THURSDAY, OCTOBER 5, 1905.

MODERN GEOLOGISTS AND THE "OLD MASTERS."

Ice or Water. Another Appeal to Induction from the Scholastic Methods of Modern Geology. By Sir Henry H. Howorth, K.C.I.E., D.C.L., F.R.S., V.P.S.A., F.G.S. Vol. i. Pp. xlvi+536. Vol. ii. Pp. viii+498. (London: Longmans and Co., 1905.) Price 32*s.* net.

THE two volumes before us must be regarded as parts of a complete work in which the author has set himself the task of disproving the usually accepted glacial theory. As he himself says in his preface, "the two volumes now published contain a large part of, though not all, my supplementary arguments against the glacial theory; a portion being still reserved for a succeeding volume which will also contain an enlarged presentation and justification of the theory I substituted for it in my 'Glacial Nightmare,' namely, the diluvial theory."

In the volumes under review the subject-matter may be considered under three heads:—(1) the theories which have been proposed to account for Glacial periods; (2) the efficiency of water as an agent of erosion; (3) the capacity of ice to produce the effects which have been assigned to it by modern geologists.

(1) *Theories of an Ice Age.*—The four opening chapters of the first volume are devoted to a criticism of the various theories, astronomical and geographical, which have been put forward in attempts to solve the problem of the Great Ice Age and of former periods of glaciation. Sir Henry is ever skilful in detecting the weak points in his opponents' armour, and here, as in his book on the "Glacial Nightmare," he has an imposing array of objections raised by others and himself to the various explanations which have been offered.

Our present inability to offer any adequate explanation of the Glacial period seems to be largely recognised; as Prof. Chamberlin has said, "The riddle remains to be read." This grieves the author greatly, perhaps unduly.

"It is not encouraging," he says, "to read of a succession of failures by men of parts and ingenuity in futile efforts to solve what is apparently an insoluble problem; to measure the waste of thought and time and oil involved in these efforts of the geological Sisyphus to roll the glacial snowball on to some stable foothold, and to see it roll down the hill in every case into the abyss where so many scientific hopes and efforts lie buried."

But is the waste so complete as the author seems to imply? Though the riddle is not yet read, the number of facts which have been garnered during the process of testing the inadequate explanations remain for use when seeking the correct solution, and many a minor point has already been settled.

The occurrence of Glacial periods is not the only climatic problem to which the geologist is without clue. We have not yet explained the existence of beds containing rich floras in Greenland. To the ordinary geologist the evidence for a Glacial period is as strong as that for the former occurrence of warmer conditions in Greenland, and he is hardly likely to reject the evidence in the former case any more than in the latter, simply because he has not yet arrived at an adequate explanation of the phenomena.

(2) *The Efficiency of Water as an Agent of Erosion.*—The author devotes several chapters to a discussion of the potency of the various agents of subaërial and marine erosion under existing conditions, and refuses to recognise the efficiency of these agents to do the work claimed for them by the great number of living geologists. He supports his arguments by a large number of quotations from various writers, ancient and modern, great and small. But we look in vain for any recognition of the principles of erosion which were laid down by G. K. Gilbert in his "Geology of the Henry Mountains," and form the basis of modern writings on erosion. He quotes Mr. Harker's paper on the subaërial denudation of Skye (*Geol. Mag.*, 1899, p. 485) to show that in that district "the agents of atmospheric degradation, erosion and transportation, are at the present time almost wholly inoperative," but ignores that writer's statement concerning the great erosion of the district in Tertiary times. Sir Henry, in fact, does not seem to have recognised the importance of the "base-line of erosion" as one of the controlling factors in the sculpture of a district, and this vitiates many of the arguments advanced in this section of the book.

But there is much in this section that is suggestive, especially the portions dealing with the effects of earth-movement and fracture in the production of valleys. In the "heroic age" of geology too much influence was undoubtedly assigned to these effects in accounting for valley-formation, and one cannot but feel that with the swing of the pendulum, and owing to the importance which geologists now attach, and rightly attach, to agents of erosion, the influence of movement accompanied by fracture, at any rate as an indirect factor, has been unduly minimised.

(3) *The Capacity of Ice to Produce the Effects Assigned to it.*—In the two concluding chapters of vol. i. and in the greater part of vol. ii., Sir Henry is directly at issue with the modern geologists, for in the majority of the phenomena which have been appealed to in support of the operations of ice he refuses to see any signs of ice-work. Notwithstanding the ingenuity with which he argues, we cannot see that he makes out a case. The Glacial period has been established as the result of cumulative evidence, and although there are many differences of opinion on minor points, geologists are agreed as to the occurrence of such a period in late Tertiary times in consequence of what most of them consider to be overwhelming evidence.

Here we must insert a word concerning the author's "old masters." In vol. i., p. 213, he takes his stand "with the old masters, Hopkins and Whewell, Conybeare, Sedgwick and Murchison. These men knew something more than geology; they were mathematicians and physicists as well." Again, on p. 460 he says:—"I do not hesitate myself to confess, and to be proud of the confession, that I

believe in the old men rather than in the new." It is true that in these cases he is referring to special points, but again and again one cannot but feel in reading the book that the writer pays undue regard for authority, without considering that his "old masters" were not acquainted with all the facts which we now possess, and that they themselves changed their views. Sedgwick, for instance, came to believe in an Ice age. Moreover, if these were old masters, so were Hutton and Playfair, Lyell and Buckland, whose views are not always so palatable to the author. It may be remarked, also, that a knowledge of mathematics and physics was not confined to the geologists of those days. One of the most ardent of the existing advocates of ice-erosion, concerning whose paper on ice action in Skye (*Trans. Roy. Soc. Edin.*, vol. xl., 1901) Sir Henry is silent in these two volumes, was a high wrangler, and took a first class in physics at Cambridge.

The theory of an Ice age was largely put forward owing to the existence of rounded and striated rock-surfaces and scratched and polished boulders. These resemble similar productions of modern ice to such a degree that the geologist has no more hesitation in referring them to ice-action than he has to assign the formation of the pebbles of a river to stream-action. The inference drawn from the existence of these phenomena has been supported by a host of other observations, biological as well as physical, and if Sir Henry should succeed in disproving the existence of an Ice age he will also break down the essential principle of geology, "that like effects imply like causes."

It would be impossible in a brief article to discuss all the questions raised in this part of the work. We must content ourselves with a few observations. Though reference is made now and again to the Greenland ice and to the ice masses of Spitsbergen, it is the glaciers of the alpine type to which most frequent appeal is made. To this we shall recur, but in the meanwhile would invite the author's attention to yet another treatise concerning which he is silent, where another type of ice work is described, namely, I. C. Russell's volume on the Malaspina Glacier (thirteenth annual report of the U.S. Geological Survey).

When describing the Till or Boulder-clay, the author quotes a description of it by Prof. James Geikie, and goes on to observe, "this being without question the most typical of so-called glacial deposit, it is a remarkable fact that no such deposit is now being made, so far as we know, by land-ice anywhere." He must have overlooked a passage in a paper to which he elsewhere refers, by Messrs. Garwood and Gregory, on the glacial geology of Spitsbergen (*Quart. Journ. Geol. Soc.*, vol. liv.). They say:—

"On the broad plain at the foot of Booming Glacier we found some square miles of a tough mud containing boulders and pebbles; it only needed to be dried and hardened to form an ideal Boulder Clay. Clearly this deposit had been laid down by land-ice."

The author objects to the sharp line which is drawn by many geologists to show the margin of the ice at its period of maximum extension, and denies the existence of any evidence for this, arguing that the Boulder-clay, the masses of gravel and loam, and the loess are genetically connected. Of this we shall doubtless hear more when the third volume appears.

Much is naturally made of the conflict of opinion among geologists concerning the occurrence of inter-Glacial periods, and the relative importance of land-ice and floating-ice in producing the phenomena generally taken to indicate the occurrence of a Glacial period. These questions are certainly not settled to everyone's satisfaction, but they in no way invalidate the conclusions which have been drawn as to the existence of an Ice age.

