popular work on astronomy, particularly one by so experienced a worker as Dr. Abbot, is an event of much interest to those who believe that science has a message for the general public, for there is no science which bears more closely than does astronomy on the intellectual problems that face all educated men. It is probably true also that no science can claim so copious a literature of the popular kind, but the rapidity and revolutionary character of recent advances has left the great bulk of astronomical treatises hopelessly behind the times. A book of the type of Dr. Abbot's is therefore anything but superfluous, and the reader will find in it information which even the publications of a year ago were too early to supply.

The general plan of the book is drawn, in the main, on conventional lines. Following a brief survey of the heavenly bodies and a chapter on "Some Famous Astronomers and Famous Instruments," the reader is given some idea of the order of magnitude of the electron and the stellar system, and the principle of the spectroscope is briefly described. It is doubtful whether the account of the processes of emission and absorption of light is sufficiently definite to be intelligible to the uninitiated reader. The earth, moon, and the sun's family then come under consideration, after which three chapters are devoted to the sun. Despite the title of the book, the sun claims more space than any other individual body—as, indeed, we should expect in a book by Dr. Abbot. He considers in some detail the possibilities of direct mechanical utilisation of solar energy, and is of the opinion that "there is, perhaps, no field where investigation is more needed, or more apt to produce useful results for mankind." A chapter on "The Calendar, Star Places, Navigation," is succeeded by some stories of the constellations, and the last four chapters are devoted to the system of stars and the stellar universe. These contain an outline of the chief facts which have been gleaned with regard to the stars and nebulæ, individually and collectively, concluding with a summary of the work of Jeans on the evolution of stars from spiral nebulæ and that of Eddington on the interiors of stars and the source of stellar energy.

The book concludes with six short appendices, giving notes on the solar eclipse of January 1925, and the tides, tables of data concerning the solar system and the first magnitude stars, a list of the constellations, and a comprehensive, non-technical dictionary of astronomical terms. The numerous figures and diagrams are mostly excellent, but one or two of the latte (*e.g.* Fig. 40, p. 196) are capable of considerable improvement.

The book is very interesting, and in spite of some digressions Dr. Abbot has managed to include a large amount of material in a well-arranged form. The information given is up-to-date, and has the general character and freedom from technical details which are desirable in a work of the popular class. There can be no hesitation in saying that the author has succeeded in his aim of producing a book helpful "to those who wish to acquire by easy reading a general survey of the universe they dwell in." A considerable number of pertinent anecdotes are included, and one or two the relevance of which is not so clear. The style is conversational—an excellent method of presenting a subject popularly, but one which, as here, may be followed too slavishly.

Conversation has, indeed, the advantage over the formal written statement in that it is alive, and holds the reader's attention more firmly, but it has defects which can and should be removed on revision. On p. 195, for example, we read: "We shall mention a little further on, perhaps, one or two other special parallax methods." The word "perhaps" here is excusable when spoken, for the fulfilment of the promise may depend on time or some such limitation, but it is surely superfluous on the printed page. Another preservation of the defects of conversation is to be found in the frequent repetitions of turns of phraseology or playful asides. Thus on p. 92 we read, *à propos* of the sun: "No star could have obeyed better the spirit of the advice of Robinson Crusoe's father to stick to the middle class as the happiest," and on p. 226 the same comment occurs again. So common, indeed, are such repetitions that we soon learn, on encountering an illustrative saying of this kind, to await its recurrence with a confidence which is rarely unjustified. Nor is it only such phrases as these that are reproduced; the same lack of critical revision is evident with respect to plain statements of fact, *e.g.* Kepler's laws, which are thrice set out on pp. 9, 13, and 68. The several occurrences of the same statement do not always agree; as, for example, the definition of the precession of the equinoxes, which on pp. 14, 20, and 55 and in the glossary is rightly given as a westward movement, and on p. 7 as an eastward movement; or the three accounts of the distribution of novæ in the sky on pp. 182, 212, 223. This feature of the book is much to be regretted, inasmuch as a very little care would have removed it and brought about a vast improvement.

A few slips occur, of varying degrees of importance.

Spectrum lines from the sun's western limb are said to be displaced to the violet instead of to the red (p. 73). On p. 94 we read: "Eddington has shown it to be probable that . . . light pressure . . . actually prevents the existence of any stars of masses more than five times the sun's mass." In another connexion, however, the existence of more massive stars is referred to. We are surprised also to find the discovery that flame, arc and spark spectra of the same element are different in character attributed to Gale and Adams (p. 101); surely Lockyer's work can no longer be ignored.

There is one other point which it is important to mention. In two or three places occur statements which, considering the character of the book, we think too dogmatic. Thus we are told on p. 85 that Clerk-Maxwell *proved* (instead of *predicted*) theoretically that light exerts a pressure on small particles. No physicist, of course, would misunderstand this, but the man in the street is entirely dependent on the statements of specialists, and the word "proved" is for him final. He would be surprised to learn that on the same principles it could be "proved" that the atom is unstable and the universe cannot exist for a day. Again, on p. 214 it is stated definitely that Cepheids are not double stars, and on p. 222, spiral nebulæ are described without qualification as "island universes."

It is regrettable, though necessary, to direct attention to so many blemishes in a book which has given us great pleasure. The faults are mostly of a trivial character, but taken together become of considerable importance. Fundamentally the book is excellent, both in matter and in form; what it suffers from is lack of a final revision. It is greatly to be hoped that this will be supplied in the next edition. H. D.

Comparative Morphology of Fungi.

Vergleichende Morphologie der Pilze. Von Ernst Gäumann. Pp. x+626. (Jena: Gustav Fischer, 1926.) 28 gold marks.

THE need for a good and well-balanced treatise on the morphology of the fungi, incorporating the results of modern work, is one that has, no doubt, been felt by many botanists in recent years, and the present book comes nearer to meeting it than any that has hitherto appeared. One may, perhaps, regret that so much space is given to cytological details, but this is inherent in the author's expressed object, namely, to apply the data obtained from cytological studies to the interpretation of the problems of comparative morphology in the fungi. This method of treatment leaves comparatively little room for the consideration of the fungi as living organisms, adapted to their surroundings: physiology is not touched on; and life-histories are scarcely described except as incidentals to the cytological story. As a result, the imperfect forms of fructification are relegated to the background and the Fungi Imperfecti as a whole are dismissed in four pages. These, however, are the author's self-imposed limitations and are not open to criticism, however much they may be regretted.

The book is divided into a short opening section on the vegetative and reproductive organs of the fungi, and a main part, in which a detailed account is given of the morphology of the four classes, Archimycetes, Phycomycetes, Ascomycetes, and Basidiomycetes. The heterogeneous class of the Archimycetes, containing the Olpidiaceæ, Synchytriaceæ, Plasmodiophoraceæ, and Woroninaceæ, is derived from various roots in the Sporozoa-Flagellate-Myxomycete alliance, while the rest of the fungi are regarded as a single phylum, originating, in all probability, from the green algæ. The Oomycetes diverged early to a blind end, the Chytridiaceæ progressed through the Zygomycetes (Endogone-like forms) to the Ascomycetes and Basidiomycetes.

The Hemiasci are considered to form the connecting link between the Zygomycetes and Ascomycetes proper and are divided into two orders, the Endomycetales (including the yeasts) and the Exoascales in which are grouped the two isolated and not completely understood families of the Protomycetaceæ and Exoascaceæ. The gradual reduction of sexuality in the Ascomycetes affects chiefly the male gametes, which become functionless and disappear, their place being taken by secondary spores or by cells of the female organ; with the loss of the latter, conjugation between two vegetative hyphæ may be all that is left of the sexual act.

Where the author's views diverge from those of others who have concerned themselves with the phylogeny and comparative morphology of the fungi, he has indicated and explained the differences in their points of view, while the copious literature references have been selected especially to include those in which detailed bibliographical accounts of earlier work may be found. In such matters as the derivation of the Oomycetes from the algæ, he takes only the balance of probabilities as he sees them, and there is a refreshing absence of dogmatism throughout the work. It is stiff reading, owing to the very full documentation and the great extent of the literature covered, but the arguments are clear and the descriptions of the forms selected to represent the different families are concise and admirably illustrated. The author is to be congratulated on his excellent presentation of a most difficult subject.

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.*]

Electrical Constitution of the Upper Atmosphere.

RECENTLY considerable interest has been evinced in the nature and constitution of the upper atmosphere (NATURE, March 13), and it has been suggested that wireless methods are perhaps the most effective in exploring this region.

In this connexion the following facts, and possible explanations, may be of interest. In a recent paper in the *Philosophical Magazine* (June 1925) the writer suggested that a certain type of atmospheric disturbance which is semi-musical in nature, *i.e.* consisting of a musical note the pitch of which falls to a limiting frequency n_o, may throw some light on the electrical constitution of the upper atmosphere. The interpretation suggested was that these disturbances owed their musical nature to the dispersive action of the medium, which was assumed to consist of an assembly of electrons in a rarefied atmosphere. Such a medium will have the effect of transmitting different frequencies with different velocities, with the result that the spectrum of frequencies comprising an impulse is drawn out into a musical note of varying frequency.

It was shown that the lowest pitch of the disturbance is determined by the relation

$$n_o^2 = \frac{Ne^2}{\pi m},$$

where N is the number of ions per c.c., e is the charge on an ion, and m the mass of an ion. This is what I call the characteristic frequency of the medium.

In some experiments about a year and a half ago I found the prevailing characteristic frequency to be from 300 to 500 a second. In making some recent tests I noticed that the prevailing characteristic frequency had risen two or three times, suggesting a four- to tenfold increase in the ionic density. Associated with these changes there has recently been an increase in sunspot activity, magnetic storms and an auroral display so far south as London, and a noticeable falling off of the strength of short-wave signals from America. There seems little doubt that these are all associated with the approach of the period of sunspot maximum in 1928, especially in view of the theoretical deduction that such an increase in ionic density must necessarily increase the attenuation for night transmission if the constitution of the layer is as assumed above, provided the time period of the waves is short compared with the mean time between electronic collisions with molecules. Further evidence in confirmation of these views is afforded by measurements of trans-Atlantic telephony signals on a wave-length of 5270 m., published in the *Bell System Technical Journal*, July 1925. It is there shown that the average night strength of signals is largely decreased during magnetically disturbed days, a fact which is in accord with the foregoing theory, and confirms the hypothesis that the recent reduction of short-wave signal intensity is due to the sunspot activity.

It seems also probable that the explanation of the musical atmospheric disturbances given by the writer is substantially correct, and that observations of these will provide additional data for determining the electrical constitution of the upper atmosphere.

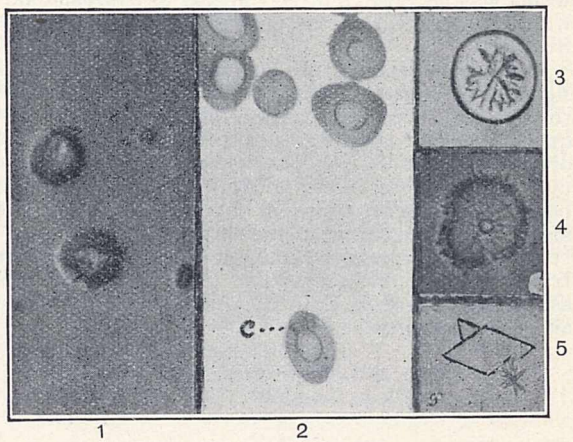
T. L. ECKERSLEY.

Research Department,
Marconi's Wireless Telegraph Company, Ltd.,
Marconi Works, Chelmsford,
May 25.

Hydrolysis of Starch Grains by Light Polarised by Small Particles.

DURING the last three winters I have been engaged in an experiment, which throws additional light on the work described in a former paper (Baly and Semmens, *Proc. Roy. Soc.* B, 97, 250), and as the effects took place in a small flask, disposes of the 'accidental pressure' hypothesis of critics.

The well-known scattering and polarising effect of colloidal particles suggested the use of a suspension of diastase as a polarising agent, and the experiment was thus arranged: About 10 cc. of a suspension



Potato starch grains in distilled water after exposure to polarised light.

1. Exposure two days; examined and photographed immediately after bright afternoons.
2. After less intense exposure; on partial drying, change inside grain is shown, canals (*c*) to exterior forming.
3. Exposure four days; crystals forming inside grain. (× 300.)
4. Exudation from holes in coat beginning to crystallise. (× 200.)
5. Bunch of crystals from single grain—with crystal plates.

of well-washed potato starch in distilled water was placed in a small thin-walled flask (A), and this was immersed in a beaker containing a strong colloidal solution of taka-diastase. As control, an equal quantity of the starch suspension was used, contained in a flask (B), which was lightly waxed, to depolarise any reflected light. The outer vessel in this case contained tap-water. The necks of both flasks were plugged with cotton-wool dipped in toluene, and the vessels were exposed for several days in a window at the top of a tall building, to catch the horizontal rays of the morning and evening sun.

The light polarised by the particles of diastase was thus reflected vertically upward and irradiated the starch grains lying at the bottom of the inner vessel (A). The control received direct light through a cleared space in the waxed surface of B. The results were tested at intervals of two or three days by examination on a microscope slide and were as follows:

(1) Immediately after a bright sunrise or sunset, many of the grains in flask A were found to be rapidly breaking (Fig. 1) while in flask B they were practically intact.

(2) If the weather were dull or the examination delayed, the grains merely showed a transparent streak in the centre, which gradually extended and formed little canals to the exterior (Fig. 2) through which the contents exuded, leaving the shrivelled skeleton or coat.

(3) When some of the liquid was mounted on a microscope slide with cover glass and left to dry in the dark, a film was formed showing diffraction fringes and crystals slowly formed in the liquid.

(4) Occasionally the hydrolysed contents crystallised within the grain (Fig. 3) or exuded from it, leaving the tiny shell in the centre as in Fig. 4.

(5) After prolonged exposure the empty shells or coats break down to a fatty substance (giving black or brown with osmic acid and red with Sudan III.), and rhomboidal or hexagonal plates are left near the crystallised grain-content (Fig. 5). These plates are often very thin, and in this case the outline in the photograph was slightly darkened for reproduction in print. On boiling with Fehling solution, the contents of flask A gave a distinct change of colour, which was not visible in B. Specks of cuprous oxide were also seen within the partially hydrolysed grains from A.

It would be premature to discuss the theoretical significance of these results, but they seem to indicate that in the action of certain enzymes, beside the quantum factor in energy absorption, there is also an orientation factor. As physiological reactions take place at surfaces, there must be some correlation between the orientation of the vibration and the molecular arrangement at the surface.

I wish to express my indebtedness to Sir James Irvine for valuable suggestions and criticisms, and, as always, to Prof. E. C. C. Baly for his continued help and encouragement.

ELIZABETH SIDNEY SEMMENS.
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Upper Air Temperatures and Thunderstorms.

IN NATURE of November 14, 1925, p. 709, I directed attention to the method of plotting upper air temperature readings by the use of temperature and log. potential temperature as co-ordinates, the curves being designated tephigrams by their inventor, Sir Napier Shaw. It may be recalled that, by the use of these curves, the energy available from a mass of air rising under unstable conditions is shown directly as an area on the graph. Opportunity has now been taken to study these diagrams in connexion with thunderstorms in the south-east of England during the three months June, July, and August of last year, and the results obtained are of interest.

Aeroplane ascents are made daily (Sundays excepted) by the Meteorological Flight at the Royal Air Force Station at Duxford, near Cambridge, on which dry and wet bulb temperatures are read at each 50 mb. step of pressure from 1000 or 950 mb. up to the highest point reached. This is generally in the neighbourhood of the 500 mb. isobaric surface (18,000-20,000 feet height). From these readings the humidity of the air is calculated. Unfortunately the wet bulb thermometer becomes useless soon after the aeroplane passes through the 32° F. isothermal surface, owing to the impossibility of keeping the bulb moistened, but it does not appear that humidities above this level are of very much importance in the formation of thunderstorms, so that the drawback is not a serious one for the present inquiry. To obtain a quantitative measure of the energy available from a mass of ascending air, it is necessary to know the temperature conditions existing in the atmosphere up to the point where the rising air loses its buoyancy and comes to rest, and this point is generally in cases of marked instability above the level to which areoplanes can fly as a matter of day-to-day routine. The investigation has therefore had to be on a qualitative rather than a quantitative basis, but from the data studied it appears that this is sufficient to give results of great value.

In the three months, 71 days were available on which an aeroplane ascent was made, such ascent normally taking place at about 8.30 A.M. in the morning. In a few cases where no morning ascent was available an afternoon one was utilised, but as the inquiry was mainly directed to the utility of the method for the forecasting in the early morning of thunderstorms during the coming day, the morning readings were primarily used. The three months varied in character; June had only one day of thunder, while July was thundery with 12 days, and August took an intermediate position with 9 days. The method of plotting humidity on tephigrams was discussed in my previous communication, and the proposal there put forward has been followed and has proved very satisfactory. It is clear that on a day of instability the air in each layer of the atmosphere will, in rising to its equilibrium position, develop its own amount of energy, and some one layer will on each occasion show maximum potential energy. This energy is very closely dependent upon its humidity and the heat liberated by condensation. It is easy on tephigrams to see which layer gives this maximum energy without plotting the relative humidity of every layer, and for each ascent the humidity has only been plotted at the layer which shows maximum energy on days of instability or the nearest approach to a development of energy on days when stable conditions prevailed. In this way the diagram is kept free from complication and the degree of energy available is seen at a glance.

The 71 days were divided into days of no thunder and days of thunder, the latter division containing all days on which thunder was reported from one or more of the stations contributing to the Daily Weather Report in the south-east of England, broadly defined in this case as the area south and east of Birmingham. The thunderstorm must thus have occurred within a radius of about 100 miles of Duxford. A cursory glance at the tephigrams indicated the closeness of the connexion between energy available and thunderstorms, and a more detailed study showed that the 71 days might be divided into three classes, only 7 cases remaining which did not fall readily into one of these classes.

Class A. *No energy and no thunder.* This contained those cases where there was no thunder, and either no energy was shown or there was energy only in a shallow layer below a layer of marked stability (36 cases).

Class B. *Energy high up generally without thunder.* In these cases energy was available, but not below the 700 mb. isobaric surface (say 10,000 feet) (13 cases). In 10 of these cases there was no thunder. In the remaining 3 cases there was thunder, but in 2 of these an evening ascent showed that later in the day energy was available at a lower level (below 700 mb.), so that the days might have been put into Class C below.