Though we do not agree with the author in his main conclusions put forward in this section of the work, we must admit that much that he writes is worthy of consideration, even though his views seem exaggerated. For instance, he argues that much of the material forming the drifts was broken up prior to the so-called Ice age, and this we believe to be true, even though the breakage did not occur in the manner advocated elsewhere by the author; but if true, it invalidates the appeal to modern Alpine glaciers to prove the inadequacy of ice as an erosive agent. The loose materials ready to hand at the beginning of Glacial times would supply the ice with the tools for rasping and grinding. As that material became comminuted, unless new material was supplied in abundance, the ice would become less effective as an eroder. Also ice, like water, has a base line of erosion beneath which it cannot work. This line may have been reached in the case of Alpine glaciers, and the supply of material to the sole have been also largely diminished, in which case one can no more argue from what Alpine glaciers are now doing as to the effects of land ice in the Glacial period than one can explain the cañons of the Colorado by reference to a little stream which has established its base level.

Throughout the work much has been made of the conflicting views of geologists as to the details of ice action. Sir Henry is obviously greatly impressed with the fact that in the long and arduous attempt to unravel the Gordian knot the skein sometimes seems to have become hopelessly twisted; but he who carefully studies the process of disentanglement sees that, notwithstanding the many kinks, the tangle is becoming less. The author, impatient of the slow process, has elsewhere attempted to cut the knot, and will evidently give reasons for this act in the third volume. We fear that the attempt will not be regarded as successful, either by the "ultra-glacialists" or by geologists in general.

We cannot recommend the book to geological babes and sucklings, but it will well repay perusal by the advanced reader. He will forgive the "energetic adjectives and adverbs," which are hardly necessary to a calm and dispassionate discussion, on reading the author's frank apology in the preface. The store of facts collected in the book is of the utmost value

to the student of glacial geology, though we wish that references to the original memoirs had been in all cases added. There are, as we have tried to show, many valuable criticisms and suggestions contained in the work. Lastly, it will prove a useful intellectual exercise to weigh the author's arguments in the balance. For these reasons we believe that readers who have an extensive acquaintance with the facts and principles of geology will read the book with profit—and with pleasure. J. E. M.

PHYSICAL CHEMISTRY.

Theoretical Chemistry. By Prof. Walther Nernst. Revised in accordance with the fourth German edition. Pp. xxiv+771. (London: Macmillan and Co., Ltd., 1905.) 15*s.* net.

THE fact that three further editions of the German text of Nernst's well known treatise on theoretical chemistry have been called for since the appearance of the original in 1893, affords ample testimony to its intrinsic merits. An English translation of the first edition by Prof. C. S. Palmer appeared in 1895, and this, until now, has been the only English version.

During the last ten years much valuable work has been carried out in the province of physical chemistry, and the publishers have recognised the necessity of bringing the English edition up to date. With that object Dr. R. A. Lehfeldt has translated the whole of the new matter contained in the fourth German edition and has revised certain parts of the original translation.

It has been the reviewer's experience to hear the original translation adversely commented upon, and it is perhaps to be regretted that the bulk of the old text remains as it was in the first edition. After careful perusal of the work, it is indeed difficult to suppress the feeling that a better result would have been attained by an entirely new translation of the fourth German edition.

Two new chapters in the work under review deal with "The Atomistic Theory of Electricity" and "The Metallic State." In the first of these an account is given of the electron theory and of the phenomena of ionisation and electric conduction in gases. In the second the nature of the metallic condition is discussed on the basis of results which have been obtained by the study of the freezing point curves and of the electrical conductivity of mixtures of metals. These chapters form very interesting reading, although, of course, it has not been possible within the compass of seventeen pages to give more than the briefest outline.

The space given to electro-chemistry has been extended from 26 to 46 pages, and the exposition of the subject-matter greatly improved. The application of thermodynamics and of the osmotic theory to electrochemical systems is now treated in separate chapters, and many new observations bearing on the theory of electrolysis have been incorporated.

It is not possible to mention more than a few of the alterations and additions which have been made in the text generally. One notes with pleasure that the somewhat abstruse exposition of energy relationships in the introductory chapter has been made more lucid. The discovery of the inert gases of the argon series has led to much discussion of late years in reference to the periodic classification of the elements, and these recent views are summarised in the chapter on the atomic theory.

Other important new sections deal with Werner's theory of molecular compounds, catalysis, the mechanism of autoxidation processes, tautomerism, and the kinetics of heterogeneous systems. The view that tautomerism is due to the co-existence in dynamic equilibrium of mutually transformable isomeric substances seems to be very probable in the light of recent work. In this connection the interesting observations of Hantzsch on the transformation of the tautomeric forms of nitrophenylmethane and similar bodies are recorded, but one looks in vain for any reference to Lowry's investigations on dynamic isomerism. In reference to the kinetics of heterogeneous systems and the mechanism of chemical change, it is now recognised that many gaseous reactions, usually regarded as taking place in a single phase, are possibly examples of changes essentially conditioned by phenomena at a boundary surface. The rate at which arsine or phosphine decomposes is in accord with the formula for a unimolecular change, but this agreement really affords no conclusive argument with reference to the mechanism of the change. The measured rate of change has possibly nothing whatever to do with the chemical change involved, but merely with a physical change at the surface of the containing vessel. In a third edition reference should be made to this in the section dealing with the mechanism of reactions on pp. 562–564.

Of necessity, much new work has had to be left unmentioned in the new edition, but the author is to be congratulated on the large amount of new matter which he has been able to introduce without appreciable alteration in the size of the volume. With the issue of this second edition one may confidently anticipate that Nernst's book will still maintain its position as one of the classics of theoretical chemistry.

H. M. D.

STOKES'S MATHEMATICAL AND PHYSICAL PAPERS.

Mathematical and Physical Papers by the late Sir George Gabriel Stokes, Bart. Vol. v. Pp. xxv +370. (Cambridge: The University Press, 1905.) Price 15*s.*

THE speedy completion of the reprint of Stokes's papers is matter of congratulation to the distinguished editor, to the Cambridge Press, and to all students of mathematical physics. The general character of the contents of this concluding instalment is sufficiently described in the following extract from Prof. Larmor's preface:—

"It will be observed that the present volume represents the period in which Sir George Stokes' scientific activities were mainly expended in the work of the Royal Society and of public Scientific Committees,

and in giving assistance to the investigations of others. The volume thus consists largely of additions and notes originally appended to memoirs by other authors."

Hence, although we meet abundant evidence of Stokes's constant occupation with scientific subjects, and of the characteristic generosity with which he placed his powers at the service of others, we miss something of the more spontaneous activity which characterised his earlier period. We find various proofs, however, that the subjects which had first fascinated him were never long absent from his thoughts; and occasionally they receive a flash of unexpected illumination. We may cite the various notes on water-waves, the brilliant little paper on semi-convergent series, and the admirable interpretation of Prof. Hele-Shaw's experiments on the flow of a viscous liquid between parallel plates. We have also a record of the keen interest which in the last few years of his life he took in the subject of Röntgen rays. The lecture (p. 256) which he gave to the Manchester Literary and Philosophical Society in 1896 was written out (with the help of reporters' notes) *after* delivery; bright and genial as it is, it gives no adequate idea of the buoyant freshness and vivacity which characterised the oral exposition.

The volume includes, by a happy determination, a collection of the papers set by Stokes in the mathematical tripos, and in the old Smith's Prize examination. It is well known that through this unusual channel several important scientific results were first made known to the world; for example, the notion of group-velocity, and the famous "Stokes's Theorem," respecting which we have an interesting historical note by Prof. Larmor. We suspect that a mathematical antiquarian might make further interesting "finds." If we are not mistaken, we detect prior publications of a remarkable theorem relating to the infinite product for sin x, and of a definite integral property of Bessel's functions, which are usually attributed to Weierstrass and to H. Weber respectively. Of course, no one, least of all Stokes himself, would attach much importance to the question of priority under these conditions; but such instances are of interest as showing, in unexpected directions, the singular vigour and independence of Stokes's mind.

The Royal Society obituary notice, with its authoritative appreciation of Stokes's scientific researches by one of his keenest admirers and disciples, forms a fitting accompaniment to this monumental publication. The volume is further adorned by an excellent photograph by Mrs. Myers, of date 1892.

The scientific world will await with great interest the publication of the "volume of biographical character, to be occupied in part by a selection from Sir George Stokes's voluminous scientific correspondence, including some unpublished manuscript material," which is promised in the preface. The great energy with which Prof. Larmor has discharged his present honourable task justifies the hope that we shall not have to wait too long for the proposed supplement.

H. L.

OUR BOOK SHELF.

Notes on the Drawings for Sowerby's "English Botany." By F. N. A. Garry. Reprinted from the *Journal of Botany*, 1904–5. Pp. 276. (London: West, Newman and Co., 1905.) Price 6*s*.

THE series of volumes known as "English Botany" was begun in 1790 by James Sowerby, the botanic artist, who engaged Dr. James Edward Smith, the possessor of the Linnean collections and founder of the Linnean Society, to describe the plants depicted by him. At first the name of the draughtsman only appeared on the title-page, but in 1795 a preface to the fourth volume by Smith acknowledged his authorship, and he was much annoyed in after years by "the flippancy with which everybody quotes "Sowerby," whom they know merely as the delineator of these plates, without adverting to the information of the work, or the name of the author." The artist and those who followed him preserved the original drawings of the phanerogams and vascular cryptogams, which ultimately came into the possession of the trustees of the British Museum, and are now in the department of botany. Here are to be found the drawings, with impressions from the original plates, and also from the third recast edition, laid down side by side on the same sheets. The drawings (which had been submitted to Smith for his criticism and his text which accompanied them) bear many notes and directions to the engraver, which are of great interest as showing not only the state of botany at the time, but mentioning the numerous contributors of plants to the work and its supplement. Mr. Garry has done excellent service in the laborious task of transcribing and editing these notes, which can now be read by those who have not seen the originals themselves. Turning over these pages, the writer is reminded of the days when, more than thirty years ago, he first made acquaintance with the drawings in the old rooms of the department at Bloomsbury, recalling the charm they possess for all who care for the history of the native plants of Great Britain.

Without going into detail it would be impossible to set out many most interesting items which are to be found in the pages of this modest reprint from the two years' supplements to the journal in which they made their first appearance. We have here glimpses of a big book in the making, which extended in the first instance to thirty-six volumes and closed in 1814 with a general index. Further discoveries and greater discrimination of critical forms induced the beginning of a supplement in 1831, which died out in 1866 in its fifth volume; the text in these later volumes was by many hands, amongst them the most active and critical of the botanists of the day. These last plates are now in the Fielding herbarium at Oxford, whence they were borrowed by the author so as to complete his work.

B. D. J.

A Text-book of Chemical Arithmetic. By Horace L. Wells. Pp. vii + 166. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 5*s*. 6*d*. net.

IN the preface it is stated that this book "is designed especially for the use of students of quantitative analysis, many of whom, even after having taken extensive courses in higher mathematics, show little ability to solve simple chemical problems. Certain portions of the work are suitable also for the use of those who are studying elementary chemistry." It appears, therefore, that an American professor is no better off than his English cousin in this matter of student arithmetic The difficulty is two-fold. In

the first place, the student has never been taught arithmetic in relation to actual measurements, but has been exercised in fictitious transactions with oranges and nuts, rods, poles or perches, and vats into which liquor flows at the rate of so many gallons a minute and out of which it flows (notwithstanding the dwindling pressure) at another exact and steady rate. The result is that the student has no idea of the relation of magnitude to measurement, and no opinion whatever on the subject of significant figures; he cannot use logarithms or a slide-rule, and is unpractised in contracted methods of computation. In the second place, it is very likely that he has no sound idea of proportion. Given a student in this condition—and it is still the common case—the teaching of what is called chemical arithmetic becomes a serious part of the duties of a teacher of chemistry. The fundamental numbers of chemistry—the atomic weights—are proportional numbers, and it may be said without exaggeration that the failure to realise this and the inability to see how proportional numbers may be used for the calculation of absolute weights, locate the real *pons asinorum* of elementary chemistry.

In these circumstances any well considered attempt to expound the elements of chemical arithmetic is to be welcomed, and Prof. Wells has certainly succeeded in writing something on the subject which is likely to be very useful. He does not quite descend to the meanest capacity, but he deals in a very clear way with the meaning of figures and the limits of accuracy in measurement and computation. He also gives a good survey of the chief types of chemical problems, including all kinds of analyses and the corrections of gas volumes. Great pains are taken to impress the student with the importance of using common sense and judgment whilst performing arithmetical operations, and to this end set rules and stereotyped formulæ are avoided. An appendix to the book contains tables, including a well printed set of five-figure logarithms. Altogether the work is one that may be warmly recommended to the notice of English teachers. A. S.

The Physics and Chemistry of Mining. By T. H. Byrom. Pp. xii+160. (London: Crosby Lockwood and Son, 1905.) Price 3*s.* 6*d.* net.

THIS elementary class-book supplies information required for such examinations as the Board of Education principles of mining, stage i. The idea is a good one, as the principles of pure science upon which mining practice is based are apt to receive scant attention in mining classes. The author, who is chemist to an important colliery company, has, as lecturer at the Wigan Technical College, become acquainted with the needs of students, and he gives in concise form much useful information regarding the atmosphere, the laws relating to the behaviour of gases, the diffusion of gases, the composition of the atmosphere, water, carbon, fire-damp, combustion, coal dust, explosives, the composition of coals, the analysis of coal, the strata adjoining the Coal-measures, magnetism and electricity. The language is simple, and chemical symbols are sparingly used. There is, however, a want of uniformity in nomenclature that might confuse the beginner. The terms "carbonate of magnesium" (p. 96) and "magnesia carbonate" (p. 125), "iron oxide and aluminia" (p. 46) and "iron peroxide and alumina" (p. 125) are examples. The author, too, should not have included Cumberland hæmatite among the ironstones, nor granite among the strata adjoining the Coal-measures.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

On the Absorption Spectrum of Benzene in the Ultra-violet Region.

IN the *Transactions of the Chemical Society* for August Messrs. Baly and Collie, referring to the previous work of Baly and Desch (*Trans. Chem. Soc.*, 1904, lxxxv., 1029, and 1905, lxxxvii., 766) on the absorption spectrum of acetylacetone and its derivatives and the conclusions arrived at, namely, that the absorption band is caused by dynamic isomerism, or rather isodynamic changes, are led to infer from the occurrence of bands in the spectrum of benzene that these also are caused by the making and breaking of the carbon bonds in the molecule of the substance. I have given a similar, but not identical, explanation of the cause of the bands in the spectra of uric acid, murexide, and the ureides, and have pointed out that there is but little difficulty in accepting a like explanation in order to account for the bands in aromatic hydrocarbons, seeing that this would harmonise with Kekulé's view of the constitution of benzene. The particulars are contained in two papers communicated to the Chemical Society on May 17, but as they are still unpublished I cannot refer to them in detail.

Messrs. Baly and Collie consider all the possible phases in change of linking between the six carbon atoms in benzene, and assign a band to each phase. In doing this they feel justified in assuming that an even number of carbon atoms is concerned in each individual process, and in accordance with chemical evidence it could scarcely be imagined otherwise. They argue that there are only seven different makings and breakings of bonds possible, to which seven different absorption bands should belong, and on investigating the spectrum of benzene they find only seven bands. Seven bands were photographed (*Phil. Trans.*, 1879), as they remark, by Hartley and Huntington, but no measurements are given. The wave-lengths of lines in the ultra-violet had not been determined at that time (1878), with the exception of the principal lines of cadmium measured by Mascart, hence the reason for the absence of measurements.