Class C. *Energy with thunder.* In this type energy was available below 700 mb., and was associated with subsequent thunder (15 cases).

These classes thus cover 64 out of the 71 cases and indicate a very close connexion between the energy shown on the tephigram and the subsequent development or non-development of thunder. The 7 cases not included in the above three classes represent only

10 per cent. of the whole, and it is not necessary to discuss them here in detail. They consist of—(1), 3 days when energy was available below the 700 mb. level, though thunder was not reported, and (2), 4 days with thunder, though little or no energy was shown. As regards (1) it must be remembered that thunder may occur but escape the network of Daily Weather Report stations; and as regards (2), Duxford will not always be typical of the air over the south-east of England for the remainder of the day.

As regards Class B, it is scarcely surprising to find that energy developed above the 700 mb. level is ineffective in producing thunderstorms, when it is remembered that the moisture content of saturated air above this level is comparatively small.

The close association between energy and thunderstorms shown by these ascents is most encouraging for the forecasting of thunderstorms and gives further proof, if such were needed, of the importance of regular aeroplane ascents to a modern forecast service.

J. S. DINES.

Meteorological Office,
Air Ministry, May 13.

New Experimental Results concerning the Doublet $K\beta_1$.

IN a communication under this title in NATURE of April 17, p. 554, N. Seljakow and A. Krasnikow have inferred from measurements on the lines $K\beta_1$ and $K\beta'$ in the Röntgen spectrum of manganese, that they form a relativity doublet characterised by the energy difference $M_{II} - M_{III}$. Now with molybdenum the corresponding difference is about $0{\cdot}8\ \frac{\nu}{R}$ units, whereas with elements of lower atomic number similar measurements have so far not been published. The very small value found for molybdenum makes it reasonable to suppose that, for the elements between calcium and zinc in the periodic system, the corresponding energy difference would not give rise to any separable lines. For even if we assume the appearance of 3_3-orbits, which begin with scandium, to cause a disturbance in the M-level, so that the 3_2-orbits are unequally screened for this and the next element, it still follows from an approximate calculation that this effect cannot possibly give rise to a larger difference than about one-third of that actually measured. On the other hand, the broadening of the $K\alpha$-doublet of iron found by Siegbahn and Ray (*Ark. Mat., Astr. Fysik*, vol. 18, No. 19) and recently studied by Thoræus (*Phil. Mag.* (7), vol. i. p. 312, 1926), which represents a much smaller value of the energy difference, may well be attributed to such a screening effect of the 3_3-orbits, as this would, of course, be equivalent to a slight increase of the nuclear charge.

With the $K\beta$-lines, the interpretation of the doublet as due to a relativity effect would doubtless require a more detailed explanation. The intensity ratio $\beta_1 : \beta' = 2 : 1$, which supports this interpretation, appears so far to have been definitely established only with manganese (N. Seljakow and A. Krasnikow, *Zs. f. Physik*, 33, 601, 1925). Investigations by the writer carried out in this Institute seem to prove that with iron in compounds the intensity ratio (estimated) has also approximately the same value, *i.e.* 2 : 1. With titanium and vanadium, however, a value considerably larger than 2 : 1 was found.

Seljakow and Krasnikow also state that the intensity ratio $\beta_1 : \beta'$ is not sensibly affected by passing the rays through foils of the same element. A similar observation on the satellite lines in the L-series of the rare earths has been described by D. Coster (*Zs. f. Physik*, 25, p. 98, 1924). This fact supports the view that the K- or L-electron is completely removed from the atom in the absorption process. Moreover, the explanation suggested by G. Wentzel (*Ann. der Physik*, 66, p. 458, 1921), who attributes the satellites to supernumerary excess electrons in the M-level, does not appear to be refutable on this basis.

Another point should be noticed in this connexion. The elements of the rare earths offer many analogies to those between calcium and zinc. A 4_4-orbit occurs for the first time with cerium, where also the β_{14} and γ_9 lines have been found by D. Coster to accompany the β_2 and γ_1 lines, as satellites of lower frequency. The increase in intensity of these satellites with increasing atomic number appears to be closely analogous to that of the β'-satellite for the elements next to iron. On the other hand, a cursory examination of the energy levels of the rare earths seems to exclude a relativity explanation of the satellites in the case of cerium and the following elements.

The interpretation of the $K\beta_1\beta'$ lines as a relativity doublet, offered by the Leningrad physicists, appears therefore scarcely admissible, whereas the hypothesis of Wentzel seems to be in better agreement with the experimental facts. If we try to estimate the effect of the supernumerary electrons involved by this hypothesis, we are led to the conclusion that such electrons cannot be limited in number to only one, otherwise we must assume rearrangements of the electron groups to occur. Especially the fact that the β'-line appears sensibly broadened seems to exclude a normal energy level as the origin of this line, and to support the view that several kinds of radiating atoms may co-exist, these differing from each other in the number or arrangement of their electrons within the M-level

G. ORTNER.

Institut für Radiumforschung,
Wien, May 10.

Wasteful Research?

THE issue of NATURE of May 1 contains a letter by Messrs. Morgan and Holmes from the new government "Chemical Research Laboratory, Teddington," describing results of their study of certain fatty materials. I venture to ask directly and plainly: Why is such work being done in a State laboratory? Years ago there was much heartburning among consulting chemists because the National Physical Laboratory was taking the bread out of their mouths. Is it now to be the turn of the universities and technical schools to suffer from the State poacher? The work described is purely academic, such that any intelligent fourth-year student could do.

To-day the chemical schools are in large part engaged in so-called research which is of no consequence and often detrimental as training—clearly because they are led by men without practical outlook. These need even to have practical subjects of study forced upon them, which will afford their students training in laboratory methods. With scarcely an exception, the real work that is being done in chemistry is with materials of natural origin. Fats are among them. A special technical professorship to deal with these has only recently been established in Liverpool, and is in specially able, experienced hands. Another of the professors in that University, only a month or two ago, made known the results of several years' close study of perhaps the most remarkable fat yet examined—that from shark's liver. The inquiry is probably the most finished and meritorious piece of work of the day. Sir William Bragg's school

has scored its chief triumph off fats. Sheffield studies them rather than iron. Last, not least, one very expensive organisation of the Department of Industrial and Scientific Research has fats specially under its charge. It has a habit of putting its work out, and some has already been placed with the University of Manchester. So it is clear that even the university may be trusted with fat. Why, then, further workers and new buildings in a field already so fully occupied?

Every halfpenny spent thus wastefully by State agencies out of the grant from the State is money withdrawn from the schools of experimental science, to which the grant was primarily made, to enable them to prosecute original inquiry and train a research force for the service of the State. The future of higher scientific inquiry is being gravely imperilled by the bureaucratic machinery which is fast closing its clutches upon our scientific liberties. We are false to the trust that is imposed on us if we further countenance a system which not a few of us regard as indefensible. The nation cannot afford to waste money in any quarter to-day, nor should it be led into thinking that it is getting special service from a Department which is showing that it is technically unfitted for the work it has undertaken. I may instance particularly fuel research, upon which half a million sterling seems to have been spent without result, mainly because practical needs have never been taken into account and existing knowledge and experience put aside.

HENRY E. ARMSTRONG.

May 2.

The Anomalous Flocculation of Clay.

IN NATURE of May 1, p. 624, there appears a letter from Dr. A. F. Joseph and Mr. H. B. Oakley regarding the so-called anomalous flocculation of clay. We should like to point out, however, that it is doubtful whether the experiments referred to in the first part of the letter could be expected to show anomalous flocculation as ordinarily understood. In the first place, it has been suggested by Comber (*Journ. Agric. Sci.*, 1920, 10, 432; *loc. cit.*, 1921, 11, 460 *et seq.*; and *Trans. Faraday Soc.*, 1922, 17, 349) that the phenomenon referred to is dependent on the presence of colloidal silica in the outer surface of the particles, and the "highly purified clay" used by Dr. Joseph and Mr. Oakley might well have lost this coating. Further, the phenomenon is shown, not so much by differences in the minimum amount of ion required for flocculation, as by an increased rate of sedimentation when a sufficiency of the ion is present. It would be interesting to know whether the particular clay used would show the phenomenon of anomalous precipitation at higher concentrations of salts either alone or after the addition of colloidal silica.

It may be mentioned that with suspensions of kaolin we have obtained very marked anomalous precipitation in alkaline solution by calcium ions after the addition of small quantities of colloidal silica, although these suspensions did not exhibit this phenomenon when silica was not present. We have also observed a similar effect with cæsium chloride, although in this case the phenomenon, under certain conditions, may be delayed for approximately 24 hours. Ammonium and potassium salts give similar results after still longer delays. The effect seems to be related to the precipitating action of the cations of these salts on colloidal solutions of silica at *p*H greater than 7,—a phenomenon which appears first to have been described by Pappadà (*Gazzetta Chim. Ital.*, 1903, 33, (ii.), 272). The nature of the precipitate in this anomalous flocculation is quite different from that obtained at other concentrations of the ions and other reactions of the medium. For example, in the case of calcium chloride a voluminous and highly flocculent sediment separates in the first two or three minutes at concentrations exceeding 39×10^{-4} *N* and at *p*H 8-9. At the end of such periods there is practically no flocculation apparent at corresponding concentrations of the salt in neutral or acid medium, or at any reaction or concentration of salt when silica is not present.

W. O. KERMACK.
Royal College of Physicians' Laboratory, Edinburgh.
W. T. H. WILLIAMSON.
Edinburgh and East of Scotland College of Agriculture, Edinburgh.

Major-General William Roy.

REFERENCE was made in NATURE of May 1, p. 630, to the life and work of Major-General William Roy. It is stated in the note in question that Roy entered the army at twenty years of age; his own statement is that a "body of infantry was encamped at Fort Augustus in 1747," when he was twenty-one, and that "as Assistant Quarter-Master it fell to my lot to begin . . . the execution of that map." It appears that he held a minor position in the Post Office at Edinburgh until 1747. As to the date of his joining the army, Mr. George Macdonald, in his valuable study "General William Roy and his Military Antiquities of the Romans in North Britain," published by the Society of Antiquaries in 1917, states that it is quite possible that Roy was not in the army at all during the construction of the map of Scotland. All that we know for certain on this point is that Roy was appointed Practitioner Engineer on December 23, 1755.

No mention is made in the note of Roy's archæological work. As a fact, throughout the whole of his life he was deeply interested in the history of the past, and he is probably nearly as well known as the author of the "Military Antiquities" as he is as the founder of the Ordnance Survey. It may interest readers of NATURE to know that the terminals of the base which he measured on Hounslow Heath in 1784 were replaced by guns buried vertically, muzzles upward, in 1791, and that these guns still remain in position.

C. F. CLOSE.

Coytbury, Winchester, May 25.

Hydrogen as Anion.

WE are all so much entertained by Prof. H. E. Armstrong's broadside attacks that those of us who happen to come within his range must not complain; but I feel that I must protest against his criticism (NATURE, April 17, p. 553) of the beautiful experiment of Bardwell which proved that hydrogen is an anion in metallic hydrides (*J. Am. Chem. Soc.*, 44, 2499 (1922)). If Prof. Armstrong would read carefully Dr. Bardwell's paper he would see what pains were taken to separate the anode and cathode chambers, and since hydrogen was evolved quantitatively at the anode it could scarcely be due to liberated alkali metal unless this also were set free at the anode—which even a thorough-going opponent of physical chemistry would scarcely assume. This being so, it is perhaps unnecessary to mention the bald chemical fact that the alkali metals do not in any case react with metallic hydrides to set free hydrogen.

GILBERT N. LEWIS.

Berkeley, California, April, 29.

The Steel Industry.[1]

By Sir WILLIAM PETER RYLANDS.

AS there are now indications that the world has made some definite progress towards a return to normality, this occasion is not inappropriate for presenting a picture of the past history of the steel industry, so that it may help in forming some reasoned judgment as to future prospects. For this purpose, with the assistance of Mr. Lloyd, I have prepared a chart (Fig. 1), and in this connexion I desire also to express my thanks to Sir William Larke for the valuable information he has placed at my disposal. In this chart I have set out four main curves, one representing the total of the world's production of steel, and the other three the respective annual productions of the United States, the Continent of Europe, and of Great Britain. I had expected to find a steady development in the world's consumption of steel, but I must admit to a feeling of some amazement when the curves were finally plotted out.

Measured in terms of present consumption, the total production of steel was almost insignificant up to forty years ago, and the year 1885 may be taken as marking the commencement of what may fairly be described as the 'Steel Age,' for which the discovery and development of the basic process was so largely responsible.

The most striking feature in the curve of the world's production of steel is the extraordinary uniformity in the rate of increase. Periodical fluctuations which must have taken place are entirely obscured in the curve plotted as a bold line, and up to 1914, instead of any inclination for the rate of increase to diminish, the curve tended continually to become more steep. It is difficult to avoid the conclusion that had the normal development of the world not been interrupted by the War, the world's consumption of steel would have continued to increase at a rate not dissimilar from that previously experienced, and might to-day have exceeded 100 million tons per annum.

In addition to certain subsidiary points of interest from which useful deductions may possibly be drawn, the curves bring to the eye three other main features. The first is the disturbing effect of the War, as illustrated by the curve movement between 1913 and the

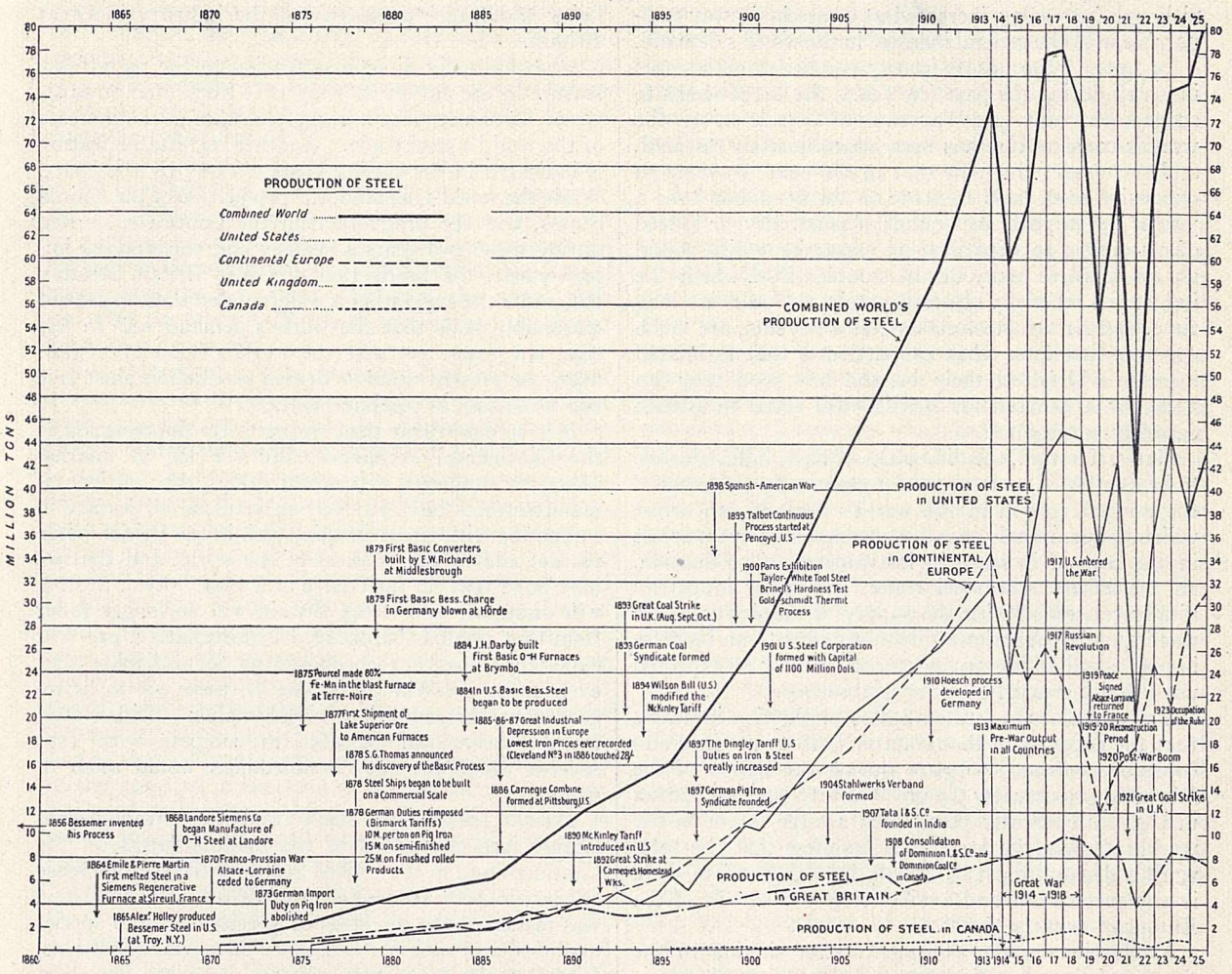

FIG. 1.—The world's production of steel, 1870–1926.

[1] From the presidential address to the Iron and Steel Institute, delivered at the annual meeting on June 3.

present time; secondly, the extraordinary similarity of the total production of the United States and the Continent of Europe respectively during the pre-War period; and thirdly—a matter with which Great Britain is peculiarly concerned—the failure of Great Britain to maintain her position in relation to the United States and the Continent. Until the year 1890 the respective productions of Great Britain, and United States, and the Continent of Europe were approximately the same. Thereafter, the production of steel in the United States and on the Continent grew with amazing rapidity, while the production of Great Britain, although increasing, increased at a rate in no way comparable with the general increase in the world's demand.

In spite of the unsatisfactory condition of the steel industry during the past few years, the curve seems to suggest that the pre-War rate of expansion of the world's consumption has been approximately restored, and encourages the hope that in the next ten years an expansion even to the extent of thirty million tons a year is not beyond the bounds of possibility, or indeed of reasonable anticipation—an expansion which would go far to solve many of the troubles from which the industry is suffering. Unfortunately, ten years is a long time, and British steel-makers, at all events, are much concerned to know what proportion of that estimated increase will fall to their lot, and how soon they can hope for a demand for British steel equal to British capacity to produce.

Many, if not all, the difficulties of basic industries are to be attributed to an arrest for practically ten years of the normal growth in the world's demand, an arrest which, unfortunately, was not accompanied by an arrest in the rate of increase in instruments of production. In the case of the steel trade, and other industries vitally concerned with the supply of munitions, there was in many countries a direct stimulus to an increase in plant, and an improvement can scarcely be expected until that increased capacity is absorbed.