In a subsequent observation (Hartley and Dobbie, "Notes on the Absorption Spectrum of Benzene," *Trans. Chem. Soc.*, 1898, lxxiii., 695) seven bands were photographed and measured, but one of these appeared to differ from the others in constitution, and it was indicated as doubtful; it is also a feeble band. The general character possessed by the first six bands was most distinctly marked in the four strongest; each was stronger and generally sharper towards the side where the rays of shorter wave-lengths lie, and was weakened in the opposite direction, as if the bands were composed of groups of lines occurring closer together and being stronger towards the more refrangible edge. Baly and Collie appear to have overlooked some points of importance in this communication, since they state that Hartley and Dobbie found only six bands, and that the measurements of the actual heads of the bands are not given. They give a series of numbers derived from Hartley and Dobbie's measurements which for comparison with their own are printed in a parallel column. The gist of the paper by Hartley and Dobbie was to show the structure of the benzene absorption spectrum partly by measurements and partly by the aid of a photograph. The bands which distinctly showed the structure were numbered, but unfortunately the manner in which the photograph was reproduced failed to render delicate details which were visible on the original plate. The statements contained in the paper appear, however, to have been clearly and fully understood by W. Friederichs, who photographed the vapour of benzene with a Rowland grating. He found fifty-six bands of absorption in its spectrum in the ultra-violet, which are arranged in eight groups, and he compared the principal lines of each group with the

points of maximum absorption, or most persistent edges in each of the bands measured by Hartley and Dobbie. This is shown in the following statement quoted from his paper (Wilhelm Friederichs, *Zeit. für wissenschaftliche Photographie*, B. iii., 154–164, 1905).

I have added in italics the wave-length numbers corresponding to Baly and Collie's oscillation frequencies for comparison :—

	Vapour. Friederichs. λ	Solution in alcohol. Hartley and Dobbie. λ	Difference.	Baly and Collie. λ
(1)	2670	2681	11	*2683*
(2)	2633	—	—	*2656*
(3)	2588	2599	11	*2610*
(4)	2526	2541	15	*2554*
(5)	2458	2485	27	*2484*
(6)	2404	2429	25	*2433*
(7)	2356	2376	20	*2380*
(8)	2305	2330	25	—

He points out that the bands of the substance in solution which without doubt correspond with those of the vapour are all shifted towards the red, as might be expected, but that the shift appears to be greater the smaller the wave-lengths of the absorbed rays. The comparison of Baly and Collie's numbers with those of Hartley and Dobbie is very interesting in this connection, inasmuch as they show a close general agreement in their divergence from the measurements of Friederichs. Furthermore, the following points may be noted :—

First, the omission of the second band in Hartley and Dobbie's spectrum; second, the omission of the eighth band by Baly and Collie; third, there is a close agreement between Hartley and Dobbie's and Baly and Collie's numbers in the first, fifth, sixth, and seventh bands, but the two sets of measurements for the third and fourth bands differ more widely than the others.

It may be mentioned that the second very narrow band is visible on the photographs taken by Hartley and Dobbie, though it can scarcely be considered as measurable; no doubt a longer exposure would have rendered it more plainly. Those who have measured similar series of bands in the visible region, for example, those in the spectrum of potassium permanganate, which are also eight in number, will appreciate the close approximation of the above figures.

W. N. HARTLEY.

Royal College of Science, Dublin, September 19.

Rhymes on the Value of π.

THE following rhyme is in imitation of the French and German verses given in NATURE (August 17) in which the number of letters in each word correspond to a numeral in the value of π. The three concluding lines are somewhat obscure; it seems to have occurred to the author that the method is a misuse of language, and he expresses the hope that NATURE will take a more lenient view than Dr. Johnson might be imagined to express.

To the Editor of NATURE.

Sir,—I send a rhyme excelling
3 1 4 1 5 9
In sacred truth and rigid spelling.
2 6 5 3 5 8
Numerical sprites elucidate
9 7 9
For me the lexicon's dull weight.
3 2 3 8 4 6
If "Nature" gain,
2 6 4
Not you complain,
3 3 8
Tho' Dr. Johnson fulminate.
3 2 7 9

F.R.S.

The Celtic Pony.

IN a review, signed "R. L.," of "The Færöes and Iceland," in NATURE of September 21 (p. 506), I was surprised to read that I had credited Prof. Ewart "with being the first to regard Przewalsky's horse as a variety of *Equus caballus*." I have just re-read the paragraph relating to the wild horse in my "Appendix on the Celtic Pony," and I can find no passage which, it seems to me, could by any possibility be made to bear this strange construction.

Sanson's subspecies *E. c. hibernicus* appears to include all the various ponies of the British Isles, the Breton in France, as well as the horses of Iceland, Norway, and Sweden. It has been recognised for some time past that the Icelandic horses are of two different types, while the Swedish horses are admittedly very mixed. Moreover, as a result of a recent tour in Norway, it has become evident to me that there are in that country at least two distinct kinds of native horses (represented by the pure fjord horse and the Gudbrandsdal horse). In view of these considerations, the statement that the Celtic pony is "probably inseparable" from the somewhat heterogeneous assemblage (as it now appears to be) included under *E. c. hibernicus* becomes a little obscure. But, as "R. L." points out, I did *not* make this statement. I grant, however, that it might have been better had I made some allusion to this matter.

But why I should have been expected in an "Appendix on the Celtic Pony" to have entered into a discussion as to the proper technical name to apply to *E. przewalskyi* or to have recorded an irrelevant criticism of Prof. Ridgeway's new name of *E. c. libycus*, I am at a loss to understand.

FRANCIS H. A. MARSHALL.

The University, Edinburgh, September 24.

GREEK ARCHÆOLOGY.[1]

THE archæologist justly ranks himself as a contributor to the world's knowledge on the same level as those who discover previously unknown forces in nature or new facts in the life-history of animals, extinct or living. Archæology, which is a branch of the great science of anthropology, discovers and correlates new facts in the early history of civilisation. Greek archæological discovery must always be of most especial interest, since it tells us of the origins of that early civilisation of the Mediterranean basin from which our present-day culture is derived. One of the most welcome yearly publications dealing with the subject is the "Annual of the British School at Athens," the tenth volume of which lies before us. It deals with the British work of 1903–4, besides containing independent articles on matters of archæological interest.

Dr. Arthur Evans's work at Knossos does not occupy so much space in the "Annual" as usual. The discoveries of the year, while most interesting, were not so new and epoch-making as those of former years, and the chief find, the tombs of "Ja'fâr's Papoúra" (*τοῦ Τζαφὲρ ἡ Παπούρα*) and Isópata, are described by Dr. Evans in a separate communication to *Archaeologia*. The first-named tombs, on a hill north of the Knossian palace, were of various types; (1) chamber-tombs approached by a *dromos*; "in many cases these contained clay coffins, in which the dead had been deposited in cists, their knees drawn towards the chin"; (2) shaft-graves; (3) pit-caves, "or pits giving access to a walled cavity in the side below." In 2 and 3 the skeletons were extended at full length. On the hill of Isópata, about two miles north of Ja'fâr's Papoúra, a very fine tomb, no doubt that of a king, was found, with a smaller one by its side. The larger consisted of a square chamber of limestone blocks, eight metres by six, "with the

[1] "The Annual of the British School at Athens," No. x. Session 1903–4. (London : Macmillan and Co., Ltd.)

side walls arching in 'Cyclopean' fashion towards a high gable," which had long ago been quarried away. The lofty entrance-hall was approached by an imposing rock-cut dromos. "In the floor of the main chamber was a pit-grave covered with slabs. Its contents had been sifted for metal objects in antiquity, but a gold hairpin, parts of two silver vases, and a large bronze mirror remained to attest the former wealth of such. A large number of other relics were found scattered about, including repeated clay impressions of what may have been a royal seal. Specially remarkable among the stone vessels is a porphyry bowl of Minoan workmanship, but recalling in material and execution those of the Early Egyptian Dynasties. Many imported Egyptian *alabastra* were also found, showing the survival of Middle Empire forms besides others of Early Eighteenth Dynasty type. Beads of lapis lazuli also occurred, and pendants of the same material, closely imitating Egyptian models. Four large painted jars with three handles illustrate the fine 'architectonic' style of the Later Palace of Knossos, in connexion with which the great sepulchral monument must itself be brought."

The form of this square-chambered mausoleum is unique, and may be compared as a contrast with the *tholos* or beehive tombs of the Greek mainland. Dr. Evans says that he was tempted to recognise in it the traditional tomb of Idomeneus, but that the other tomb near by, which is cut in the rock, is hardly considerable enough to be taken for that of Meriones, which tradition placed beside the other. Nevertheless, Dr. Evans's identification may be correct; the important tomb on the slope of the hill looking towards Knossos and Heráklcion would naturally be identified by the later Greeks as the resting-place of one of the greatest heroes of the island, and any other tomb close by, whether it were as large as the first or not, would then be dubbed the grave of his legendary companion.