The curve of the United States production indicates that the capacity of that country both to produce and consume continued to grow during the period of the War at approximately the pre-War rate, and the market in the United States being such a large factor in the world's demand for steel, it is manifest that the total world's demand must be greatly increased before there is any surplus demand available for the benefit of the European manufacturers.

Production on the Continent, after sinking to the depths of the post-War depression, has steadily risen, and in 1925 was but little short of the aggregate production of 1913. There is, however, a large amount of plant on the Continent still lying idle, of an estimated capacity of ten to fifteen million tons per annum, which can only be brought into operation by a corresponding increase in the world's demand.

The production of the United States in 1925 exceeded the highest level reached before the War by more than ten million tons, and to absorb this increase and to occupy the idle European plant and provide for a normal increment in the steel requirements of the United States, there must be an increase in the world's demand of at least thirty million tons, or, say, ten years' increment at the remarkable rate of increase experienced prior to the War.

It is difficult to avoid the conclusion that the pressure of competition from the Continent during the next ten years must continue to be very severe. In this connexion we must bear in mind that there are many new developments in steel manufacture in other countries of the world, and this increase in local production must diminish the share of the world's demand available to the old steel-producing nations.

Up to this point we have discussed the prospects of the steel industry, particularly from the point of view of the United States and the Continent of Europe, but we here are more intimately concerned with the well-being and future prosperity of the industry in Great Britain.

I have already directed attention to the regrettable feature in the curves showing that from 1890 onwards Great Britain secured a negligible share in the increase of the world's steel trade. Another regrettable feature is indicated in the closing years covered by the chart. While the world's demand, the production of the United States, and the production on the Continent showed during those two years a healthy and encouraging improvement, the production of Great Britain steadily fell, and if the suggestion is well founded that we cannot reasonably hope that the world's demand will, in less than ten years, overtake the world's capacity to produce, the present trend of British production must give rise to feelings of profound anxiety.

It is no doubt true that, owing to the depreciation of the Continental exchanges, and the lag in internal values, as compared with world values, the Continental manufacturers have enjoyed an artificial advantage in competing with Great Britain, both in the British home market and in the markets of the world, and that we may hope that, in the course of a year or two, this lag will disappear and Great Britain will no longer suffer from that peculiar handicap. Unfortunately, pre-War experience does not encourage us to anticipate that even under pre-War conditions—if these are to be regarded as the conditions of normality—British steel manufacturers will be able to compete with that success which present circumstances would seem to demand.

Prior to the War the heavy competitive trade passed largely into the hands of the manufacturers on the Continent and in the United States, while such increase as was, in fact, secured by the British steel industry, was rather in the direction of special lines and special qualities, and with the assistance of special conditions. Even for the home requirements of billets and sheet bars a large proportion was imported from abroad.

Clearly, with the great increase in British steel-making plant, it is now essential that the British steel manufacturers endeavour to secure a greater share of the heavy competitive trade, since it is doubtful whether any increase in the world's demand which can be anticipated during the next ten years will be accompanied by a sufficient increase in the special trades where Great Britain enjoys some peculiar advantage. Otherwise, without a serious reduction in productive capacity, the conditions of the British steel industry may be difficult for a considerable number of years to come.

These reflections invite consideration as to the reason why Great Britain failed to maintain its share in the

general expansion of the world's trade, and after maintaining its position for twenty years up to 1890, thereafter was left behind in the race.

Great Britain was the cradle of the steel industry. Some of the most revolutionary advances in technique originated in Great Britain. There were bountiful supplies of cheap coal, and although the Minette ore fields were of great assistance to the German industry, much of their steel was made from ore derived from other sources, presenting no particular advantage.

No doubt the United States derived great advantage from their immense and expanding home market, but it is a notable feature that the increase in production on the Continent kept pace step by step with the corresponding increase in the United States, and it is not easy to appreciate the exact advantage enjoyed by the Continent of Europe over those who conduct the industry in Great Britain.

Examining once more the history of the steel industry, it will be noted that its early development following on the introduction of the basic process was accompanied by a serious trade depression—a depression experienced not only in Great Britain, but also shared by the United States and the Continent. Between the years 1885 and 1887 the price of Cleveland iron reached the lowest figure ever recorded.

Two important factors developed both in the United States and on the Continent approximately at that time: the first was the definite adoption by both the United States and Germany of a tariff policy designed to protect the home market; the second, arising without doubt out of the depressed condition of the industry, was the development of a high degree of internal organisation of the trade in both those countries. At the depth of the depression the Carnegie Group was formed in the United States, followed later by the United States Steel Corporation, while in Germany syndicates were created for controlling the coal, pig iron, and finally steel, by means of the Stahlwerks Verband. It would not be appropriate to lay any stress upon the desirability of an import duty, or to draw any deduction as to the advantage which accrued from that policy to the industry in the United States and in Germany. This is a matter of political controversy. We are on safer ground if we argue that organisation was the responsible and dominant factor.

In few, if any, other industries are the costs of production so profoundly affected by large scale output and continuous operation as in the industries of steel and coal, and I am strongly convinced that the remarkable success of Germany and the United States in securing the lion's share of the increasing world's demand for steel is to be attributed to organisation directly aimed at securing that result.

As an illustration, on a visit to Germany in 1912, I was informed that the cost of producing mild steel billets in Westphalia exceeded 80 marks per ton, approximating very closely to the cost of manufacture in Great Britain. Those same billets were delivered to buyers in England at a delivered price of less than 4*l.* per ton, and having regard to the cost of carriage, it was manifestly impossible for the British manufacturers to compete.

No doubt the pursuit of special qualities is not entirely compatible with the policy of large and standardised production, and so long as the capacity of Great Britain can be satisfied by special business of this kind, and the manufacturers concerned are content, a valuable and important industry can be maintained; but if, as appears now to be essential, Great Britain is to secure a greater share of the world's steel trade, a different policy is imperatively demanded.

The commercial greatness of Great Britain was largely founded upon its production of coal and steel, and if that industrial position is to be maintained, the problem should be approached from the broadest point of view in the interests of the country as a whole. Some national responsibility attaches to the steel-makers. It is not enough that a few steelworks should be conducted with success. It is rather a matter of great national concern that the industry should secure the greatest possible share of the world's steel trade, and give the utmost employment to the industrial workers of the country.

A further reflection, not altogether fanciful, is suggested by the amazing rate of increase in the world's consumption of steel. It is difficult to believe that a cheaper substitute for coal could ever be discovered for the manufacture of pig iron, and while we are assured that the coal resources of Great Britain may be expected to last for some hundreds of years, that is a comparatively short period when measured in terms of geological time. Even, however, if we need not concern ourselves with anxieties which lie in the dim and distant future, the cost both of coal and of ore must increase under the law of diminishing returns. Within the recollection of many of us, slack was regularly sold by collieries at 3*s.* per ton at the pit, and forty years ago the price of Cleveland pig iron was so low as 32*s.* per ton; yet in spite of improvements in technique, the real costs of both coal and pig iron have greatly increased. It would appear certain that this tendency must continue, and the real cost of steel in Great Britain, with the exhaustion of home supplies of ore and the inevitable increase in the cost of coal, will steadily rise. It is equally likely that certain other parts of the world more favourably situated in regard to ore and steel will enjoy an increasing economic advantage. Practical steel-makers will no doubt be better able to judge how far the cost of home supplies of ore will be affected during the next ten or twenty years, but taking a broad view, this reflection, so far as it is of substance, emphasises the importance of scientific organisation of the industry, both on the technical and commercial side.

The Iron and Steel Institute has done much in the past to assist in technical development, but still more intimate co-operation is now necessary. The vast world's consumption of iron and steel demands correspondingly large scale productions, the co-ordination of technical knowledge, and the most efficient application of every technical advance if a steel-producing nation is to hold its position in the race.

The manufacturers in the United States of America, and on the Continent, seemed to have realised this, and have set an example which might wisely be followed if the steel trade of Great Britain is to overcome the pressing difficulties of the next ten years and of the more remote period when we may gradually lose some of the national advantages which we at present enjoy.

Fossil Insects in Relation to Living Forms.

By Dr. R. J. TILLYARD, F.R.S., Cawthron Institute, Nelson, New Zealand.

WHEN Handlirsch completed his great work "Die Fossilen Insekten" in 1908, it was possible to take a wide survey of the problem of fossil insects. The outstanding feature of this was the great gap in our knowledge of Permian and Triassic forms. On one side it was seen that the present type of insect fauna could be traced back with little essential modification right to the English Lias, in which all the chief existing orders of insects are known except the Lepidoptera and Hymenoptera; on the other, there lay the very different Upper Carboniferous faunas of the Age of Giant Insects. The only connecting type common to both was the cockroaches, which are thus seen rightly to merit the name of aristocrats of the insect world, and, like other aristocracies, are in this democratic age a small and disappearing unit. Between these two were known only Permian cockroaches and a few Permian and Triassic types, not enough to enable us to trace a good connexion.

Three large and important insect faunas have since been opened up and carefully studied. Taken together, they almost completely fill the Permian-Triassic gap in the record, and show us in large measure the lines of evolution of the chief orders of insects. These beds are enumerated below.

(1) The Upper Triassic Beds of Ipswich, Queensland.—These were discovered many years ago by Mr. T. H. Simmonds of Brisbane, but more thoroughly explored by Mr. B. Dunstan, Chief Government Geologist of Queensland. From these about 250 specimens have been taken, yielding a complete fauna of about 120 species. Coleoptera are dominant, making 46 per cent. of the total fauna. Hemiptera (Fig. 5) come next in abundance, the sub-order Homoptera being much more strongly represented than the Heteroptera. Other orders present are the Odonata, Protorthoptera, Orthoptera (including a few Blattoidea or cockroaches), Mecoptera (scorpion-flies), Neuroptera (sub-order Planipennia or lacewings only), and a very interesting new order, Paratrichoptera, containing four-winged insects ancestral to the true Diptera. Of these last, four well-marked genera have been found.

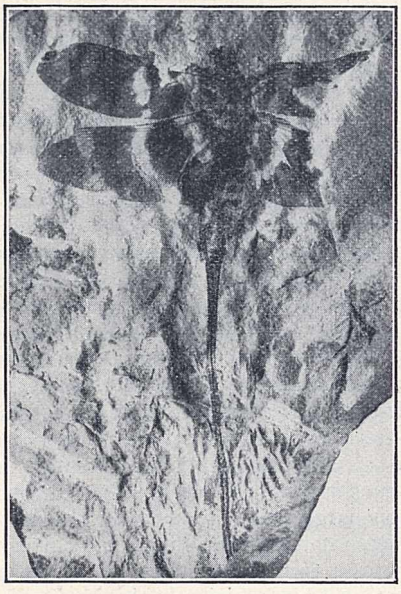

FIG. 1.—*Dunbaria fasciipennis* Till., the only known representative of the order Palæodictyoptera in the Lower Permian of Kansas. (Natural size.)

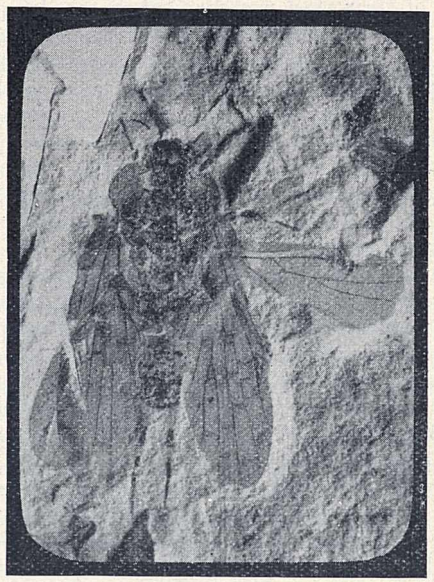

FIG. 2.—An undescribed species of Lemmatophora belonging to the new order Protoperlaria, ancestral to the stone-flies, and showing well-developed wing-flaps on the prothorax. (×3.)

(2) The Upper Permian Beds of Belmont and Newcastle, N.S.W.—The discovery and working of these beds is due to Mr. John Mitchell, formerly head of the Newcastle Technical College, who in spite of his advanced age is still wielding his huge hammer on this hard, cherty rock, and, with the assistance of Mr. and Mrs. T. H. Pincombe of New Lambton, continues to add wonderful new types to the record. Nearly 200 specimens have been found and about fifty species so far described. These beds, originally classed by geologists as Permo-Carboniferous, have been shown to lie only about 300 feet below the bottom of the Trias, with no break hereabouts between Palæozoic and Mesozoic strata. The flora consists almost entirely of Glossopteris, and the associated insects form a highly specialised fauna of very few orders. Homoptera and Mecoptera are dominant; no Heteroptera have yet been found. With the numerous scorpion-fly remains there has been found one type allied to the anomalous recent American genus Merope, and, closely allied to that also, a type recognisable as the oldest known true lacewing (Neuroptera Planipennia). A new order, Paramecoptera, allied to the Mecoptera and evidently representing the common ancestors at that period of the three orders Diptera, Trichoptera and Lepidoptera, is found in these beds, there being two genera, Belmontia and Parabelmontia. A few true Coleoptera occur, together with a most remarkable series of larger forewings evidently allied to them and showing all gradations from a flattened, apically pointed tegmen with complete venation down

to half-formed elytra with the venation completely lost except in the anal region. These must be regarded as being remnants of the older order from which the true Coleoptera originated, and are called Protocoleoptera. As several quite distinct types occur, even in these small beds, these fossils give point to the remark frequently made by that wise old coleopterist the late Dr. D. Sharp, that the enormous order Coleoptera as we know it to-day must have had a polyphyletic origin.

(3) The Lower Permian Beds of Kansas.—A magnificent collection of fossil insects, totalling 2000 specimens, has recently been taken from this locality by the Yale University Expedition led by Dr. Carl Dunbar. The beds were originally discovered by Dr. Sellards of Yale, who also possesses an extensive collection, mostly unstudied. This fauna is the most important and best preserved of all known insect faunas, many of the specimens showing the colour-pattern and minutest hairs on veins and membrane of the wings. From its study we learn how the insects reacted to the change of climate between the Upper Carboniferous and Lower Permian. The advent of hot, arid conditions, with

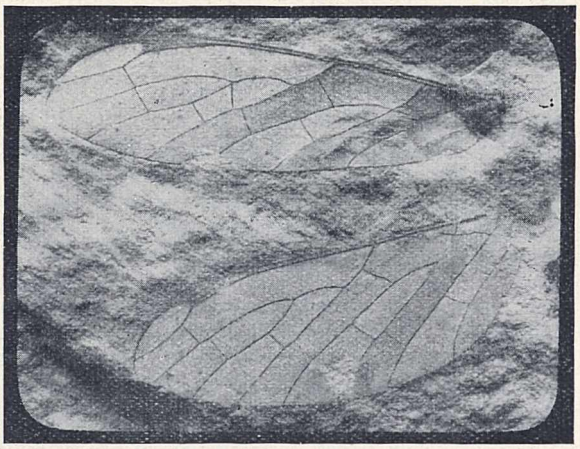

FIG. 3.—*Permohymen schucherti* Till., order Protohymenoptera, Lower Permian of Kansas. (×4.)

formation of salt lake areas, sounded the death-knell of the Age of Giant Insects, the only ones remaining in the Lower Permian being a few Protodonata and Protorthoptera and a single wonderfully preserved species of the old order Palæodictyoptera, *Dunbaria fasciipennis* Till. (Fig. 1).

The dominant type of insect was an aquatic type ancestral to the Perlaria or stone-flies of the present day. Some of these are preserved perfectly in every detail, and show a very unexpected character in the presence of well-formed wing-flaps with extensive venation, on the sides of the prothorax (Fig. 2). Mayflies (order Plectoptera) were also very abundant, but differed from those of the present day in having all four wings of about equal size and similar venation. Two genera of true dragonflies (order Odonata) are preserved, one showing almost a complete wing; their venation is much simpler than that of even the smallest damsel-fly of to-day, not even the closed quadrilateral cell being present. True scorpion-flies (order Mecoptera) were abundant, and all of very small size. Most of these were close allies of the existing Australian family Choristidæ, but one form was ancestral to the American genus Merope. The absence of any true lacewings, raphidians and sialoids is most remarkable; the geological record of the Permian makes it almost certain that these are later specialisations from a much older mecopteroid stock. Incidentally, the scorpion-flies

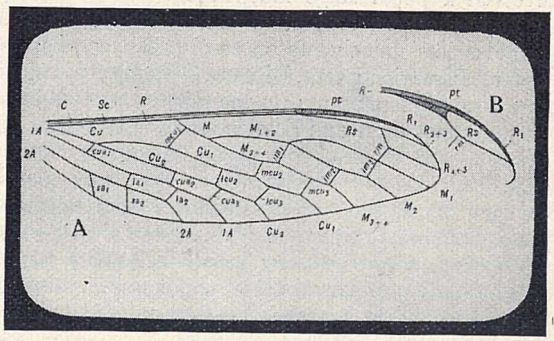

FIG. 4.—A. Diagrammatic representation of *Protohymen permianus* Till., order Protohymenoptera, forewing, from Lower Permian of Kansas. (×3.) B. Pterostigma of *Permohymen schucherti* Till. (×4.)

can be traced back to the Upper Carboniferous and are as old as any known winged insects; so that the problem of the origin of what is called holometaboly, or the formation of a true pupal or resting stage in insects, is bound up with the evolution of this little-known group of insects.

Other orders recognisable in the Kansas beds are the Copeognatha or psocids, the Embiaria or web-spinners, and four types which can be definitely classed as Homoptera and are of exceptional interest in giving for the first time an accurate interpretation of the venation in that order. But the most wonderful find of all was a whole series of wings and some nearly complete insects belonging to the extinct order Protohymenoptera, containing the ancestors of the Hymenoptera in which fore and hind wings were of almost equal size and were not yet linked together in flight by hooklets. The astonishing simplicity of the venation in these types has

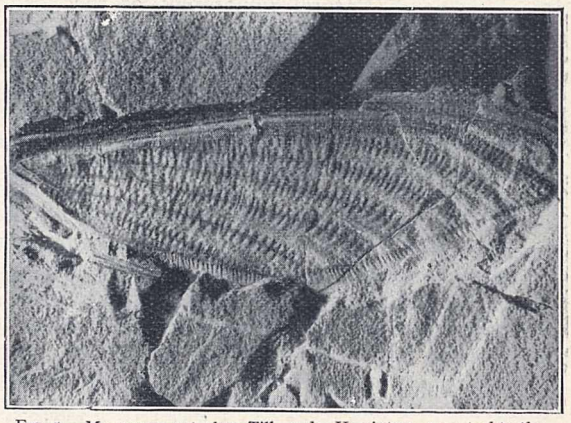

FIG. 5.—*Mesogereon superbum* Till., order Hemiptera, ancestral to the Cicadidæ, from Upper Trias of Ipswich. (×1½.)

quite upset the complex hypothetical explanations of Hymenopterous wing-venation due to MacGillivray and others, and at one stroke shows the true homologies of the veins and also makes it an easy matter for students to master the subject for systematic work. Of the three genera discovered, Protohymen (Fig. 4) stands right in the ancestral line of the recent order

Hymenoptera, leading directly to the horntails and sawflies, while Permohymen (Fig. 3) and Asthenohymen must be regarded as specialised side branches.