FIG. 1.—Two polychrome vessels of the Middle Minoan Period. From the Palace at Knossos.

Another interesting discovery was made outside the limits of the palace in the shape of a Minoan paved way leading due west from the "Stepped Theatral Area" discovered in 1903 towards the modern road to Candia. By the side of this were found magazines with interesting deposits of inscribed tablets apparently referring to the contents of the ancient royal stables and armouries; chariots, wheels, and yokes are pictured on them, and large numbers of arrows. Close by were found bundles of the very arrows mentioned on the tablets. A later Roman causeway overlay part of this road, but this was evidently merely a coincidence, for that the knowledge of the old road was lost after the close of the Minoan period is shown by the fact that during the early Hellenic ("Geometrical") age a well was sunk over the old Minoan way and driven right through it. This is a very interesting proof of the entire break in culture between the Mycenæan and "Geometrical" peoples in Crete, and is a strong argument in the armoury of those who believe that the Minoans or Mycenæans were not Greeks in our sense of the word at all, but a totally different race probably of non-Indo-European speech.

In the palace itself interesting finds were made. A section cut in the western court enabled more accurate notes of the stratification of the ancient remains to be made, resulting in a further subdivision of the Minoan period and a more accurate placing of the polychrome ("Kamáres") pottery as belonging to the stratum "Middle Minoan II." The Kamáres pottery is known by Egyptian evidence to be contemporary with the twelfth dynasty. The palace as it stands is late Minoan, which corresponds with the Egyptian evidence, which dates the Keftians who brought vases of the grand Knossian style to Egypt as contemporary with the eighteenth dynasty. Beneath the Minoan strata was found a deep Neolithic stratum going down to the virgin rock. From the modern surface of the ground to the base of "Early Minoan I." (the sub-Neolithic period) measures 5 m. 33 cm. in depth; the Neolithic stratum is 6 m. 43 cm. The date B.C. of the eighteenth dynasty and the late Minoan palace is roughly 1500; that of the twelfth dynasty and Middle Minoan II. about 2200. "Middle Minoan II." is 2 m. 50 cm. below the surface; the virgin rock is 7 m. 75 cm. From this the great age of human settlement at Knossos will be seen at a glance. A peculiarity of the Knossian site is that the late Minoan remains are found almost immediately beneath the modern surface of the ground. This points to the place having been kept clear of later buildings, the tradition of its sanctity and heroic associations having always persisted.

An earlier western façade of the central court was also discovered, and further cists belonging to the first period of the later palace, in the magazines. The discovery of fragments of reliefs in these cists (one of them, representing the head of a charging bull, was identified by one of the workmen as a portrait of the devil) led Dr. Evans to suppose the existence of upper halls, to which the reliefs had belonged, above the magazines. These halls seem undoubtedly to have existed, and a ramp led up to them from the "Stepped Theatral Area."

These are all very interesting results, and show how much there is still to be discovered at Knossos.

The excavations of the British School at Athens at Palaíkastro are described by Messrs. Dawkins and Currelly. The remains of a shrine of the Cretan snake-goddess (analogous to those at Knossos and Gourniá) were found, besides some interesting *larnax*-burials. Mr. Dawkins gives a careful analysis of the pottery found in the town ruins, and a very useful comparative table of the strata of the Minoan period, with illustrative examples from Cretan and non-Cretan sites (p. 195). Mr. H. R. Hall publishes a

photograph of an important Egyptian tomb-painting depicting Minoan ambassadors bringing rare vases of Cretan workmanship to the court of Queen Hatasu or Hatshepsu at Thebes.

In connection with the point raised anent the Minoan way, already described, at Knossos, that there was a great gap in history between the last (presumably non-Aryan) Minoans and the first (Aryan) Hellenes, we may note that Mr. R. S. Conway returns to the charge in defence of the "Aryanism" of the Minoans in another article on the Eteocretan inscriptions of classical times, which he considers to represent the speech of the Minoan Cretans. There is no proof of this whatever, and even if Mr. Conway were to succeed in proving the Indo-European character of this late "Eteocretan" language up to the hilt, this would not in the least shake our conviction that the old Minoans spoke a non-Indo-European tongue. The craniological and archæological evidence must be taken into consideration as well as the philological, which can apparently be twisted into meaning anything that the investigator wishes. The craniologist assigns the Minoans to the "Mediterranean" race, to which the ancient Egyptians also belonged; and the archæologist brings the Minoan and Egyptian cultures back almost to a common origin. Further, Mr. Conway's idea goes counter to those of many of the philologists themselves, especially Kretschmer, whose view that the præ-Hellenic speech of Greece was non-Aryan agrees with the results of craniological and archæological research, and is generally accepted now.

This completes the list of articles dealing directly or indirectly with the Minoan or Mycenæan antiquities, the relics of the prehistoric culture of Greece.

Mr. Dawkins contributes an interesting philological article, entitled "Notes from Karpathos," describing the linguistic phenomena of that little known island, which he visited two years ago. The dialect seems to be more divergent from that of Crete than might have been expected. It presents all the peculiar dialectical phenomena of the Southern Ægean. Such pronunciations as "hyaloshorzho" (χγαλοšορžο) for Καλοχωρίον, which strike one so forcibly in Crete, are well represented. Aberrant grammatical forms are not uncommon. The old third plural in -σι(ν) survives. Here we have a considerable difference from Cretan practice, which prefers third plural in- νε: "they went," in Cretan ἐφύγανε, is in Karpathian ἐφύγασι(ν), and "they are walking," Cretan πατούνε, is in Karpathian πατούσι(ν), which sounds quite "Attic." This is an interesting survival. Articles of this kind are of great use and value.

Mr. M. N. Tod and Mr. E. S. Forster add contributions to epigraphic scholarship, and the latter also describes Laconian topography and archæological sites. Mr. A. J. B. Wace has an article on Greek grotesque figures as charms against the evil eye. The modern Hellenes wear charms in the shape of little silver or coral figures of hunchbacks (*gobbi* or *gobbetti*) for the same purpose.

Dr. Schäfer's German article on "Altägyptische Pflüge, Joche," is apparently published in the "Annual" on account of the ancient Egyptian basket figured on p. 140, which is of the same type as the Greek *liknon*, discussed by Miss Jane Harrison in her note on the "Mystica Vannus Iacchi," which follows. Otherwise one would have thought that its proper place would have been found in an Egyptological publication. The Berlin Museum has a large collection of ancient Egyptian agricultural implements, which are, however, of course all, with the exception of a fine plough and the basket aforesaid, of well known types equally well represented in other museums.

H. R. HALL.

SOUTH AFRICAN MEETING OF THE BRITISH ASSOCIATION.

LETTERS from local correspondents in South Africa have just brought us some notes upon the recent meeting of the British Association. During the progress of the meeting several cablegrams which appeared in the *Times* were summarised in these columns, so that many of the matters mentioned by our correspondents have already been recorded. Dr. J. D. F. Gilchrist has sent us an account of the part of the proceedings of the association at Cape Town, and the following particulars in so far as they are connected with Cape Town are from his communication. As, following our usual custom, we have arranged with officers of the sections for reports of the proceedings at sectional meetings, it is unnecessary now to give any account of these meetings.

Dr. Gilchrist states that as early as August 6 some of the British Association visitors began to arrive in Cape Town by the *Tintagel Castle*; eighteen more arrived on August 8 by the *Kildonan Castle*, and forty-three by the *Durham Castle* on August 12. The main body, however (eighty-six), including most of the official party, arrived by the *Saxon* on Tuesday, August 15.

The voyage of the main party was favoured by excellent conditions of weather, and the usual routine of life and entertainments on board was diversified by lectures by members on appropriate subjects of interest, and in one or two cases by scientific work, such as the collecting of plankton and temperature observations of sea and air. A few advance copies of "Science in South Africa," a handbook prepared on the occasion of the visit, were on board, and afforded some insight into the scientific work and problems engaging the attention of South Africans.

On arrival at Cape Town Docks the passengers were transferred to the train waiting alongside, and about 10 a.m. on August 15 arrived at the main station, where they were met by the mayor, the hospitality committee, and others. The council of the association met at 12 noon and the general meeting at 2 p.m., and the formal business was quickly got through.

The details of the somewhat extensive programme were in an advanced state of preparation, the general plan and coordination of the whole having been undertaken by a central organising committee for South Africa, the local details by the several reception committees at the seven local centres to be visited. These local committees were subdivided into entertainment, hospitality, excursions, and finance subcommittees.

Great assistance was rendered by Mr. Silva White, assistant secretary of the British Association, who arrived some weeks before the first meeting and took over the general direction of, and responsibility for, the arrangements. He arranged for the services of four assistant secretaries, who were instructed as to the details to be carried out on certain sections of the programme allotted to them, an arrangement which was fully justified by the subsequent results.

The formal business of the association commenced with the presidential address, which was delivered on the evening of August 15 in the City Hall, which had just been completed in time for the meeting. The work of the various sections began the following day, and occupied the mornings from Wednesday, August 16, to Friday, August 18, half the sectional work being transacted at Cape Town and half at Johannesburg.

In the afternoon of August 16 there was a large attendance at the Governor's garden party, and in the evening the Mayor met the visitors at a reception in the City Hall.

A large number of papers were read on the mornings of the two following days. As a special feature of the papers and presidential addresses was their bearing on South African questions, exceptional interest was taken in the sectional proceedings.

The following excursions were made on August 17:—(1) botanical excursion to the Kloof Nek; (2) visit to Groote Schuur for lady members of the British Association by invitation of the Loyal Women's Guild of South Africa; (3) visit to the Central Electric Station of the Cape Town Corporation. In the evening a lecture was given in the City Hall before a crowded audience on "W. J. Burchell's Discoveries in South Africa," by Prof. E. B. Poulton, F.R.S.

The afternoon of August 18 was devoted to excursions; and a reception was held by Sir David and Lady Gill at the Royal Observatory. In the evening a lecture was given in the City Hall on "Some Surface Actions of Fluids" by Mr. C. V. Boys, F.R.S.

Saturday, August 19, was devoted entirely to the following excursions:—(1) geological excursion; (2) Wellington; (3) De Beers Explosive Works; (4) Houts Bay; (5) Groot Constantia and Tokai; (6) Robben Island; (7) Stellenbosch; (8) Admiralty Works at Simons Town and Marine Station at St. James; (9) Table Mountain *viâ* Saddle Face; (10) Table Mountain *viâ* Wynberg; (11) Table Mountain *viâ* Kasteel Poort.

Dr. W. Flint (librarian to the Houses of Parliament), who accompanied the association throughout its entire journey, has undertaken to send NATURE some account of the Natal, Johannesburg, and Rhodesian proceedings. The following notes are from a letter just received, with the promise of a further instalment by the next mail.

On the termination of the meeting in Cape Town the main body of the members of the association proceeded to Durban in the Union Castle steamers *Saxon* and *Durham Castle*. The former steamer left the docks on Friday evening, August 18, and its passengers were debarred from taking part in the numerous Cape Town excursions which had been arranged for the Saturday. The *Saxon* passengers had, however, the advantage of brief visits to Port Elizabeth and East London, at each of which ports of call a few hours were spent, and hospitality was tendered by the mayor and citizens. The *Durham Castle* proceeded direct to Durban, and, making a record passage, arrived a little in advance of the mail steamer. A party of some thirty persons elected to proceed to Durban overland in one of the trains provided by the Cape Government, which was proceeding to Durban to meet the steamers. A special geological excursion through the Hex River Pass on to the Karroo captured a few enthusiasts, who, under the guidance of Mr. A. W. Rogers, of the Cape Geological Survey, spent a few days which proved to be of great interest. These members necessarily had to deprive themselves of the pleasure of the Natal section of the tour. The trip overland to Durban, which occupied four nights and three days, was unanimously voted a great success, and as several of the passengers are proceeding to England by Beira and the east coast, the opportunity of seeing the Karroo was much appreciated.

The two days spent in Durban and the neighbourhood were very fully occupied, the hospitable ideas of the mayor and his numerous helpers having provided a very attractive programme. Tuesday morning, August 22, was occupied in settling down and taking the bearings of the town, and early in the afternoon a public welcome was tendered by the mayor, Mr. Henwood, to which Prof. Darwin responded. A garden party generously given by Sir Benjamin Greenacre, for which very elaborate preparations had been made, was partly spoiled by a heavy thunderstorm, but large numbers braved the downpour and were rewarded by seeing a few of the glories of the Berea.

Two lectures were given in Durban to very large audiences. Mr. Douglas W. Freshfield discoursed on "Mountains—the Highest Himalaya," and Prof. W. A. Herdman on "Marine Biology."

The second day in Durban was occupied chiefly with excursions. Perhaps the first place was taken by the entertainment provided by the Hon. Marshall Campbell at the Mount Edgecombe Sugar Estate. The contrast afforded by a Zulu war dance and a demonstration by Christian native girls was an object lesson which many were glad to have seen.

The excursion to Umkomaas was scarcely less enjoyed, the romantic subtropical scenery being a revelation to many of those who were privileged to be present. The botanists especially seemed to revel in the opportunity, the wealth of Strelitzias in their native habitat being particularly attractive.

On Thursday morning, August 24, the whole party left in four trains, to be known henceforth as A, B, C, and D trains, and arrived about mid-day in Maritzburg. The journey is one of the most attractive in South Africa, passing in its earlier stages through sugar, banana, and pine-apple plantations, and ascending rapidly to the Botha Hill heights, from which views of singular extensiveness and beauty are obtained. On reaching Maritzburg admirably complete arrangements were found to have been made, and members found themselves welcomed with great cordiality by Mr. A. W. Kershaw, the Mayor, and a host of willing citizens who had thrown themselves with great zeal into their task.

His Excellency Colonel Sir H. E. McCallum held a garden party at Government House which was a very successful function, and in the evening the Town Hall was thronged when His Excellency and the Mayor gave addresses of welcome. Colonel Bruce followed with a lecture on "Sleeping Sickness" which created great interest.

On the following day there were visits to the Government experimental farm and the Government laboratory, but it is to be feared that these were somewhat overshadowed by the Kafir dance and wedding which took place at Henley. The wedding was that of a young hereditary chief, and was preceded by the various dances and ceremonies customary on such an occasion. Never, probably, were so many photographs taken on a single day in Natal. The cameras were legion, and some of the photographers were not content with less than two or three dozen of pictures.

In the evening the young Natalian member of the official party, Mr. H. D. Ferrar, by special request, gave a lecture on "Antarctic Regions," he having been a member of the *Discovery* Antarctic Expedition.

Both in Durban and Maritzburg all members of the association had free use of the municipal trams, and nothing was left undone to ensure the comfort and enjoyment of the visitors, who in their turn were loud in their praises of the reception accorded.

TWO REPORTS OF THE FRENCH GLACIER COMMISSION.

A RECORD of observations on snowfall and avalanches undertaken by the Forestry Department of Savoy during 1904 on the south-west flank of Mont Blanc is contained in a paper entitled "Observations sur l'Enneigement et sur les Chutes d'Avalanches," issued by the Commission française des Glaciers (Paris: Club Alpin français). The

paper is a continuation by M. Mougin of his report of June, 1903, and deals with the results obtained from the seven instruments placed at appointed stations between the village of Houches and the Aiguille du Goûter. Unfortunately, the snow-gauge placed on the Aiguille du Goûter was destroyed by a party of young students from Geneva who attempted the ascent of Mont Blanc without guides in 1902. On the Tête-Rousse, again, the instrument was found completely empty; fortunately, however, the platform snow-recorder, placed on the glacier, enabled an estimate of the snowfall to be made.

The general results derived from the records of these seven stations show that between 1000 metres and 3200 metres the snowfall increases with altitude, but the results are not altogether satisfactory. Thus the record at 2100 metres gives a fall equivalent to 0·3194 mm. of water only, whereas the stations above and below show falls of 1·848 mm. and 0·491 mm. respectively.

Even if the upper station is excessive, the station above at 2850 metres at the Pierre-Rondestill shows an increase, being 0·4461 mm.; it is possible, therefore, that the mouth of the instrument has become blocked by a film of verglas. With regard to the large fall recorded at 2550 metres, it is possible that here we have the altitude at which the greatest precipitation takes place. The loss of the instrument at the summit of the Aiguille du Goûter is all the more to be regretted on this account, as it would undoubtedly have thrown light on this point, and it is to be hoped that the instrument may speedily be replaced.