The fossil evidence is now fairly strong that there were three distinct groups of holometabolous insects which evolved a pupal stage independently of one another early in the Permian period. These are (*a*) the Mecopteroid orders, namely, Mecoptera, Neuroptera, Parameco-ptera, Paratrichoptera, Diptera, Trichoptera, Lepidoptera, and Siphonaptera; (*b*) the Hymenopteroid orders, Protohymenoptera and Hymenoptera; and (*c*) the Coleopteroid orders, Protocoleoptera, Coleoptera and their parasitic offshoot Strepsiptera. The only possible explanation of this appears to have been the marked change of climate which ushered in the Lower Permian. We must conceive that the pupal stage was a response to a new environment, the larva going underground and shortening the later nymphal instars into a single more complex change or metamorphosis.

In concluding this article, we must point out that the evidence as it stands at present points to a long history for winged insects before the Upper Carboniferous, though no fossils have yet been found in the Pterygota older than these. For the Apterygota, or primitive wingless insects (orders Thysanura, Protura and Collembola), an even longer geological history must be demanded, probably taking them back to the Lower Devonian. We know nothing as yet of the most primitive type of insect wing, whether it evolved from a gill or from a paranotal expansion, nor do we know anything at all about the original type of wing-venation except that it was probably a very simple one, not complex as in the highly specialised Upper Carboniferous groups. The problematical remains recently described as jaws and palpi of insects from the Rhynie Beds (Old Red Sandstone of Scotland) may well have belonged to Thysanura, but only careful study of definitely well preserved specimens could finally determine this point.

REFERENCES.—"Mesozoic Insects of Queensland," R. J. Tillyard, *Proceedings Linnean Soc. N.S.W.*, 1916–1924, 10 parts; various papers on fossils from the Belmont Beds by same author, *l.c.*, 1916–1926; Kansas Permian Insects, *American Journal of Science*, 9 parts, C. O. Dunbar and R. J. Tillyard, 1923–1926.

Obituary.

DR. J. T. BOTTOMLEY, F.R.S.

JAMES THOMSON BOTTOMLEY, who died in Glasgow on May 18, was born in Belfast on January 10, 1845. His father was William Bottomley, of Belfast, and his mother a sister of the late Lord Kelvin. He was educated at Queen's College, Belfast, and Trinity College, Dublin, where he had a distinguished career and was gold medallist at the degrees of B.A. and M.A. He started his scientific career by becoming assistant to Prof. Andrews at Belfast, afterwards a demonstrator of chemistry and physics in King's College, London, and in 1870 he came to the University of Glasgow to act as Arnott and Thomson demonstrator in the Department of Natural Philosophy, at the head of which was his uncle, Sir William Thomson. He held this position until 1899, when Lord Kelvin resigned from his professorship.

During these twenty-nine years Dr. Bottomley was continuously engaged in research work, and his researches covered a very extensive field, including liquefaction of gases, the use of liquid air for experiments on radiation at very low temperatures, the air thermometer, the bolometer, emissivity and conductivity of wires in vacuum, radiation from bright and black bodies, vacuum pumps, thermo-couples, modulus of elasticity, and the electrical properties of platinoid, etc. These papers were contributed mostly to the *Proceedings of the Royal Society*, and the Reports of the British Association. He published a book on theoretical mechanics in two parts, vol. 1 on dynamics, and vol. 2 on hydrostatics. But in this line he is best known as the author of "Four-Figure Mathematical Tables: Comprising Logarithmic and Trigonometric Tables, and Tables of Squares, Square Roots, and Reciprocals."

As time went on, Sir William Thomson delegated a good deal of the lecturing to students to Mr. Bottomley. He belonged to a type not uncommon in our universities, of distinguished scholars and amiable gentlemen, enthusiastic in their own department of study, and with every good desire in the world to help their students, but largely unable to impart their knowledge in the class-room. Uncle and nephew were both deficient in this respect, one being too advanced and abstruse for the average student, the other in being too ridiculously simple. He elaborated the obvious, sometimes painfully though unconsciously, wasting time striving to elucidate minor points which all understood. He did not seem able to state the salient points and pass on. Hence when he was getting on very well with his audience, often they would lose all patience with his meticulous niceties. When an emergency arose it appeared how difficult it is for the cloistered man of science to deal with a practical situation. Physics and psychology seemed to have no common ground. A sense of humour or power of repartee would heal the breach in a moment, but Dr. Bottomley was too serious for that and could not retaliate or change his mode of lecturing. Kelvin might bore the hilarious dawdlers quite as much, but they did not dare to take liberties with him.

As consulting engineer, Dr. Bottomley acted for the Scottish Asylums Board and for Nobels, Ltd. He had a regular electrical engineering consulting practice mostly concerned with lighting installations, such as Skibo Castle, Roxburgh Castle, etc. He joined the Institution of Electrical Engineers as an Associate in 1872 and was elected a member in 1889.

Dr. Bottomley became associated with the business of Kelvin, Bottomley and Baird when the firm was floated as a private limited company in 1900, and on the death of Lord Kelvin in 1907 he was appointed chairman, a position which he continued to fill until his death. In recognition of his distinction as a scientific worker and of his long and honourable connexion with the University of Glasgow, the degree of Doctor of Laws was conferred upon him in November 1904.

M. M.

MR. STEPHEN PAGET.

STEPHEN PAGET was born in Henrietta Street, Cavendish Square, London, in 1855, the fourth and youngest son of Sir James Paget, who was well known as the leading scientific surgeon of the mid-Victorian period. The tide was turning in the fortunes of his father when Stephen was born, for Sir James was writing that if he can afford that brougham his wife shall walk fewer miles in the week than she has often walked in the day. Stephen received his preliminary education at St. Marylebone and All Souls Grammar School in the Regent's Park just at the top of Baker Street. The school had been established by his maternal grandfather, the Rev. Henry North, domestic chaplain to the Duke of Kent, and received most of the doctors' sons in the neighbourhood. From this school he proceeded to Shrewsbury, where he had a good training in the classics, and from there he passed to Christ Church, Oxford, where his brother Frank was a senior student, graduating in 1878 after gaining second class honours in "Greats."

His eldest brother had been called to the Bar, the second and third had taken holy Orders, one afterwards becoming Bishop of Oxford, the other Bishop of Chester; Stephen decided to follow his father's profession. He entered as a student at St. Bartholomew's Hospital, obtained the F.R.C.S. Eng. in 1885 and was almost immediately elected assistant surgeon to the Metropolitan Hospital, whence he migrated to the West London Hospital. Here he became full surgeon until he determined to specialise, and was appointed surgeon to the Throat and Ear Department at the Middlesex Hospital. Ill-health overtook him and he was presently obliged to abandon all thought of practising his profession. He left London and settled at Limpsfield in Surrey, where he died on May 8.

Stephen Paget was ill-suited by health, temperament and education for the arduous life of a consulting surgeon, but he attempted it, failed, and by his failure was able to render services of the greatest value to physiology and pathology. Gentle in character, logical in thought, and before all things a lover of truth, he devoted the last eighteen years of his life to make known the truth about experiments upon animals and to show how the advance of medicine in every branch depends upon freedom of research. To this end he was instrumental in founding the Research Defence Society, of which he was the first secretary. The object of the Society was to fight against and expose the lies, half-truths and innuendoes of prejudiced anti-vivisectionists. Paget carried out the campaign with deadly effect against a host of fanatics and faddists. He wrote books, delivered lectures and published addresses, always courteously worded and without heat, which did much to allow an unscientific public to see the matters under discussion in their true proportion.

Paget wrote charmingly and in an easy style, which make it pleasant to read his many books. Biography perhaps interested him most. In "The Memoirs and Letters of Sir James Paget" he accomplished successfully the difficult task of a son writing the life of a distinguished father, whilst in the "Life of Sir Victor Horsley" he had to meet difficulties of an entirely different kind and he was equally successful. His lives of Ambroise Paré and John Hunter give delightful accounts of these great surgeons of a bygone age, whilst the "Confessio Medici" should be read and re-read by every student of medicine.

He married a daughter of Dr. Burd of Shrewsbury. To her and their two daughters medicine owes a debt of gratitude. Their loving care enabled him to devote all his time and energies to the great object of his life—the freedom of research.

MR. H. KIRKE SWANN.

HARRY KIRKE SWANN died on April 14 in New Barnet, near London, at the age of fifty-four years, after a short illness. He was chiefly known to ornithologists by his excellent books on the bibliography of British birds and his writings on the Accipitres or birds of prey. In 1916 appeared the "Bibliography of British Ornithology," a volume of 691 pages, which he wrote in collaboration with W. H. Mullens, and in 1919 appeared the "Geographical Bibliography of British Ornithology" in conjunction with W. H. Mullens and the Rev. F. C. R. Jourdain, in 1923 "A Bibliography of British Ornithology from the Earliest Times," by Kirke Swann alone, a chronological list of British birds, termed a supplement to the above-named bibliography.

His love of ornithology dates from Swann's boyhood; at twenty years of age he visited Nova Scotia and eastern Canada, and his zoological observations are embodied in an attractive little book, "Nature in Acadie," which appeared in 1895. In 1892 he founded in London the *Naturalist's Journal*, eventually continued by Mr. S. L. Mosley; the first two volumes were edited by him, and contained several articles by himself on British birds. Mr. Swann was always a busy man and could generally only devote his spare time to his beloved ornithology. He became a partner and later proprietor of the booksellers' firm of John Wheldon & Co., and in 1921 he joined with William Wesley & Son to form a company under the name of Wheldon & Wesley, Ltd., of which he was a director and very active member when he died. In 1913 appeared Swann's "Dictionary of English and Folk-Names of British Birds, with their History, Meaning, and First Usage; and the Folk-lore, Weather-lore, Legends, etc., relating to the More Familiar Species," a work containing a wonderful amount of information.

For a long time Mr. Swann took a special interest in the Accipitres or diurnal birds of prey, collected their eggs, and later on their skins. In 1920 there appeared his "Synoptical List of the Accipitres," followed in 1922 by a second revised edition under the title "A Synopsis of the Accipitres." These lists contained, in addition to the names, in accordance to the strictest priority, short diagnoses of the (unnecessarily numerous) genera, species and subspecies; considering the great variability of plumage, according to age, sex, and individual variation of most Accipitres, these diagnoses, though often useful to ornithologists, cannot suffice to determine the forms without more knowledge.

A few years ago Mr. Swann visited the United States, where he studied birds of prey in most of the larger museums, while in 1925 he made a collecting trip to Rumania and the Danube delta, with Mr. J. H. McNeile,

and wrote an attractive little book, "Two Ornithologists on the Lower Danube."

In 1924 there appeared the first part of a large, ambitious work in quarto, called "A Monograph of the Birds of Prey," beautifully illustrated with coloured plates by Mr. H. Gröuvold, of birds and eggs, and some photographs of nests, very well printed and well written. Possibly the Accipitres are not only the most attractive but also the most difficult group of birds for a systematist, and it is therefore not to be expected that Mr. Swann's work was in every case correct in the recognition and grouping of species and subspecies, but it is very regrettable that he could not finish it; so far only five parts have appeared, which is less than half the work.

Sir James Cantlie, K.B.E.

THE death on May 28 of Sir James Cantlie, at the age of seventy-five years, removes from our midst a man of originality and untiring energy, and a ready writer and speaker. In his early days he was demonstrator of anatomy and assistant surgeon and later surgeon to the Charing Cross Hospital, but most of his life work outside his practice, whether in London, Hongkong, or again in London, was devoted to teaching and pioneering in unexplored fields of medical education. A great believer in physical training and fresh air both for the young and the middle-aged for the maintenance of health, he first set out some of his views in 1885 in a remarkable paper entitled "The Degeneration of Londoners," which encountered a good deal of ridicule, but was remembered during the War when a large number of recruits for the army were placed in Class C.

Cantlie's knowledge of tropical medicine began in Egypt, when he was one of twelve young medical men sent out there to assist in combating the 1883 epidemic of cholera. His next experience was in Hongkong, where he became Dean of the Chinese Medical College, and in conjunction with Sir Patrick Manson carried on a large practice. In Hongkong he did some good work in helping to check the local outbreak of plague in 1894, though the measures were not successful in preventing the disease from being carried by infected ships to the ports of other countries. In close association with Yersin and Kitasato, he became conversant with the most recent knowledge concerning the disease at that time, which, when he returned to London two years later, was made use of by the London County Council, which employed him as its adviser on plague.

It was Cantlie who first started the idea of the necessity of the establishment of a School of Tropical Medicine in London. He was also a founder of the Society of Tropical Medicine and Hygiene, of which Sir Patrick Manson was the first chairman, and of which, when some years later it became the Royal Society of Tropical Medicine and Hygiene, Cantlie also became president. By his influence a tropical section was added to the annual meetings of the British Medical Association.

During the War, Sir James Cantlie, with the assistance of Lady Cantlie, performed very valuable services to the country by the training of men and women for Red Cross work.

Mr. John Stuart.

IT is with much regret that we learn from the *British Journal of Photography* of May 7 that Mr. John Stuart died quite suddenly on April 28 in his ninetieth year. He had been chairman of the well-known firm of opticians, Ross Ltd., for many years, and was the proprietor of the *British Journal of Photography*. Mr. Stuart was born at Lossiemouth, and was attracted to photography in the very early days of the collodion process, and for a few years travelled in Spain, Portugal, and Italy making a large number of wet-plate negatives, many of which were used for publication. At this time Andrew Ross, who founded the firm, was dead, and his son, Thomas Ross, had succeeded him. Mr. Stuart joined the firm in 1870, and shortly after the death of Thomas Ross he married his widow. Under Mr. Stuart's direction the firm continued to expand, and all who are interested in optical matters will call to mind the name of Francis Wenham, who was a valued colleague. Mr. Stuart was the sole proprietor of the *British Journal of Photography* for more than forty years, and the editor states that his editorial and business staff were given a completely free hand, his influence, when exercised, tending towards the restriction of the publicity in the pages of the journal of the manufactures of Messrs. Ross Ltd.

IT is announced in the *Chemiker Zeitung* that Dr. Carl J. Lintner, emeritus professor of applied chemistry at the Technische Hochschule in Munich, died on April 9 in his seventy-first year. After graduating at Munich, Lintner turned his attention to the technology of agriculture and of brewing, and after some experience at the Experimental Station for Agricultural Chemistry in Halle and at the Institute for Brewing in Berlin, he returned to Munich in 1884 and began to collaborate there with Soxhlet. In 1896 he was appointed to the chair of applied chemistry, and from 1902 until 1914 he directed the Experimental Station for Brewing at Munich. His chief researches were upon enzyme action, especially in relation to brewing.

WE regret to announce the following deaths:

Sir Thomas Elliott, Bart., K.C.B., for twenty years secretary to the Board of Agriculture and afterwards Deputy Master of the Mint, on June 4, aged seventy-one years.

Prof. Nils Gustaf von Lagerheim, professor of botany and director of the Botanical Institute of the University of Stockholm, and corresponding member since 1892 of the Pharmaceutical Society.

Lieut.-General Sir William Leishman, K.C.B., F.R.S., Director-General of the Army Medical Service, on June 2, aged sixty years.

Dr. E. S. Reynolds, emeritus professor of clinical medicine in the University of Manchester, on May 22, aged sixty-five years.

Sir Stewart Stockman, Chief Veterinary Officer and Director of Veterinary Research at the Ministry of Agriculture and Fisheries, on June 2, aged fifty-six years.

Sir John Williams, Bart., G.C.V.O., emeritus professor of midwifery at University College, London, and president of the University College of Wales in 1913 and first president of the National Library of Wales, on May 24, aged eighty-five years.

News and Views.

AN interesting feature of the proceedings at the anniversary meeting of the Linnean Society on May 27 was the presentation to the Society by Sir David Prain, on behalf of the subscribers, of a portrait of the general secretary, Dr. Benjamin Daydon Jackson. The portrait, by Mr. Ernest Moore, will commemorate Dr. Jackson's long and helpful association with the Society as an officer for a period of forty-six years—a period equal to one-third of the present life of the Society, which was founded in 1788. In 1880 Dr. Jackson, who had joined the Society in 1868, was elected one of the two honorary secretaries, succeeding Mr. Frederick Currey on the botanical side, and as such he continued to serve until 1902, when on the retirement of the assistant secretary, Mr. J. E. F. Harting, he was appointed to the specially created post of general secretary. As general secretary Dr. Jackson has for the past twenty-four years ably administered the Society's affairs, and his knowledge and experience have been invaluable to the successive presidents, secretaries, and councils.

THOUGH he completed his eightieth year on April 3, Dr. Daydon Jackson looks back on an almost unbroken record of attendance at the fortnightly meetings of the Linnean Society during his forty-six years' official connexion with it. Even during his earlier period of service as botanical secretary, Dr. Jackson made the Society his headquarters, and his unrivalled knowledge of the Linnean collections has been at the service of fellows or visitors. Several generations of workers retain a grateful recollection of assistance given with equal cheerfulness to the eminent visitor from abroad or the young student at home. Reference was made to Dr. Jackson's encyclopædic work; the compilation of the "Index Kewensis" was necessarily centred at Kew, but the "Glossary of Botanical Terms" is a product of leisure moments at the Linnean Society, while his "Catalogue of the Linnean Herbarium" is intimately associated with the genius of the place. His reputation as our authority on the work and collections of Linnæus was recognised at the Upsala celebrations in 1908 by the conferment of honorary degrees (Ph.D. and A.M.) and a royal honour (R.N.O.). Dr. Jackson will continue his association with the Linnean Society as Curator of the Linnean Collections; in this capacity his services will still be available to workers, and it is hoped that he may find ample leisure for putting on record more of his great knowledge on Linnean matters.

THERE is some risk that expectations not likely to be justified are being founded on the recent discovery of fresh foot-and-mouth disease carcases as a source of outbreaks of foot-and-mouth disease. All those who have had to give serious consideration to the introduction of the disease from abroad in recent years have recognised importation of entire carcases or portions of carcases of animals slaughtered while affected with the disease as a clear possibility. In spite of this, very great quantities of chilled or frozen beef are introduced from foreign countries, including Argentina, in which foot-and-mouth disease constantly exists. There was reason, however, to think that that could not be a very fruitful source, because the virus of the disease would probably have lost its vitality in the carcases by the time they arrived here.

WHAT makes fresh, unpreserved meat from Belgium and Holland particularly liable to start an outbreak of foot-and-mouth disease is that it may arrive in Great Britain within 24 or 48 hours after the animals are killed, and would then be certainly infective. That source can be effectively stopped, but it is much to be feared that it will not prevent the recurrence of outbreaks in Great Britain so long as the disease is highly prevalent in the adjacent countries of the continent. It is an important fact that Scotland has for a period of two years been free from foot-and-mouth disease, although it is known that during that period thousands of pigs' carcases have been imported from the continent. Besides, the disease was frequently introduced before the present practice of killing pigs and dispatching their fresh carcases immediately had been begun. The real risk lies in the fact that every person or thing that has been in contact with an animal affected with foot-and-mouth disease, or in a place where diseased animals have recently been kept, becomes capable of spreading the disease for a period that may last for some days at least, and may therefore cause an outbreak on arrival in Great Britain after the comparatively short journey from Belgium and Holland.

THE address delivered to the Iron and Steel Institute by Sir Peter Rylands, which appears elsewhere in this issue, is an exceedingly illuminating one, and the chart showing the facts concerning the production of steel in different parts of the world is very striking. That the fraction of the world's production contributed by Great Britain is a diminishing one is, however, inevitable in view of the vast resources of easily accessible and chemically suitable ores and fuel possessed by the United States, and of the entry of other countries, having natural resources of an extensive kind, into the field of production. It would be of interest to see a similar chart in which the value of the steel produced was shown instead of the tonnage, when perhaps the British share would prove to be somewhat larger, on account of the position occupied by Great Britain as a producer of the highest classes of steel. Sir Peter Rylands rightly emphasises the importance of organisation to the industry, and attributes much of the success of American and German undertakings to the industrial organisation which has improved efficiency. On the scientific side, the British steel industry is already responsible for the conduct of a large volume of research work, but much more thorough co-operation is required in order that the fruits of research may be made available to the industry as a whole. Nowhere is the influence of purely scientific investigations on manufacture to be more clearly seen than in the

steel industry, except perhaps in the electrical industry, in which the necessity of co-ordinating scientific knowledge with practice has been recognised to the fullest extent.

IN the course of his lecture on "Iron in Antiquity," delivered at the Royal Institution on June 3, Dr. J. Newton Friend referred to some interesting historical points as to the early use of metals. Native gold was known to man at a very early date and was highly prized on account of its intrinsic beauty and resistance to tarnish. Native copper and iron were also known in certain districts, but it was centuries later before man learned to reduce those metals from their ores. Iron was manufactured in the Near East at an early date. About 1300 B.C. the Hittites were beginning to use iron weapons for military purposes, and in a letter, thought to have been addressed to Rameses II. of Egypt, the Hittite king states that he is sending with the letter an iron dagger. The Romans, in late years, were skilled metallurgists. Virgil in his "Aeneid," written about 40 B.C., describes the smithy in full work, whilst Pliny, whose work on natural history appeared in A.D. 77, shows a considerable knowledge of iron ores and of the working of the metal. He appears also to have recorded the accidental formation of cast iron. An iron ring of Roman origin, probably the remains of a ferrule, was found recently at Uriconium, and appears to have been made by bending a strip of iron into the form of a ring and soldering the ends with some copper alloy. Cast iron was known in Sussex about 1350, and soon became quite a common product. It was at first used exclusively for casting purposes, and in 1588 cast-iron guns were used, as well as bronze, by the Spaniards in their Armada. When, many years later, it was found that cast iron was the most suitable starting-point for the manufacture of iron and steel, the demand for it increased enormously. In 1800 the United Kingdom produced about $\frac{1}{4}$ million tons of pig iron, a quantity that had increased by 1913 to more than 10 million tons, but fell again to just over 6 million tons in 1925.

IT is possible that the activities of the Russians in the scientific exploration of northern Siberia may be strengthened by the co-operation of Norway. It is reported in the *Times* of June 3 that a conference has been held in the Soviet Legation at Oslo under the presidency of Dr. Nansen to consider the possibility of a joint Russian and Norwegian expedition to Yakutsk. The conference was attended by representatives of the University of Oslo, the Geographical Society, and the Foreign and Commercial Departments. The Russian Academy of Sciences was represented by Dr. Wittenberg. It was stated that there are at present sixty Russian men of science engaged in investigation in Yakutsk. This area is one of special interest, particularly to the anthropologist, on account of the light which investigation of its people may throw on ethnology and racial movement in Asia. Any investigation of the people and culture of Russian territory in Asia, however, and especially the investigation of its archæological remains, is of interest to a wide circle outside Russia. Any attempt, therefore, to strengthen Russian effort by interesting scientific workers of other countries in these investigations deserves careful and, where circumstances permit, sympathetic consideration.

MANY interesting facts relating to the early manufacture of glass were mentioned by Sir Flinders Petrie in the course of an address delivered at the annual meeting of the Society of Glass Technology held at University College, London, on June 1. Glass was produced in the Euphrates region and in northern Mesopotamia so long ago as 2500 B.C., but in Egypt all glass was imported until 1500 B.C. Fifty years after the introduction of Syrian workers into that country, however, it became one of the commonest of all objects. Glass beads, the most popular use of glass, were not then made from liquid glass but from glass paste, glass-blowing not having been introduced until the Christian era. Sir Flinders, in referring to the use of glass by the ancients for the purpose of weights, said that three glass weights of the same denomination which had been found proved on testing to agree within $\frac{1}{200}$ of a grain.

AN organisation similar to Science Service of Washington, for the purpose of supplying to the press readable and accurate knowledge of scientific progress, has been formed in Paris under the title of "Office d'Information scientifique et technique," at the instigation of M. le duc de Gramont. The board of control consists of J. L. Breton, director of the National Office of Scientific and Industrial Research and Inventions; Charles Fabry, professor at the Sorbonne; Armand de Gramont, president of the council of the Institute of Optics; Paul Janet, director of the École supérieure d'Électricité; Louis Lumière, of the Academy of Sciences; Louis Mangin, director of the Muséum national d'Histoire naturelle; Émile Picard, permanent secretary of the Academy of Sciences; Georges Roger, of the Academy of Medicine; Émile Roux, director of the Pasteur Institute. The director of the office is Lieut.-Col. J. Raibaud. The new institution will co-operate with Science Service of Washington in the exchange of news of scientific and industrial progress in France and the United States.

SOME interesting side-lights were thrown on Indian religious custom and medical practice in Sir J. C. Bose's lecture on the action of cobra venom on plants which was delivered before the Royal Society of Medicine on June 2. Sir J. C. Bose found by experiment on animals and plants that a moderate dose of cobra venom produced an arrest of the pulse before death. In Indian popular belief it was thought that when a person bitten by a snake exhibited signs of death, revival was possible. For this reason the body was not cremated but was placed on a raft and allowed to float down the river. *Shuchikavan*, of which an ingredient is a minute quantity of cobra venom, has been employed in Indian medicine for a thousand years when a patient is at the point of death from heart failure. It is believed to revive the failing activity of the heart.

He had found that minute doses of cobra venom also stimulate certain nervous activities of plants.

THE annual conversazione of the Royal Society to which ladies are invited will be held in the Society's rooms on Wednesday, June 16, at 8.30 P.M.

THE annual visitation of the National Physical Laboratory, Teddington, will take place on Tuesday, June 22.

SIR DUGALD CLERK, K.B.E., well known for his work on the development of the internal combustion engine, has been elected Prime Warden of the Goldsmiths' Company.

THE Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S.W. 15, will be opened by the Prince of Wales on July 15. The Government of Nigeria has given a sum of 1000*l.* to the Institute to mark its appreciation of the services rendered by Sir Ronald Ross to residents in the tropics by his researches into the causation of malarial fever.

AT the forthcoming Oxford meeting of the British Association, August 4-11, Prof. A. S. Eddington will deliver an evening discourse upon the subject of "Stars and Atoms," and Prof. H. F. Osborn one on "Discoveries in the Gobi Desert by the American Museum Expedition." Public lectures will also be given in Oxford by Sir William Bragg, Sir Dugald Clerk, Capt. Eckersley, Prof. Julian Huxley, and Prof. P. F. Kendall.

IT is announced in *Science* that the Willard Gibbs Medal of the Chicago section of the American Chemical Society has been awarded this year to Sir James Colquhoun Irvine, of the University of St. Andrews. The presentation will take place at the September meeting of the Chicago section of the Society, when Dr. Irvine will be attending the Philadelphia meeting of the American Chemical Society.

THE following have been elected officers of the Manchester Literary and Philosophical Society for the ensuing year: *President*, Dr. H. Levinstein; *Vice-Presidents*, Prof. W. L. Bragg, Prof. H. B. Dixon, Mr. E. A. Eason, Dr. R. S. Willows; *Secretaries*, Mr. John Allan, Prof. W. H. Lang; *Treasurer*, Mr. R. H. Clayton; *Librarians*, Mr. C. L. Barnes, Dr. Wilfrid Robinson; *Curator*, Mr. W. W. Haldane Gee.

IT is expected that the *Proceedings of the Optical Convention* will be published not later than August 1 next, and that they will therefore be available during the meeting of the British Association at Oxford. Owing to the large number of papers read at the Convention, and the consequent size of the Proceedings, it has been found necessary to increase the price, which is now fixed at 30*s.*, plus 9*d.* postage, instead of 25*s.* as previously announced. Orders should be addressed to the Secretary, The Optical Convention, 1926, 1 Lowther Gardens, Exhibition Road, London, S.W.7.

AN exhibition of Tardenoisian and pygmy types of stone implements is being held (June 8-22) at the Royal Anthropological Institute, 52 Upper Bedford Place. The exhibits will form a very fairly representative collection of the microlithic industry such as, we understand, has not hitherto been gathered together. Specimens will be included from Northumberland, Yorkshire, East Anglia, the south of England, Cornwall, Somersetshire, and Wales, France, the Fayum, Mesopotamia, East Africa, India, and Sydney, N.S.W. The exhibition is open to all fellows of the Institute; those who are not members may obtain admission on presentation of a visiting-card.

ACCORDING to a statement of the Berlin correspondent of the *Times* in the issue of June 3, a public Marriage Advice Bureau has been opened in Berlin under municipal auspices and with the support of the Prussian Minister of Social Welfare. It will conduct free medical examination of those about to marry. Advice will be given in those cases where hereditary or acquired disease seems to make postponement or renunciation of marriage advisable. The services of the Bureau are to be available also for those already married.

THE Council of the Institution of Electrical Engineers has made the following award of premiums for papers read during the session 1925–26, or accepted for publication: The Institution Premium to Mr. L. C. Grant; Ayrton Premium to Mr. S. Mavor; Fahie Premium to Messrs. B. S. Cohen, A. J. Aldridge, and W. West; John Hopkinson Premium to Mr. S. Ferguson; Kelvin Premium to Mr. P. Dunsheath; Paris Premium to Mr. T. Carter; Extra Premiums to Prof. S. P. Smith, Messrs. J. L. Thompson and H. Walmsley, Dr. A. B. Wood; Wireless Premiums to Messrs. R. A. Watson-Watt and J. F. Herd, Mr. J. Hollingworth, Dr. R. L. Smith-Rose, and Mr. R. H. Barfield.

THE Wellcome Historical Medical Museum, 54A Wigmore St., London, W.1, which has been temporarily closed for alteration and reorganisation, was partially re-opened on June 1. The work of reorganisation is still proceeding, and when completed the arrangement and classification of the collections will be systematised, and the objects made more accessible for inspection and study. The Museum is open to members of the medical profession and research workers generally from 9 A.M. to 6 P.M. on week days, except Saturdays, when the Museum is closed at 1 P.M.

AT the recent annual meeting of the Iron and Steel Institute, the following awards of Carnegie scholarships were announced: Mr. F. H. Arnfelt (Stockholm), 100*l.*, for research on iron aluminium alloys; Mr. V. N. Krivobok (Pittsburg), 100*l.*, for a study of recrystallisation of metals after cold-working; Mr. A. G. Lobley and Mr. C. L. Betts (Great Britain), 100*l.*, for an investigation on the viscosity of iron and steel at high temperatures; Mr. A. R. Page, 100*l.*, to enable him to carry out research on the hardening and tempering of high-speed steels; Mr. Tibor Ver (Budapest), 100*l.*, to study the effect of alternating stresses on the structure and mechanical properties of metals; Mr. L. B. Pfeil (Swansea), 100*l.*, to continue his investigation on the growth and properties of single iron crystals; and Mr.

J. H. Partridge (Birmingham), who received 100*l.* in 1925 in aid of a research on the electrical and magnetic properties of cast iron, a further award of 50*l.* to enable him to continue the investigation.

THE Council of the Institution of Civil Engineers has made the following awards in respect of papers read and discussed at the ordinary meetings during the session 1925–1926:—A Telford Gold Medal to Mr. O. L. Prowde (Makwar, Sudan); a Watt Gold Medal to Mr. H. R. Lupton (Leeds); Telford Premiums to Messrs. A. S. Angwin and T. Walmsley (London), V. Bayley (London), C. F. Bengough (Tewkesbury), A. Honeysett (London), J. N. Reeson (Melbourne, Victoria), and H. A. Reed (Manchester); and a Crampton Prize to Colonel G. R. Hearn (Calcutta). The Council has also awarded the Coopers Hill War Memorial Prize for 1925 (consisting of a bronze medal, parchment certificate, and a sum of money) to Mr. E. L. Everatt (Bombay). This prize was founded by the Coopers Hill Society in memory of Coopers Hill men who lost their lives in the War.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer and demonstrator in the department of Zoology of the East London College—The Registrar, East London College, Mile End Road, E.1 (June 16). An assistant lecturer in mathematics at King's College, Strand—The Secretary (June 23). Lecturers in physics and chemistry in the University of Durham—Head of the Department of Pure Science, South Road, Durham (June 26). An assistant for technical records work at the Building Research Station of the Department of Scientific and Industrial Research—The Director, Building Research Station, Garston, nr. Watford (June 26). A principal of the Pibwrylwyd Farm Institute of the Carmarthenshire Agricultural Committee—J. W. Nicholas, County Offices, Carmarthen (June 26). A lecturer in mathematics at University College, Southampton—The Registrar (June 29). An assistant lecturer in chemistry at the Liverpool Central Municipal Technical School—The Director of Education, 14 Sir Thomas Street, Liverpool (July 5). A keeper of the Department of Zoology of the National Museum of Wales—The Director, National Museum of Wales, Cardiff (July 9). A junior scientific assistant for Admiralty Research—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1. A woman resident lecturer in agricultural chemistry and botany at Studley College, Warwickshire—The Principal. An entomologist and research workers able to undertake independent inquiries on malaria, in the field or laboratory—The Secretary, Indian Research Fund Association, Simla, India. A teacher of mathematics and physics at the Wandsworth Technical Institute—The Principal.

Our Astronomical Column.

WOLF'S NOVA OF OCTOBER 1925.—Dr. W. H. Steavenson noted, at the meeting of the British Astronomical Association on May 26, that this object in Aquila increased slightly in brightness during the last two months of 1925, attaining mag. 8·7. Recent observations show that it is still of mag. 9, so that the decline is very slight. He suggested that the object is not a Nova but a normal star which has hitherto been hidden by a nebulous cloud from which it has just emerged. Its behaviour is so unusual that it deserves careful watching. Plates taken a few years ago show no trace of it, though they include stars of mag. 15.

COLOUR STUDIES OF VARIABLE STARS.—*Astr. Nach.* No. 5440 contains a study of certain variables by J. Hopmann; the colour index and bolometric magnitude were deduced at various stages of the light curve. Mira Ceti, when near minimum, became so red that it went beyond the limits of the comparison stars, and only estimates were possible. The last maximum of light occurred 1925, Dec. 7±2d, about 17 days later than the predicted date. The effective temperature of the star was then found to be 3470° as compared with 3780° at the maximum 11 months earlier. The star was, however, brighter last December than in the previous maximum: visual magnitude 3·20 compared with 3·61; bolometric magnitude 2·92 compared with 3·24. In the case of ζ Geminorum the range of bolometric magnitude is shown to be very much smaller than that of visual magnitude; in fact, the measures as they stand indicate an actual reversal of the curve, but this is not regarded as proved.

PARALLAX SURVEY OF KAPTEYN'S SELECTED AREAS.—Publications of Yerkes Observatory, vol. 4, part 4, contains a photographic determination of parallaxes in these areas (zone +45°) by Mr. Oliver J. Lee. The plan of wholesale photographic parallaxes was suggested by Kapteyn but has not met with general approval. The large scale of the 40-inch refractor is obviously an advantage in this research. Three hundred and ten photographic plates were used, all but nine being taken with a colour-filter; these nine were used mainly for proper motions. The parallax determinations are necessarily only relative. Ten or twenty stars were selected on each plate as standards: they were the faintest stars that had crisp, firm images (average magnitude 12·64), and a preliminary solution showed that they had very little proper motion, so they were presumably distant. The separate parallaxes and proper motions of 1041 stars are printed. The largest parallax is 0·113″ for a star of mag. 12·8 and proper motion 0·035″. About 3 per cent. of the stars have parallaxes so large as 0·06″. As one will expect, there are a large number of negative parallaxes. The effect of magnitude error is discussed and concluded to be small; a few of the plates were taken with a developed negative of the field used as a screen (a plan suggested by Kapteyn, which gives nearly equal magnitudes to all stars), but difficulties were found in working it.

The reduction of the relative parallaxes to absolute ones needs more absolute proper motions than are at present available in the region. Prof. Comstock, in a note included in the article, considers that the relative proper motions deduced need on the average a correction of about 1″ per century to reduce to the system of Boss.

Diagrams of the distribution of proper motions in the different areas are given; some of these, but not all, appear to conform to the two-drift configuration.