The report gives a detailed description of the instruments used. These consisted of horizontal boards placed one metre above the ground, and also of Vallot's snow-gauges of a modified design.

Comparative experiments were made during the winter at Chambéry between the official rain-gauge, the Vallot tubes, and the snow-table. The results are expressed in tables and by curves. No useful comparisons could be made between the rain-gauge and the Vallot tubes, but the results obtained with the latter instrument are compared with those obtained with the snow-table, and are expressed both in depth of snow and amount of water melted. The small number of snowstorms during the winter of 1902–3 was also unfavourable to any definite conclusion being arrived at; further experiments are required.

The report ends with tables showing the snowfall and number of avalanches which fell in Savoy during 1902, also the damage done to forests, roads, and water-courses, and accidents to men and animals.

Another report received from the Commission française des Glaciers deals with the observations by M. Paul Girardin on the glaciers of Maurienne, Vanoise, and Tarentaise during August and September, 1903, and also with the glaciers of the massif of La Vanois in 1903, by J. A. Favre (Extrait de l'Annuaire du Club Alpin français, vol. xxx., 1903). M. Girardin arrives at the conclusion that these glaciers are retreating, the amount varying in different glaciers and even in different lobes of the same glacier. The general law is, therefore, complicated by local shade, &c. Retreat is most marked where surface moraines are absent, while those covered thickly with débris are more stationary. The rate of retreat has, however, diminished during the last ten years.

In the massif of the Vanoise we find the same story. Glaciers like the Grands-Couloirs, Pelvoz, &c., are all losing in thickness. In the case of the Pelvoz a new medial moraine has appeared owing to the marked ablation, while a glacier marked on the map north of the Col d'Aussois has completely disappeared. E. J. G.

INTERNATIONAL METEOROLOGICAL CONFERENCE AT INNSBRUCK.

Second and Third Meetings.[1]

AMONG the various points brought under notice, the president, Dr. Pernter, stated that M. Violle wished that his proposals made to the meeting at Southport on the question of solar radiation should be discussed. After considerable deliberation, it was resolved that the principal observatories should be requested to make observations of solar and terrestrial radiation. Measurements should be made daily, those of solar radiation at 11h. a.m. or from 11h. a.m. to 1h. p.m., and those of terrestrial radiation at 10h. p.m. or from 10h. p.m. to 12h. p.m. The apparatus used should be exclusively Angström's compensation actinometer.

Upon the subject of excessive rainfall, Dr. Landa, of the k.k. hydrographisches Central-Bureau (Vienna), proposed (1) that meteorological offices should be invited to inquire into the causes of origin of cases of excessively heavy rainfall over large areas, including those which have already occurred, and any that may occur in future, in the districts under their supervision, and to publish the results of their investigations, and (2) that it should be recognised as useful to investigate the historical documents of various countries for particulars of abnormal meteorological occurrences, such as floods, droughts, very severe winters, &c., and to classify and publish the results of their researches.

The classification of meteorological stations, according to the nature of the work carried out, was referred to the International Meteorological Committee, as was also the definition of such phenomena as hoar-frost, silver-thaw, glazed frost, &c.

On the important question of long series of homogeneous observations, necessary for the study of secular variations, the conference adopted Dr. Hellmann's proposal that central meteorological offices should establish in their respective organisations one or more secular stations, according to the extent of the country, and should carry on the observations as uniformly and continuously as possible. At the same time, the conference expressed the hope that old series of observations might be critically discussed and published.

On the proposal of M. Rosenthal, the conference requested General Rykatcheff to undertake, on the part of the Central Physical Observatory, St. Petersburg, the publication of a summary of the results of observations made during the last century. Dr. Hellmann was requested to assist in the preparation of this useful work.

Prof. von Bezold raised the question of the status of the conferences of directors, and of the International Meteorological Committee; he thought they should maintain an official character, so far as possible, and that the number of meetings should be as few as practicable. After considerable discussion, a proposal by Dr. Hellmann was adopted, viz. that the conference should request the International Meteorological Committee to draw up a standing order relating to the International Meteorological Organisation, at the same time taking note of the historical development of the committee. This rule, dealing with conferences of directors, the international committee, and the subcommittees, should be submitted to the next conference of directors for discussion.

M. Froc made a communication respecting the organisation of the meteorological service of the

[1] An account of the opening meeting appeared in NATURE of Septem 21 (p. 510).

Chinese Maritime Customs. We have not yet received the protocol of the last meeting, but we may state that it included reports of the various commissions.

With regard to the Solar Commission appointed in 1903, complete arrangements were made for bringing together all data necessary for the study of simultaneous solar and terrestrial changes. Letters had been received from Prof. Hale and M. Deslandres placing their photospectroscopic results at the disposal of the commission.

INTERNATIONAL UNION FOR COOPERATION IN SOLAR RESEARCH.

AT last the importance of solar research is asserting itself, even in the minds of some who in the past have shown it scant favour. It is not a little remarkable that during last month two international bodies held meetings, both of them concerned with solar observations, the one, the Solar Commission, established in 1903, which met at Innsbruck, dealing with them in relation to the meteorological changes on the earth, the other, the Solar Union, established in 1904, which met at Oxford, dealing with the physics of the sun itself. There is thus fortunately a sharp-cut line between these two efforts to advance our knowledge, and we hope that both bodies will ultimately find out the best ways of doing this. In a preliminary circular we read :—

The number of international organisations having considerably increased lately, it is desirable that overlapping of the work of different organisations should be avoided as much as possible. As far as solar research is concerned, a committee on questions dealing with radiation and the connection of solar and terrestrial phenomena has been appointed by the International Meteorological Committee. It will probably be found advisable to omit for the present the investigation of the relation of the sun-spot cycle to meteorological phenomena from the programme of the union; but the question of the solar constant being of fundamental importance must form from the beginning an essential portion of its work. The astronomical and meteorological aspects of solar radiation are, however, very different, and there is no reason to doubt that some arrangement can be made by which the efforts of the Meteorological Committee and those of the Union on Solar Research may be united.

We have not yet received the official protocols of the Oxford meeting, but some points may be referred to. The meeting was well attended, the following foreign men of science being present :—Prof. K. Ångström, Acad. Sci. (Stockholm); Prof. A. Belopolski, Acad. Sci. (St. Petersburg); Fr. Cirera, Ast. Soc. of France; Cte. de la Baume Pluvinel, Ast. Soc. of France; Mr. H. Deslandres, Ast. Soc. of France; Prof. W. S. Eichelberger; Mr. Fabry, Physical Soc. of France; Mr. G. E. Hale, Nat. Acad. Sci. (Washington); Mr. Hansky, Acad. Sci. (St. Petersburg); Mr. J. Janssen, Acad. Sci. (France); Prof. W. H. Julius, Acad. Sci. (Amsterdam); Prof. H. Kayser, German Physical Soc.; Mr. Perot, Physical Soc. of France; Prof. E. Weiss, Internat. Assoc. Acad.; Prof. Wolfer.

Dr. Janssen was elected honorary president, and Sir Wm. Christie president, of the meeting.

Among the many resolutions passed were the following, laying down the principles which should be followed in the proposed cooperation :—

(1) Cooperation is desirable in the various branches of solar research such as visual and photographic observations of the solar surface, visual observations of prominences and observations of the solar atmosphere with spectroheliographs of various types.

(2) When an institution has collected and coordinated results from various sources, members of the union shall be requested to place their observations at the disposal of the said institution.

(3) In the case of investigations which have not yet been thus collected and coordinated, special committees specially nominated by the union shall be charged with the work of preparing and carrying out the needful cooperation.

(4) It is proposed forthwith to organise such cooperation in two branches of research :—

(*a*) The study of the spectra of sun-spots.

(*b*) The study of the records, by means of the H and K light, of the phenomena of the solar atmosphere.

(5) The committee lays special stress on the fact that, notwithstanding the obvious utility of cooperation in certain cases, individual initiative is the chief factor in a very large number. It is as much the duty of the union to encourage original researches as to promote cooperation.