The author finally deduces the probable error of a proper motion as ±0·007″ and of a parallax as ±0·020″. He states that his results support the relative nearness of the galaxy in the region of R.A. 21″.

Research Items.

TEETH AND JAWS OF THE AUSTRALIAN ABORIGINES.—Anthropologists have long stood in need of data relating to the teeth and jaws of a primitive human race. This want has now been supplied by the publication, on the part of the University of Adelaide, of a thesis submitted to it by Dr. T. D. Campbell for the degree of Doctor of Dental Science ("Dentition and Palate of the Australian Aboriginal," The Hassell Press, 1925). Dr. Campbell's monograph is founded on a systematic examination of 630 dentitions collected from all regions of Australia, and representing every stage in the growth, eruption and wear of aboriginal teeth. The measurements of teeth and palate which are supplied by Dr. Campbell will prove of the utmost utility, and many of his observations are of high interest. In form and size of crown, in the number and arrangement of cusps, and in the development of roots, the teeth of the aborigines are "exceedingly primitive, probably more so than in any other living race and also than in some extinct races, such as Tasmanian and Neanderthal man." Large as are the dimensions of the molar teeth of Pithecanthropus (the Java man), Dr. Campbell met with examples in his series which outdid them. Particularly interesting to students of the teeth of fossil races of mankind are his observations on the filling up of the pulp cavity as a reaction to the wear of the crown—a reaction seldom seen in the teeth of civilised races. Campbell found that even amongst the aborigines the third molar teeth are the most variable, but whereas he had to examine nearly 200 skulls to find a single instance in which a third molar was absent, an English dentist would have to examine no more than five mouths to find a similar number. On the other hand, an English dentist would have to search 500 patients or more to find a fourth or supernumerary molar, whereas Dr. Campbell found seven or more instances in a similar number of Australian aborigines. We have touched only on a few of the important and novel observations made by Dr. Campbell.

NEOLITHIC REMAINS IN LIGURIA.—In *Man* for May, Mrs. J. W. Crowfoot gives an account of some excavations carried out by her in the cave known as the Grotte de Bertrand in the Taggia Valley, near San Remo, in 1907-9. The cave proper is 33 ft. long by about 12 ft. with a bottle-neck entrance 8 ft. 4 in. in length by 1 ft. 7 in. in width and 1 ft. 8 in. in height. It is 4 ft. high in the centre. The objects found included worked flints—a lunate arrow-point, and an arrow or javelin head, thick and roughly worked, with stem but no barbs—a needle-like pendant of bone, possibly made from a boar's tusk, six other bone pendants, also probably of boar's tusk, and five bone points, a number of shells of *Helix Nicaensis*, human skeletal remains of at least ten individuals, some showing primitive characters such as large teeth, heavy os calcis, perforation of the humerus, platycnemia, etc. Nearly all the long bones and portions of the skulls were poked under the rock at the side of the cave and piled one upon top of the other, so that they could not be in the original position of interment. Three hundred beads of five different types were found, including the winged type sometimes thought to be phallic. Beads alternating grey and white were strung into a necklace identical with some in the museum at Toulouse. The human remains have been pronounced neolithic. Both Prof. Issel and Prof. Cartailhac, to whom the results were communicated, were of the opinion that the culture of the cave belonged to the late Neolithic period.

FRESH-WATER AMPHIPODA.—Hermann Spandl (*Sitzungsber. Akad. der Wissensch.*, Wien, Abt. I. Bd. 133, Heft 9, 1924) gives a systematic survey of the fresh-water amphipods and discusses the methods—active and passive migration—by which marine animals have entered fresh water. He refers in some detail to the amphipods of Lake Baikal, and concludes that many of the genera found there can be traced back to a small number of ancestral genera; the amphipod fauna of Lake Baikal does not represent a relict fauna but has arisen by progressive differentiation in the lake itself. In the Caspian Sea, however, the fauna can be divided into two parts, one part of marine origin and the other a fresh-water fauna; the genera in each category are given, and the relationships of this fauna with that of the Arctic Sea and of the Baltic are discussed. A short account is given of the genera of amphipods found in subterranean waters and of the geographical distribution of fresh-water amphipods.

MORPHOLOGY OF FISHES.—Prof. F. H. Edgeworth (*Jour. Anat.*, vol. 60, pt. iii.) gives an account of his reinvestigation of the development of certain of the branchial muscles in the Selachii. In 1911 the author concluded that the coraco-branchiales muscles were developed from the ventral ends of all the branchial muscle plates and the cucullaris muscle from the upper ends of the same plates. This conclusion was disputed by Allis. Reinvestigation of the matter on new material has confirmed the author in his former conclusions. In the same number of the *Journal of Anatomy*, Mr. E. P. Allis contributes a paper on the homologies of the prechordal portion of the skull in the Holocephali, and concludes that the trabecular and polar cartilages of the skull are the pharyngeal elements of the mandibular and premandibular arches which have swung upwards and forwards, in connexion with the development of the mouth, into a position approximately parallel to the plane of the parachordals.

RESIN EXCRETION IN THE BUDS OF *ALNUS VIRIDIS*.—The development and micro-chemistry of the glandular hairs on the epidermis of the leaves and bud scales of Alnus have been studied by Friedrich Dormann (*Sitzungsber. Akad. der Wissensch.*, Wien, Abt. I. Bd. 133, pp. 585-612, 1924). Many of these glandular hairs never share in the excretion of resin. Under examination these are found to be full of spherical droplets which, from their micro-chemical reactions, would appear to be complex terpenes. These contents, which seem similar to those in the glandular structures of Betula and Populus, are probably connected with resin formation. They occur, however, not only in the glandular hairs in Alnus, but also generally distributed in epidermal cells of the young leaves, so that the epidermis probably shares in resin secretion. Dormann concludes that the membrane of the cells shares in the work of resin excretion so that to this extent the expression 'resinogenous layer' used by Tschirch may be justified, but there is no reason for thinking that this part of the membrane is alone responsible for the complicated chemical changes involved in the production of resin.

CAMPANULA MUTANTS.—A large tetraploid mutation from *Campanula persicifolia* was exhibited horticulturally in 1916 under the name "Telham Beauty." It appears to be identical with a form recorded as coming from South Carolina in 1791, and must have arisen independently. It is self-fertile, while the

species is self-sterile. Like similar tetraploids, Telham Beauty is stouter, has larger nuclei, and frequently more pores in the pollen grains. Its much larger flowers are, however, shallower in shape. It was crossed by Miss A. E. Gairdner (*Journal of Genetics*, vol. 16, No. 3) with *C. persicifolia* and with a dwarf form called *nitida* in which the flower has an almost superior ovary. Miss Gairdner finds that in the triploid F_1 (24 chromosomes) in diakinesis, univalent, bivalent and trivalent chromosomes occur. In the F_2 offspring various other chromosome numbers are obtained, one plant having 17, *i.e.* a single extra like many Œnotheras and Daturas, another being tetraploid (32 chromosomes). The hereditary behaviour of the latter indicates that the maternal chromosomes in the egg had been doubled. In the pollen formation of the tetraploid form, occasionally half of the heterotypic chromosomes split without separating, thus forming a tetraploid pollen nucleus.

DISCOVERY OF A DINOSAUR IN QUEENSLAND.—The remains of a large herbivorous dinosaur have been found in the Walloon series (Lower Jurassic) of Durham Downs in the Roma district of Queensland. They consist mainly of vertebræ with fragments of femur, tibia, fibula and pelvic bones, and are referred to a new genus, Rhœtosaurus, which is tentatively placed in the family Camarasauridæ of the Sauropoda. It is probable that Rhœtosaurus attained a length of more than 40 feet (H. A. Longman, *Mem. Queensland Museum*, 8, 3, 1926, p. 183, pls. 29-33).

AIR TEMPERATURE IN THE ARCTIC.—Six years in the Arctic have enabled Dr. H. U. Sverdrup to draw some valuable conclusions from his scientific observations with the Maud expedition. In an article in the *Scientific Monthly* for May on the results of the expedition, he points out that in winter the air temperature is always lower close to the ice than three hundred metres above it. The mean temperature at the ice is $-28{\cdot}4°$ C., with a fall to about 100 metres, then a rapid rise to about 300 metres, and then a slower rise to $-20{\cdot}3°$ C. at 1000 metres. On calm days the mean temperature at the surface averages about $-33°$ C. but corresponds with the mean at higher altitudes. The low surface temperatures are due to contact with the ice, which loses heat by radiation. Wind causes a mixing of the lower layers of the atmosphere on account of numerous eddies, and there is a decrease of temperature with altitude, but this clearly affects only the lower layers. At higher altitudes an inversion of temperature is the normal condition. Thus an explanation is offered of the phenomenon, previously noticed in polar regions, of a rise in temperature when the wind begins, independently of its direction. The minimum surface temperature is about $-45°$ C. because, though the ice loses heat by radiation, it is always gaining heat by conduction from the underlying sea, which retains a temperature of about $-1{\cdot}7°$ C.

THE CONSTITUTION OF MALTOSE.—Irregularities in the results obtained by workers on the constitution of the polysaccharides caused considerable suspicion to fall on the formula given to maltose by Haworth and Leitch, and evidence has been published by J. C. Irvine and J. M. A. Black in the *Journal of the Chemical Society* for April 1926, which disproves Haworth's formula and substitutes two others between which no discrimination has yet been made. In the same issue of the journal a paper by C. J. A. Cooper, W. N. Haworth and S. Peat appears, confirming Irvine's work but admitting Irvine's priority. The constitution of maltose given by Haworth was based on the formation of 2:3:4 trimethyl glucose, but Irvine, by exact repetition of the experiments, has shown that this product is 2:3:6 trimethyl glucose. The revision of the structure of maltose involves the constitutional formulæ given to the other di-saccharides and poly-saccharides based on glucose.

THE CONDUCTIVITY OF PURE SODIUM HYDROXIDE SOLUTIONS.—The mobility of the hydroxyl ion has been determined by H. R. Raikes, A. F. Yorke and F. K. Ewart from conductivity measurements of sodium hydroxide in very pure water. Preparation of the carbonate-free hydroxide was carried out by electrolysis of sodium chloride solution, using a carbon anode and an iron cathode. The values, which appear in the *Journal of the Chemical Society* for March 1926, obtained from Washburn's value for the mobility of the sodium ion, are 173·8 and 144·3 at 18° and 10° C. respectively.

MAGNETIC PROPERTIES OF PERMALLOY.—From a separate copy of a paper on permalloy by Messrs. O. E. Buckley and L. W. McKeehan which appeared in the August 1925 issue of the *Physical Review*, we are able to supplement the information as to the magnetic properties of this alloy which was given in a note in our issue of January 9, p. 65. Permalloy is the name given to a series of alloys of iron and nickel, containing from 45 per cent. to 80 per cent. nickel. These alloys all possess high permeability for low fields and reach saturation at fields of less than 10 gauss. They have been tested in the form of wires 0.1 cm. in diameter, 60 cm. long in a solenoid nearly as long, by reversal of the field and measurement of the induction through a search coil wound over the middle of each wire and in series with a ballistic galvanometer. The 81 per cent. nickel permalloy reaches saturation at 4 gauss, when its intensity of magnetisation is a little more than 800, and at 1 gauss it has reached 700. The hysteresis loss per c.c. per cycle at induction 8300 is only 350 ergs, and is only half that amount for the permalloy with 78.5 per cent. nickel. When these wires are subjected to tension, saturation is reached within 5 per cent. for fields so low as 0·1 gauss and the hysteresis loss per c.c. per cycle reduced to 80 ergs.

TRANSMISSION FORMULA FOR RADIOTELEGRAPHY.—Mr. L. W. Austin has published in the *Journal of the Washington Academy of Sciences* for April 19 a preliminary note on proposed changes in the constants of the Austin-Cohen transmission formula used in radiotelegraphy. The formula has for the last twelve years been known to give satisfactory results for distances up to hundreds of kilometres and for rays of medium wave-length. At distances, however, of 6000 kilometres, the computed results are only about half those observed, and at 12,000 kilometres only about one-quarter of their true values. The author has made a close study of the numerous trans-Atlantic observations made by various observers during recent years. He finds it difficult to reconcile some of these observations. In some cases the waves have passed over water all the way, in others they have passed over more land than water. The shortest great circle from Nauen to Washington is twenty-five per cent. land, but from India to the European stations nearly the whole path is over land. It is generally agreed that land attenuation is much greater than that over water. Nevertheless, by slightly altering the empirical factor of the formula and leaving the theoretical part due to Hertz alone, Mr. Austin obtains a formula which predicts with quite satisfactory accuracy the field intensities at distances ranging from 6000 to 12,000 kilometres. In a further paper he proposes to discuss the results the formula gives in all the available cases.

Visitation of the Royal Observatory, Greenwich.

THE annual visitation of the Royal Observatory, Greenwich, by the Board of Visitors, took place on Saturday, June 5, when the Astronomer Royal presented his report, which deals with the year ended on May 10, 1926. It commences with an allusion to the 250th anniversary of the foundation of the Observatory, which was celebrated last July; the King and Queen honoured the Observatory by their presence; the King presented a signed portrait of himself, which has been hung in the Octagon Room. Many foreign astronomers, who had come to England for the meeting of the International Astronomical Union at Cambridge, were also present.

The historic instruments in the Transit Circle Room were renovated for the occasion of the visitation, and it became possible to examine their beautiful graduation, which had been obscured for a long time. The standard sidereal clock is now kept in the cellar under the Octagon Room; this has been lined with cement, but is still damp; the clock being in an airtight case, this is not important.

The transit circle was used during the past year, as before, for observations of the sun, moon, planets and fundamental stars, also of stars brighter than mag. 8·0 in the zone from decl. +32° to +64°. The numbers of observations in right ascension and declination were about 10,000 each. The sun was observed on 136 days, the moon on 97. The corrections to Brown's "Tables of the Moon" for the years 1923, 1924, 1925 are: longitude +7·12″, +7·11″, +6·74″; latitude −0·55″, −0·76″, −0·84″. As regards the latitude, it will be remembered that Brown removed the constant term 1·00″ applied by Hansen; the observations indicate the need for a constant term of somewhat smaller size.

The division errors of the work transit circle were re-determined, the former values being confirmed. Observation is now beginning of 430 of the stars selected as comparison stars for Eros at the near approach in January 1931. Observations of fundamental stars with the altazimuth in the prime vertical have been continued. The results indicate that Boss's declinations between +11° and +50° need a nearly constant correction of +0·33″, agreeing closely with Raymond's result in *Astron. Journ.*, No. 857.

Work on double stars has been continued with the 28-inch equatorial; a catalogue of 400 stars has been prepared for press. 834 stellar parallax plates were taken with the Thompson 26-inch equatorial. 316 parallaxes have now been determined with this instrument, and a volume containing the first 266 of these has been published.

The 30-inch reflector is being used to study stellar temperatures of types B and A, by photographing spectra with a prism crossed by a grating. Stellar temperatures have also been compared with that of the positive pole of a carbon arc. A paper on the effective wave-lengths of stars between decl. +80° and +90° was published in *Mon. Not. Roy. Astron. Soc.* last November.

The astrographic equatorial is being used for the determination of proper motions, by repeating plates taken twenty-five to thirty years ago. In 700 square degrees, 194 stars have been found with centennial proper motion greater than 20″; 86 of these are fainter than the B.D. limit, 9·5 mag.; 17 of the 86 have centennial proper motion greater than 30″.

The sun was photographed on 251 days, the series for the year being completed by the co-operating observatories. Solar activity was great from October until March, there being twelve naked-eye sunspot groups. The magnetic disturbances of January 26, February 23, March 5, were associated with two of these groups; that of April 14-15 occurred when a spot that had been visible to the naked eye in December, January, February was near the central meridian. Magnetic observations have been made at Greenwich for the last few years merely with the object of establishing the mean differences of the readings from those made at Abinger. The recent electrification of the New Cross—Lewisham railway line has rendered the Greenwich observations nearly valueless, and they will be discontinued when the still closer line through Greenwich and Maze Hill is electrified in July. The following table gives the magnetic elements at Greenwich in recent years, those for 1925 being provisional, also the mean difference Abinger *minus* Greenwich:

Year.	Dec. W.	Hor. Force. (c.g.s. units.)	Vert. Force. (c.g.s. units.)	Dip.
1921	13° 57·6′	0·18449	0·43218	66° 53·0′
1922	13 46·7	0·18447	0·43176	66 52·3
1923	13 35·1	0·18431	0·43137	66 51·9
1924	13 22·8	0·18426	0·43112	66 51·6
1925	13 10·0	0·18413	0·43081	66 51·5
Abinger *minus* Greenwich—				
	+12·8′	+0·00183	−0·00132	−16·2′

Magnetic disturbances at Abinger are, on the average, 2 per cent. smaller than at Greenwich, while those at Stonyhurst are 20 per cent. greater.

Standardisation and certification of magnetometers has been carried out in recent years at Greenwich, but will in future be done at Abinger. A. Schuster Smith magnetometer was brought into use at Abinger on May 1, and will be used to determine the horizontal force.

The following weather details refer to the year ended April 30, 1926. The mean temperature was 50·4°, which is 0·9° above the average. The extremes were 89·5° (July 22) and 16·0° (January 16). September was 3·4° below normal, February 5·8° above it. The mean daily movement of air was 275 miles, which is 9 below normal. The extremes were 741 miles (December 29) and 65 miles (October 6). The duration of bright sunshine was 1312 hours, or 29·5 per cent. of possible. The rainfall was 24·88 inches, which is 0·64 above the average. The wettest month was April, with 3·87 inches; the only wetter April was in 1878, with 4·31 inches. June and March were both absolute records for dryness, with 0·12 and 0·14 inches.

Wireless time signals from Paris (Eiffel Tower), Nauen, Bordeaux and Annapolis are recorded regularly on a syphon recorder. After applying all known corrections they are late on Greenwich by the following amounts respectively: 0·11 s., 0·05 s., 0·09 s., 0·06 s.

Mr. Davidson was absent from the Observatory from November 11 until April 1 for the observation of the total solar eclipse of January 14 in Sumatra. Very successful photographs were obtained. Mr. G. Merton has continued his researches on cometary orbits; he also assists in the stellar parallax observations. Dr. W. H. Steavenson has made some observations of variable stars with the 28-inch equatorial. M.M. Beljaieff and Dnieprovsky made a re-determination of the longitude Greenwich-Pulkovo. The reduction of the observations is not yet complete. Dr. Lundmark, of Upsala, assisted Mr. Melotte in drawing up a list of vacant areas in the sky, from the Franklin-Adams charts.

The short free-pendulum clock has performed very satisfactorily. The rate is increasing by 0·011 s. per day per month. A second clock of the same kind is now being erected.

The Italian Chemical Congress at Palermo and the Cannizzaro Centenary.

THE second Italian National Congress of pure and applied chemistry was held at Palermo, Sicily, on May 22-June 1, simultaneously with the centenary celebrations of the Sicilian chemist Stanislao Cannizzaro, who was born in Palermo in 1826. A monument was unveiled to his memory, and the Italian Chemical Society is publishing a book describing the main features of his life and work. Sir William Tilden, who delivered the Cannizzaro Memorial Lecture to the Chemical Society, summed up Cannizzaro's contributions to chemistry very broadly under the two following heads: "First, he laid down for all time the two principal methods by which atomic weights are determined, the one by reference to the molecular weights derived from an application of Avogadro's rule, and the other by an adoption of the principle discovered by Dulong and Petit as to the general relation of atomic weight to specific heat among the solid elements, and he showed that these two methods when applicable to the same case lead to the same results. Secondly, he placed inorganic chemistry in a new light by applying to inorganic compounds the same principles which had been applied to organic compounds, and thus finally disposed of the superstition which had hovered so long in the minds of chemists that organic chemistry was subject to laws different from those prevailing among mineral substances."

No better place could have been found than Palermo for the centenary celebrations. Not only was Cannizzaro born there, but also for ten years he held the chair of organic and inorganic chemistry at that University, refusing chairs at both Pisa and Naples in order to take it. He only left it to take the highest post in chemistry that Italy could bestow, the chair at Rome. During the Sicilian revolution in 1847 he left his studies under Piria to serve as an artillery officer in the Sicilian army, and handled his battery so well at Messina that he was sent to Taormina to oppose the Neapolitan troops. The final defeat of the Sicilian troops in 1849 made him a fugitive, and he finally made his way to Chevreul's laboratory in Paris, where he stayed until recalled to Italy in 1851 as professor at the National School at Alessandria, going four years later to Genoa, whence he published in 1858 his famous "Sunto di un Corso di Filosofia Chimica." In 1860 he again took arms, this time under Garibaldi, but without seeing any active warfare. From 1861 until 1871 he held the chair at Palermo, and from there he went to Rome, being at the same time made a Senator of the kingdom. From then until his death, in 1910, his life was full and varied, and honours, both civil and scientific, were showered on him.

Besides the reading of numerous papers in various branches of chemistry, an interesting programme of sight-seeing in Sicily had been arranged for those who attended the Congress, and a wide field of historical and scientific interest was covered, amid some of the most magnificent scenery of southern Europe. The itinerary included a visit to Mondello, near Palermo, to inspect the works of the Societa Gen. Elettrica della Sicilia on May 25; to the Arenella Chemical Works on May 26; to the sulphur mines of Cozzi Disi, near Girgenti, and the Campfranco works of the Montecatini firm on May 28; to the asphalt deposits of Ragusa on May 29; to the Magnisi salt mines on May 30; to the sulphur mines and other places of interest near Catania—including Mt. Etna—on May 31; and finally to Messina on June 1.

University and Educational Intelligence.

BIRMINGHAM.—The following gifts have recently been announced: 50*l.* towards the expenses of the new Fuel Treatment Laboratory, by the Bromford Tube Co., Ltd.; mounted illustrations for use in the Botanical Department, by Mrs. Wilson King; pair of telephones, shown at the Paris Exhibition in 1878, by Mr. J. C. Vaudrey; two alternators, for use in the Electrical Engineering Laboratory, by Mr. W. F. Higgs.

CAMBRIDGE.—The late Dr. J. E. Bles has left to the University an immediate gift of his scientific apparatus and books and the contents of his private library and (subject to his wife's life interest) the entire residue of his estate. The latter benefaction is expressly for the purpose of founding a professorship, preferably in animal embryology.

A readership in ethnology is being established, the present post, a personal appointment for Dr. A. C. Haddon, terminating on his retirement at the end of the present term.

LEEDS.—Applications are invited, until June 19, for the open fellowship, value 200*l.*, of the Institution of Gas Engineers for the prosecution of post-graduate research in gas chemistry. Particulars are obtainable from the Registrar of the University.

DR. E. A. OWEN, head of the Radiology Division of the National Physical Laboratory, Teddington, has been appointed to the chair of physics at the University College of North Wales, Bangor.

LEPLAY HOUSE August Vacation Courses include this year visits to Dinant and the valley of the Meuse; Rochefort and the Belgian Ardennes; Irish Lake District; and Bagnères-de-Bigorre, in the High Pyrenees. These visits are open to all students and others interested in the study of geography, geology, plant life, history, and sociology. Particulars can be obtained from Miss Margaret E. Tatton, Leplay House, 65 Belgrave Road, Westminster, S.W.1.

THE annual report on the work of the University of London presented on May 12 by the Principal Officer, Sir Cooper Perry, who is about to retire, shows a slight decrease, from 7603 to 7577, in the total number of admissions and an increase from 31,623 to 32,353 in the number of candidates for all examinations. Of 3819 candidates for degrees, 2301 were internal and 1518 were external students; the number of internal students increased from 9002 to 9323. Specially noteworthy among the private benefactions mentioned in the report is the gift of 20,000*l.* by Sir Daniel Stevenson for the establishment of a part-time chair of international history and for the development of a department dealing with that subject. Other private benefactions to the University amounted to about 55,000*l.* and the London School of Economics received more than 30,000*l.* from the Laura Spelman Rockefeller trustees. The progress of the movement for broadening the bases of university education is exemplified by the new regulations adding music and law as optional subjects to various examinations. The holiday course for foreigners held last summer attracted more applications for admission than any of its seventeen predecessors, and more than 200 had to be refused, which seems a pity. Those admitted numbered 256, representing 22 nationalities. The courses in journalism are increasingly sought after; the number of students increased from 53 in 1924–25 to 74 in 1925–26. The scheme of advisory service for external students introduced experimentally last year proved effective.

Contemporary Birthdays.

June 12, 1851. Sir Oliver Joseph Lodge, F.R.S.
June 12, 1858. Sir H. H. Johnston, G.C.M.G., K.C.B.
June 13, 1854. Hon. Sir Charles Algernon Parsons, K.C.B., F.R.S.
June 13, 1870. M. Jules Bordet, For. Mem. R.S.
June 14, 1857. Prof. John Edward Marr, F.R.S.
June 15, 1851. Prof. E. H. Griffiths, F.R.S.
June 17, 1860. Prof. William Henry Perkin, F.R.S.
June 18, 1858. Prof. A. R. Forsyth, F.R.S.

Sir OLIVER LODGE, born at Penkhull, Staffordshire, was educated at Newport (Salop) Grammar School, and University College, London. From 1900 to 1919 he was principal of the University of Birmingham. In 1898 he was awarded the Royal Society's Rumford medal, and it was remarked then that in dealing with Hertz's discovery of electro-magnetic radiation it was requisite to recall the work done previously, or simultaneously, by Lodge on the surging or oscillatory character of the transmission of electric discharges along wires. Sir Oliver was president of the Society for Psychical Research, 1901–4.

Sir CHARLES PARSONS, inventor of the steam turbine, a son of the third Earl of Rosse (president of the Royal Society from 1848 until 1854), was born in London. Following private tuition, he graduated at St. John's College, Cambridge. An apprentice for a number of years in Armstrong's Elswick Works, he afterwards served on the experimental staff of Messrs. Kitson and Co., Leeds, leaving to enter into partnership (lasting from 1884 to 1889) with Messrs. Clarke, Chapman, and Co., Gateshead. Sir Charles has been for many years actively concerned with various electrical and engineering undertakings; among these should be mentioned the onerous post of chairman (since 1908) of the Parsons Marine Steam Turbine Co., Ltd. Awarded, in 1902, the Royal Society's Rumford medal for his success in the application of the steam turbine to industrial purposes, and to navigational uses, Sir Charles received, later, in similar recognition, the Albert medal of the Royal Society of Arts. Sir Charles was president of the British Association at the Bournemouth meeting, held in 1919. Guided by a native discretionary sense, many worthy scientific schemes have received encouragement from time to time through his beneficence.

M. JULES BORDET, foreign member of the Royal Society, was born at Soignies, Belgium. Attached to the Pasteur Institute, Paris, from 1894 to 1901, he left to become director of the Pasteur Institute, Brussels, whilst from 1907 he has been professor of bacteriology in the university of Brussels. Prof. Bordet was Nobel laureate in 1919 in the physiology and medicine section.

Prof. PERKIN, born at Sudbury, was educated at the City of London School and various foreign universities. Awarded the Royal Society's Davy medal in 1904, for his "masterly and fruitful researches in the domain of synthetic organic chemistry," this was followed last year by the distinction of a Royal medal, in recognition of his more recent contributions to chemical science.

Prof. FORSYTH is a native of Glasgow. He was educated at Liverpool College and Trinity College, Cambridge, where he was senior wrangler and first Smith's prizeman. Formerly Sadleirian professor of pure mathematics in the University of Cambridge, he was, until recently, chief professor of mathematics in the Imperial College of Science and Technology, South Kensington. Prof. Forsyth is a Royal medallist of the Royal Society.

Societies and Academies.

LONDON.

Royal Society, June 3.—A. E. H. **Tutton**: The alkali perchlorates, and a new principle concerning the measurement of space-lattice cells. The crystallographic character and optical properties of the perchlorates of potassium, rubidium, cæsium and ammonium have been investigated. The crystal angles and goniometrical constants are progressive in the order of the atomic numbers of the alkali metals, the average change for the replacement of potassium by cæsium being double as much as occurs when rubidium replaces potassium. Optical properties and the sizes, both relative and absolute, of the unit-cells of the space-lattice also show the progression with atomic number of alkali metal very clearly. The absolute dimensions of the cells have been found by a new principle. In an isomorphous series based on similar structure, if one member crystallises well and can be thoroughly investigated by X-rays and the cell dimensions determined in Ångström units, the cell dimensions of all the other members can be calculated. The case of the perchlorates and barytes group affords the first, and an excellent, example. The structure and cell-dimensions of barytes are known with certitude. The cell-dimensions of the minute crystals of the isomorphous perchlorates of the alkalies have been calculated from their topic axial ratios and the barytes data. In one case a critical test has been possible, that of potassium perchlorate, X-ray analysis of which has been just adequate to afford the cell-dimensions; and these have proved to be practically identical with those calculated on the new principle.—T. E. **Stanton**: On the flow of gases at high speeds. An experimental investigation was undertaken on the nature of the flow of a gas through orifices and nozzles at speeds in the neighbourhood of and exceeding the velocity of sound. The prediction of Osborne Reynolds that a minimum section of the jet would exist at that point in it at which the theoretical critical pressure p_0 obtains has been fully verified. The magnitude of the minimum section and its position relative to the throat of the orifice or nozzle depend on the value of the receiver pressure. The conditions for dynamical similarity in jets from geometrically similar nozzles and orifices at speeds above the velocity of sound depend on the viscosity of the gas and not solely on the ratio of the speed to that of sound. A reliable method of measuring the velocity at a point in a jet moving at speeds above the velocity of sound has been developed from the relation, determined by the late Lord Rayleigh, between the pressure in front of a fixed obstacle in the jet and the pressure of the jet. The flow throughout the jet except in the neighbourhood of the walls of the nozzle is sensibly adiabatic.—G. I. **Taylor** and W. S. **Farran**: The distortion of crystals of aluminium under compression (Pt. I.). A disc cut from a crystal of aluminium can be compressed in such a way that the distortion is uniform throughout the material. In these circumstances the distortion is of the same nature as that which occurs when a uniform single-crystal bar of aluminium is stretched, *i.e.* it is due to slipping parallel to a certain crystal plane and in a certain crystallographic direction. The sign of the component of force normal to the plane of slip appears to make no difference to the nature of the slip.—E. V. **Appleton**, R. A. Watson **Watt** and J. F. **Herd**: On the nature of atmospherics (II.). The method now involves the use of a cathode ray oscillograph with a time-base, which is both uniform in scale and unambiguous as to time-sense. Statistical analyses of approximately 8000 individual drawings of atmospheric wave forms show

that sensibly aperiodic discharges were three times as numerous as were quasiperiodics; predominantly positive discharges were one and a half times as numerous as were negatives. The mean quasiperiodic had a peak field strength of 0·159 V/m, the aperiodic 0·075 V/m. The negative discharges of both types were stronger by 20 per cent. to 30 per cent. than the positives. The mean quasiperiodic had a duration 3125 μs, 30 per cent. greater than that of the mean aperiodic. The most frequently occurring form of atmospheric was a symmetrical rounded positive aperiodic, forming 14 per cent. of the whole distribution. The most frequent quasiperiodic, forming $7\frac{1}{2}$ per cent. of the distribution, had a peaked positive half-cycle followed by a single rounded negative half-cycle. The experiments on atmospheric waveforms have been supplemented by observations on the net changes of the earth's electric field, resulting from lightning discharges. These observations at Aldershot, Cambridge, Helwan and Khartoum show that, at distances greater than 50 km. from the discharge channel, negative changes of field are at least 1·6 times as frequent as are positive changes. Since the field-changes at such distances may be taken as indicative of the sign of the thundercloud moment destroyed by the flash, it is concluded that lightning flashes resulting in the destruction of positive electric moments are at least 1·6 times as frequent as are those of opposite character.—C. H. **Lees**: On the determination of the specific heats of gases at constant pressure and at constant volume, and their ratio by adiabatic expansion. The specific heats of gases or the ratio of them cannot be determined to an accuracy of 1 part in 2000 or in 15,000 respectively unless either the temperature is determined to less than 0·01° C. or the adiabatic fall of temperature is increased above the 6° or 7° C. now used. If the latter course is adopted, the effect of the change of specific heat with temperature may be rendered negligible by taking the result calculated from the observations holding at the geometric mean of the initial and final temperatures of the expansion. Neglect of the deviation of the gas used from the perfect gas equation $pv = RT$ introduces an error of 1 part in 2000 in the value of the specific heat, calculated from observations at atmospheric temperatures with the usual expansion, if the deviation is only about one-fifteenth of that of carbon dioxide. The choice of characteristic equation for the gas introduces differences of the order 1 part in 400 in the value of the ratio of the specific heats calculated.—T. G. **Room**: A general configuration in space of any number of dimensions analogous to the double-six of lines in ordinary space. In space of three dimensions, it is possible to have two sixes of lines, of which every line of one six meets all but one line of the other six. Thirty-six such double sixes can be chosen from the lines existing on a general cubic surface. In space of n dimensions it is possible to have a set of $\frac{1}{2}n(n+1)$ lines, and a set of the same number of $(n-2)$ folds, corresponding to the lines in a like manner, as regards their intersections. It is now shown that in space of n dimensions it is possible, for any value of r less than n, to have a number of r-folds, and an equal number of $(n-r-1)$ folds, with the like property of intersection of corresponding elements. In the case of the double six of lines in ordinary space, there exists a quadric in regard to which the lines of one six are the polars of the lines of the other six. It is now shown that, except for the case when one set of elements consists of points, there exists no such reciprocating quadric in space of more than three dimensions. The existence of such a double set of corresponding elements is, however, not limited to the case when these are of dual character, such as a point and an $(n-1)$-fold, a line and an $(n-2)$-fold, and so on. In this paper a much more general theorem, establishing a double figure of elements with a like property of intersection, is obtained.—C. N. **Hinshelwood** and W. K. **Hutchison**: A comparison between unimolecular and bimolecular gaseous reactions. The thermal decomposition of gaseous acetaldehyde. The thermal decomposition of acetaldehyde in the gaseous state has been investigated over the temperature range 430°-592° C. The reaction is bimolecular, and under the conditions of the experiments, practically entirely homogeneous. The rate of reaction can be calculated from the equation

$$k = 5\cdot5 \times 10^{10}\sqrt{T}\,.\,e^{-45,500/RT},$$

k being expressed in gram molecules per litre per second. The contrast between this reaction and the chemically very similar decomposition of acetone is illuminating. The latter reaction, being unimolecular, is not necessarily dependent on collisions, and the number of molecules transformed in unit time is 10^5 times greater than the number which could receive the heat of activation from collisions. In the bimolecular decomposition of acetaldehyde there is almost the exact relation between heat of activation, number of collisions, and rate of reaction, which the simplest theory predicts.—P. A. M. **Dirac**: (1) The elimination of the nodes in quantum mechanics. (2) Relativity quantum mechanics, with an application to Compton scattering. The quantum mechanics of Heisenberg are generalised to agree with relativity kinematics and dynamics. Each step in the generalisation is obtained by putting its classical analogue into a form that can be interpreted immediately on the quantum theory. The relativity quantum theory thus obtained requires that an atomic system shall recoil when it emits radiation in agreement with the light-quantum theory. Applied to the scattering of radiation by a free electron, the frequency of the scattered radiation and the recoil momentum of the electron are the same as those given by Compton's light-quantum theory, although the present theory is entirely a wave theory. The intensity of the scattered radiation is equal to its classical value reduced by the cube of the ratio by which the frequency is reduced, which is in good agreement with experiment.—A. **Fage** and L. J. **Jones**: On the drag of an aerofoil for two-dimensional flow. Prof. G. I. Taylor has shown, from considerations of momentum, that it should be possible to determine the drag of an aerofoil from the integral of the total-head losses in the wake at some distance behind the aerofoil. For two-dimensional flow this method gives satisfactory experimental results. In the neighbourhood of minimum drag the normal components of pressure around the aerofoil account for about 80 per cent. of the total drag; the contribution of the surface tractions is therefore about 20 per cent. The Prandtl method of predicting two-dimensional drag from force measurements on an aerofoil of finite span (span = 6 chords) is fairly trustworthy. Observations of pressure and velocity taken at some distance behind the aerofoil indicate that most of the total-head losses in the wake arise from the slowing-up of the air, and that the pressure does not differ appreciably from that in the surrounding stream.—F. W. **Carter**: On the action of a locomotive driving wheel. The relation between the tractive effort of a locomotive driving wheel and the surface strains in wheel and rail at points just ahead of the area of contact—a matter affecting the running qualities of the locomotive—is investigated. In general, the area of contact between wheel and rail is divisible into two portions, characterised by distinct conditions, namely, a certain initial portion in which there is no slipping

between contiguous wheel and rail surfaces, and a final portion in which the surfaces slip as the strains tend towards the values existing behind the contact. Treating the problem as two-dimensional, the conditions to be satisfied in the two portions of the contact area are indicated, and a solution obtained.

Geological Society, May 19.—Jane **Longstaff** (*née* **Donald**): A revision of the British Carboniferous Murchisoniidæ; with notes on their distribution, and descriptions of some new species. Six new species and one variety are figured and described, as well as five species recorded by L. G. De Koninck in Belgium, which, with one exception, had not been previously noted in the British Isles. Altogether fifty-two species and one variety have been recorded, which are referable to five other genera and sub-genera besides Murchisonia *sensu stricto*, the greater number belong to the genus Hypergonia. Seventeen species are common to Belgium, all of which are Viséan except three, two being Tournaisian and one Waulsortian. Scotland has the most species; and so far twenty appear to be peculiar to that country, nine to England and one to Ireland. The greater number of British species are of Dibunophyllum age, only eight being from lower and two from higher zones.—T. N. **George**: The Carboniferous Limestone (Avonian) succession of a portion of the North Crop of the South Wales Coalfield. A description is given of the lithological and faunal succession of the Avonian along some thirty miles of the North Crop between Kidwelly and Penwyllt (Tawe Valley). The Main Limestone is much attenuated, when compared with other areas, being about 500 to 600 feet thick. The Middle Dibunophyllum zone is represented by two facies, deposited in more or less separate areas. That seen near the Kidwelly district consists of standard limestones yielding a normal fauna, and is comparable with beds of the same horizon in Gower, Pembrokeshire, Bristol, etc. The other consists of impure sandy and cherty limestones, with some calcite-mudstones, and a fauna chiefly composed of molluscs and Productids. As this facies is traced eastwards towards Llandebie it becomes more normal. It is evident that throughout Avonian times the area was subject to periodic earth-movements.

PARIS.

Academy of Sciences, May 3.—S. **Winogradsky**: The diagnosis of the aptitude of the soil for fixing nitrogen. Two factors intervene in this diagnosis: the number of nitrifying organisms present and the fertility of the soil as measured by the growth of these organisms. The method of spontaneous cultures measures the latter, and the silico-gel plate method measures the concentration of the organisms. Full details of the method proposed for applying these two tests is given.—Jean **Tilho**: An aggravation of the danger of capture by the Niger of the principal affluents of the Tchad. It is known that the existence of Lake Tchad is threatened by the possibility of the capture of the Logone-Chari hydrographic system, its principal tributary, by the Benone, which flows into the Niger. This danger has been increased by the construction of a canal between Ham and Pogo. It is pointed out that if the Tchad area became dry, some 200,000 square kilometres of soil now producing cotton, maize, tobacco, etc., would become sterile. Precautionary measures for preventing this disaster are suggested.—Enea **Bortolotti**: The envelopment of surfaces and the transport of directions along a curve.—André **Weil**: Surfaces with negative curvature.—**Tzitzeica**: A new class of congruences.—Paul **Mentré**: Surfaces of which the network of projective deformation is a conjugated network of Koenigs.—J. **Ser**: An expression of the function $\xi(s)$ of Riemnena.—B. **Finzi**: Energy proof of the paradox of d'Alembert in viscous liquids.—R. **Moineau**: Aeroplane with turning wing system.—A. **Zimmern**: A new method of production of herepathite. A method of preparing large crystals of iodoquinine sulphate.—A. **Dauvillier**: Extension of the Röntgen ray spectrum towards the ultra-violet; the *K* spectrum of carbon. The grating was composed of a preparation of melissic acid on lead, which was found to give pure spectra with a reticular distance of 87 Å.U. Difficulties were met with in separating the soft X-rays from the light diffused by the anode and reflected from the grating, and details are given of the manner in which these difficulties were overcome. With a graphite cathode there was obtained an intense line 45·3 Å.U.: this is the $K\alpha_2$ line of carbon and constitutes the unique *K* radiation of this element.—P. **Lebeau** and P. **Marmasse**: The estimation of small quantities of hydrogen in gaseous mixtures. The gas mixture is passed over a silica gel maintained at −190° C., which has been found to retain nitrogen, methane, carbon monoxide, oxygen and argon. The accuracy of the separation is shown by analyses of synthetic gas mixtures; the absence of hydrogen in two natural gases (marsh gas from a pool and gas from borings at Pechelbronn) has been proved by this method.—A. **Travers**: The oxidation of manganese to permanganic acid and its consequences in the application to the estimation of manganese.—Marcel **Guillot**: Researches on the complex salts arising from the action of α-picoline on the alkaline iridohexachlorides.—Mme. Ida **Vaillant-Couturier-Treat**: Note on the marine Permian of Madagascar.—C. **Dauzère**: The formation of the 'atmospheric vase' and of the 'sea of clouds.'—E. **Miège**: The appearance of *Triticum durum* in the descendants of hybrids of two *Triticum vulgare*.—L. **Mercier** and J. **Villeneuve**: Second contribution to the study of the anatomy of the head of the cycloraph Diptera; the lunula and its sensorial organs.—A. **Vandel**: Geographical spanandry (scarcity of males) in the Myriapod *Polyxenus lagurus*.—Gilbert **Ranson**: Nutrition in aquatic animals.

CALCUTTA.

Asiatic Society of Bengal, May 3.—Harit Krishna **Deb**: (1) When Kurus fought Pandavas. It would seem that the Kurus fought the Pandavas in the fifteenth century B.C. (2) The five-yearly yuga and the Saptarshi cycle. It is highly probable that about 1400 B.C. Garga enunciated the Saptarshi cycle in order to account for the apparent movement of the nakshatras in a direction retrogade to their daily motion, which was due, in reality, to an inherent small error in the lunar period of the five-yearly yuga, a yuga which, we know, was adopted by Garga.—R. B. Seymour **Sewell**: Maritime meteorology in Indian seas. Seasonal variation in the air-temperature over the open waters of Indian seas, the coastal region of the Andaman Sea, is recorded. Variations of other meteorological data are also discussed.—Sunder Lal **Hora**: Note on a hermaphrodite loach. An example of teratological hermaphroditism in *Nemachilus montanus* (McClelland).

ROME.

Pontificia Accademia delle Scienze (Nuovi Lincei), April 18.— — **Terkan**: New method of determining the luminosity and temperature of celestial bodies.—**Luigioni**: Two anomalies encountered in two coleoptera, *Timarcha Schenklingi* and *Dendarus tristis*.—**Gianfranceschi**: Law of distribution of the energy in the black body spectrum. The theoretical values

furnished by the author's new formula are compared with the observations made on the solar spectrum.—**Pagnini**: The hypotheses on which the undulatory theory is based.—**Giorgi**: Reference is made to Miller's recent experiments, and also to those of Wataghin, who has subjected the ballistic theory of light to further test.—**Zanon**: The biology of *Thrips tabaci*. The last generation of this insect was found in the gall caused by *Schizomya pimpinellæ* on wild fennel in the Roman Campagna.

Official Publications Received.

Scientific Papers of the Institute of Physical and Chemical Research: No. 48: On the Absorption Spectra produced by the Explosion of various Elements (Hg, Cu, Fe, etc.). By Takeo Hori. Pp. 59-78+5 plates. 70 sen. Nos. 50-51: La Konsisto de Magnezioksiklorida Cemento, de Tutomu Maeda kaj Sigeru Yamane; Viskozecosango dum la Reakcio inter Magnezioksido kaj Magneziklorida Akvosolvajo, kaj Nova Konsidero rilate al Hardigo de Cementoj, de Tutomu Maeda. Pp. 85-128. 50 sen. No. 52: Some Experiments on Spark Discharge in Heterogeneous Media—a Hint on the Mechanism of Lightning Discharge. By Torahiko Terada, Ukitirô Nakaya and Kiyoshiko Yumoto. Pp. 129-160+plates 7-14. 70 sen. No. 53: Influence of Vitamin A on the Absorption of a Foreign Fat. By Waro Nakahara. Pp. 161-166. 20 sen. No. 54: The Change of the Wave-length of the Cadmium Red-line (λ6438·7 Å). By Mitsuharu Fukuda. Pp. 167-170+plate 15. 20 sen. No. 55: On the New Lines ($1S$-$2p_1$, $_3$), of Zinc, Cadmium and Mercury. By Mitsuharu Fukuda. Pp. 171-176+plate 16. 30 sen. No. 56: The Spectra of Metals under Heavy Current Excitation. By Mitsuharu Fukuda, Tamio Kuyama and Yasushi Uchida. Pp. 177-188+plate 17. 40 sen. (Tokyo: Institute of Physical and Chemical Research, Komagome, Hongo.)

Aeronautical Research Committee. Reports and Memoranda, No. 987 (Ae. 199): The Full Scale Determination of the Lateral Resistance Derivatives of a Bristol Fighter Aeroplane. By H. M. Garner and S. B. Gates. (A.2.b. Stability, Full Scale Experiments 34—T. 2107.) (S. and C. 119.) Pp. 16+8 plates. 1s. net. Reports and Memoranda, No. 990 (Ae. 201): Full Scale and Model Measurements of Lift and Drag of Bristol Fighter with R.A.F. 31 Wings. By B. D. Clark, Dr. R. G. Harris and L. E. Caygill. (A.3.a. Aerofoils General, 153, A.4.b. Full Scale Work 28—T. 2123.) Pp. 6+7 plates. 6*d*. net. (London: H.M. Stationery Office.)

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 562: Surface Water Supply of the United States, 1923. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. iv+86+3 plates. 15 cents. Bulletin 783-A: Mineral Industry of Alaska in 1924 and Administrative Report. By Philip S. Smith. Pp. ii+39+xvii. (Washington, D.C.: Government Printing Office.)

Publications of the Kapteyn Astronomical Laboratory at Groningen. Edited by Prof. Dr. P. J. Van Rhijn. No. 40: The Stars of High Velocity. By J. H. Oort. Pp. viii+75. (Groningen: Hoitsema Bros.)

Diary of Societies.

SATURDAY, JUNE 12.

BIOCHEMICAL SOCIETY (in Wellcome Physiological Research Laboratories, Langley Court, Beckenham), at 11.45 and 2.30.—C. G. Pope: (*a*) A Direct Reading H-ion Meter; (*b*) The Surface Concentration of Phenol in Aqueous Solutions.—J. W. Trevan, H. Bainbridge, and J. H. Gaddum: Micro Volumetric Methods.—J. W. Trevan: A New Micro-Balance.—A. F. Watson and E. D. F. Langstaff: Stages in the Purification of Culture Filtrates of B. Diphtheriæ.—C. Dorée and E. C. Barton-Wright: A Note on the Stone-Cells of the Pear.—R. L. M. Wallis: The Corpus Luteum and Cholesterol Metabolism.—D. T. Davies, F. Dickens, and E. C. Dodds: Observations on the Properties and Preparation of the Para-thyroid Hormone (Collip).—H. R. Whitehead: Phosphates and the Growth of Streptococci.—A. T. Glenny, C. G. Pope, H. Waddington, and U. Wallace: Variations in Immunity Response to Different Preparations of Diphtheria Toxin.—A. F. Watson and E. D. F. Langstaff: The Preparation and Some Properties of Purified Diphtheria Antigen.—J. W. Trevan and E. M. Boock: Some Physical Properties of Local Anæsthetics.—O. Rosenheim and T. A. Webster: (*a*) The Anti-rachitic Properties of Irradiated Sterols; (*b*) Note on Alleged Specific Colour Reactions for Vitamin D.

MINING INSTITUTE OF SCOTLAND (at Dunfermline).

MONDAY, JUNE 14.

FARADAY SOCIETY (at Institution of Mechanical Engineers) (Discussion on Explosive Reactions in Gaseous Media), at 2.30 and 5.—Part I. Explosive Reactions Considered Generally:—Dr. W. E. Garner: Introductory Survey.—Prof. H. B. Dixon, J. Harwood, and W. F. Higgins: On the Ignition Point of Gases.—Prof. W. T. David: Radiation in Gaseous Explosions.—Dr. S. W. Saunders and Dr. W. E. Garner: Ionisation in Gas Explosions.—Dr. S. C. Lind: Ionisation and Gas Explosions.—Prof. R. V. Wheeler and Dr. W. Payman: The Uniform Movement of Flame.—Prof. W. A. Bone: Explosions at High Pressure.—Dr. Colin Campbell and Prof. H. B. Dixon: Explosion Wave in Cyanogen Mixtures.—At 7.45.—Part II. Explosive Reactions Considered in Reference to Internal Combustion Engines:—Sir Dugald Clerk: Introductory Survey.—Prof. W. T. David: Combustion in Gas Engines.—H. T. Tizard: Explosions in Petrol Engines.

ROYAL IRISH ACADEMY, at 4.15.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Prof. H. A. Kelly: The Silence of God—How is it explained?

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 8.—Capt. H. S. G. Sutherland: The Correlation between Size of Family and Intelligence of the Children.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.

TUESDAY, JUNE 15.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Sir Thomas Lewis: Observations upon Blood Vessels of the Human Skin (Croonian Lectures) (3).

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—Dr. E. C. Snow: Some Observations on Trade Forecasting and Prices.

MINERALOGICAL SOCIETY (at Geological Society of London), at 5.30.—Dr. F. L. Stillwell: On the Nature of Berthierite.—S. I. Tomkeieff: On some Chloritic Minerals Associated with the Basaltic Carboniferous Rocks of Derbyshire.—H. E. Buckley: The Anomalous Optical Properties of Several New Series of Isomorphous Double Tartrates.—Dr. G. T. Prior: On the South African Meteorites, Vaalbult, Witklip, and Queen's Mercy.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. H. H. Scott: A Mycotic Disease of Batrachians.—H. G. Jackson: The Morphology of the Isopod Head.—F. W. Edwards: On the Marine Chironomidæ (Diptera); with Descriptions of a New Genus and Four New Species from Samoa.—P. A. Buxton: The Colonisation of the Sea by the Chironomidæ (Diptera); with an Account of the Habits of a New Genus and Species in Samoa.—O. A. Merritt Hawkes: On the Massing of the Ladybird, *Hippodamia convergens* (Coleoptera), in the Yosemite Valley.—Dr. Marie V. Lebour: On some Larval Euphausiides (Crustacea) from the Mediterranean in the Neighbourhood of Alexandria, Egypt, collected by Mr. F. S. Russell.—D. Bhatia: On Three New Species of the Genus Anadenus (Mollusca).—Prof. J. P. Hill and Prof. J. B. Gatenby: The Corpus Luteum of the Monetremata.

WEDNESDAY, JUNE 16.

SOCIETY OF GLASS TECHNOLOGY (at Sheffield), at 2.30.

CORRELATIVE SCIENCE SOCIETY (at Royal Botanic Society of London), at 3.—Chemical Physics—The Dynamics of Molecular Motions, Planetary Nebulæ, Critical Velocity (Conference).

LONDON DERMATOLOGICAL SOCIETY (at St. John's Hospital, Leicester Square), at 4.30.—Sir Humphry Rolleston, Bart.: The Relations of Dermatology and General Medicine (Annual Oration).

ROYAL METEOROLOGICAL SOCIETY, at 5.—J. E. Clark, I. D. Margary, and R. Marshall: Report on the Phenological Observations in the British Isles from December 1924 to November 1925.—S. M. Bower: Report on Winter Thunderstorms in the British Islands from January 1 to March 31, 1925.—Dr. E. Kidson: Abnormal Rates of Ascent of Pilot Balloons in the Lower Levels of the Atmosphere at Melbourne.

THURSDAY, JUNE 17.

ROYAL SOCIETY, at 4.30.—Sir Arthur Schuster: A Review of Mr. George W. Walker's Magnetic Survey (1915).—Lord Rayleigh: The Continuous Spectrum of Mercury Vapour in relation to the Resonance Line 2536·52.—Prof. O. W. Richardson: Structure in the Secondary Hydrogen Spectrum. IV.—Prof. W. L. Bragg and J. West: The Structure of Beryl, $Be_3\ Al_2\ Si_6\ O_{18}$.—Prof. A. P. Laurie: On the Change of Refractive Index of Linseed Oil in the Process of Drying and its Effect on the Deterioration of Oil Paintings.

INSTITUTE OF PATHOLOGY AND RESEARCH (St. Mary's Hospital, Paddington), at 5.—J. E. Barnard: The Microscopy of the Filterable Viruses.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Sir Thomas Lewis: Observations upon Blood Vessels of the Human Skin (Croonian Lectures) (4).

CHEMICAL SOCIETY, at 8.—A. Hassell and Dr. C. K. Ingold: The Chemistry of Polycyclic Structures in Relation to their Homocyclic Unsaturated Isomerides. Part VII. Tautomerism corresponding with that of Nitrosophenol and Quinone-oxime in the Dicyclopentane Series.—F. R. Goss, Dr. C. K. Ingold, and I. S. Wilson: The Nature of the Alternating Effect in Carbon Chains. Part VIII. The Nitration of some Benzylamine Derivatives with Special Reference to the Respective Rôles of the Ions, Salts, and Bases.—E. L. Hirst: The Structure of the Normal Monosaccharides. Part V. Fructose.—W. N. Haworth and E. L. Hirst: The Constitution of the Disaccharides. Part XI. The Relationships of Fructose, γ-Fructose, and Sucrose.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Annual General Meeting) (at 11 Chandos Street, W.), at 8.15.—Col. S. P. James: Epidemiological Results of a Laboratory Study of Malaria in England.—Presentation of the Manson Medal to Prof. E. Marchiafava, in recognition of the part he took, with other Italian Investigators, in the Elucidation of the Life-history of the Parasites of Human Malaria.

FRIDAY, JUNE 18.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—Prof. E. V. Appleton and Dr. G. C. Simpson: Electrical Discharges in the Atmosphere. Chairman: Col. H. G. Lyons.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section) (Annual Meeting), at 5.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Dr. D. R. Grantham: The Petrology of the Shap Granite.—G. W. Young: Notes on the Shoshone Valley, Yellowstone National Park, U.S.A. (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Seton Gordon: The Golden Eagle and its Neighbours.

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children) (at Children's Hospital, Birmingham).

CONFERENCES.

SATURDAY, JUNE 12.

PHOTOGRAPHIC CONVENTION OF THE UNITED KINGDOM (at Edinburgh).

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (at Colchester).—A. Farquharson: The Social Constitution of a County.—G. E. Hutchings: The Choice of Maps for Regional Surveys.—Dr. C. Tierney: Some of Nature's Secrets.