Much time was spent in discussing the constitution of the union, and several committees were appointed. There were most interesting discussions on solar radiation, Prof. Angström describing his instrument which has now been taken as the standard, and we may add that as this subject is also dealt with by the International Meteorological Committee, Prof. Ångström has been appointed chairman of the committees appointed by both organisations. The executive is to consist of a committee with Prof. Schuster as chairman, and a "computing bureau" is suggested at Oxford in charge of Prof. Turner, which is to deal, if necessary, with classes of observations not already provided for.

The next meeting is to be held at Meudon in two years' time.

NOTES.

WE notice with much regret that Sir William Wharton, K.C.B., F.R.S., died at Cape Town on September 29 from enteric fever and pneumonia, at sixty-two years of age.

WE regret to see, in the *Athenaeum*, the announcement of the death, in his sixty-ninth year, of Dr. W. von Bezold, professor of physics and meteorology at the University of Berlin, and director of the German Meteorological Institute.

THE death is announced of Dr. A. H. Japp, author of a life of Thoreau, several works on natural history, and "Darwin and Darwinism."

THE International Congress on Tuberculosis was opened at Paris on Monday, October 2, by the President of the French Republic. Dr. Hérard, the president of the congress, gave an address on international medical congresses, and the services which they have rendered in the struggle against consumption. Addresses were then given by the foreign delegates, and by M. Loubet.

A REUTER message from Gothenburg reports that a severe shock of earthquake was felt on September 26, 1.30 p.m., at Lundby, in the island of Hisingen. Subterranean rumblings were heard, and the houses suddenly began to rock so violently that inner and outer walls were cracked. The disturbance lasted about a minute.

NEWS has been received from Samoa that a volcanic eruption occurred on the Samoan islands on the morning of August 21. The eruption was preceded by a violent earthquake shock, which destroyed a large number of buildings. During the eruption large masses of material were ejected, and for five days lava flowed over more than four miles of the surrounding country.

IT is officially reported that a case of cholera occurred in Berlin on September 23, the victim being a canal bargeman on one of the Berlin canal harbours.

THE provisional programme for the session 1905–6 has now been published by the Royal Geographical Society. The first meeting will be held on November 6, when an introductory address will be given by the president, Sir George T. Goldie, K.C.M.G., F.R.S. The paper for the evening will be "Travels in the Mountains of Central Japan," by the Rev. Walter Weston. On November 20 the paper will be "First Exploration of the Hoh-Lumba and Lobson Glaciers (Himalaya)," by Mrs. Fanny Bullock Workman; on December 4, "Exploration in the Abai Basin, Abyssinia," by Mr. H. Weld Blundell; and on December 18, "Exploration in New Guinea," by Mr. C. G. Seligman. Other provisional arrangements include the following papers:—Colonel Sir T. H. Holdich, K.C.M.G., will deal with "Unexplored India"; Prof. J. W. Gregory, F.R.S., takes up "The Economic Geography of Australia"; Baron Erland Nordenskjöld will lecture on "Explorations in Bolivia and Peru"; and Prof. Alleyne Ireland on "The Philippine Islands." Mr. G. F. Scott Elliot will read a paper on "The Geographical Influences of Water Plants in Chile," and Mr. Laurence Gomme on "Maps of London." In the research department, Sir Clements R. Markham, K.C.B., F.R.S., will lecture on the subject "On the Next Great Arctic Discovery: the Beaufort Sea." In this lecture Sir Clements Markham will advocate detailed investigation of the unknown region lying between Prince Patrick Island and the New Siberian Islands.

THE Bureau of the Government Laboratories of the Interior has issued a Bulletin (No. 25) containing two articles by Mr. R. C. McGregor on birds from various islands of the Philippine group. Several species are described as new, among the most interesting of which is perhaps a new owl of the genus Otus. Illustrations are given of the enormous nesting-mounds of the Philippine megapode and of the nests and eggs of three remarkable species of swifts from the archipelago.

THE contents of the *Zoologist* for September include an illustrated article by Mr. R. B. Lodge on birds nesting in Andalusia (in the course of which allusion is made to the devastation among the bird-fauna caused by the late drought), and the second instalment of the editor's essay on extermination. Much interesting information will be found in the latter with regard to the destruction of animals caused in different parts of the world by floods, drought, pestilence, &c.

BIRDS obtained from the islands lying between Kiushu and Formosa form the subject of an illustrated paper communicated by Mr. M. Ogawa to vol. v., part iv., of *Annotationes Zoologicae Japonenses*. Coloured plates are given of a Garrulus, a woodpecker, and a heron of the genus Nannocnus, described as new. Special interest attaches to the description, by Mr. H. Sauter, of a riband-like fish from the Sagami Sea regarded as indicating a new genus and species (*Ijimaia dofleini*) of the small and peculiar family which the author considers to be typified by the Japanese and Indian Ateleopus, the new genus being characterised by the subterminal mouth and short ventral fins.

THE mutual affinities of the species of cray-fishes of the genus Cambarus forms the title of the only biological paper in No. 180 of the *Proceedings of the American Philosophical Society*. The author, Dr. A. E. Ortmann, finds that the commonly accepted division of the genus into five groups is not based on natural affinities, which has led to some erroneous conclusions with regard to geographical distribution. Observations on columbium and tantalum, by Mr. E. F. Smith, and an inquiry into the pressure and rainfall conditions of the trades monsoon area, by Mr. W. L. Dallas, are the titles of other articles.

THE entomological collection of the natural history branch of the British Museum will shortly be augmented by the collection of beetles bequeathed by the late Mr. Alexander Fry, which has been already deposited in the building. It is reported to be the finest collection of its kind in the country, and although not especially rich in types, contains an unrivalled series of weevils and longicorns. The total number of species in the collection is reported to be about 72,000, represented by some 200,000 specimens, many of these species being new to the museum. The cabinet includes the collections made by the late Mr. John Whitehead in Borneo and by Mr. W. Doherty in the Malay Archipelago generally. The bequest also includes a number of valuable entomological books. It may be mentioned that the collection of domesticated animals in the north hall of the museum has been recently enriched by the gift of statuettes of two famous race-horses, namely, "Persimmon," the property of His Majesty the King, and his son "Zinfandel," owned by Lord Howard de Walden; H.R.H. the Prince of Wales being the donor of the one and Lord Howard de Walden of the other.

THE fourth part of the thirty-third and the first part of the thirty-fourth volume of Gegenbaur's *Morphologisches Jahrbuch* contain an exceedingly interesting and important article on the papillary ridges and grooves on

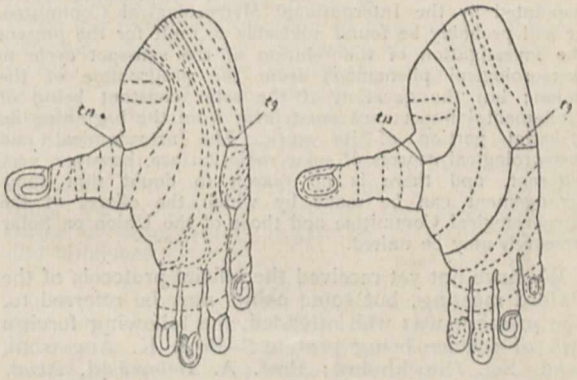


FIG. 1.—Two examples of the plantar surface of the right hind-foot of the chimpanzee to exhibit, in a diagrammatic manner, the "triradius" (*tr*). After Schlaginhaufen.

the sole of the foot in the Primates (inclusive of man), with especial reference to their serial correspondence with those of the palm of the hand, which have already been fully worked out by Hepburn and others. The article, which is by Dr. O. Schlaginhaufen, is far too long to permit of even a *précis* of its contents being given in this place, but it may be mentioned that the general arrangement of the papillary tuberosities is the same on the sole as on the palm. The most generally interesting fact brought out by the author's investigations is that while in all the Old World Primates (inclusive of man) the ridges and grooves on the sole in the neighbourhood of the great toe, or pollex, are so arranged as to form a triradiate system, termed the triradius, this feature is totally wanting in the monkeys of the New World. We have thus a new and deep-seated distinction between "Catarhini" and "Platyrhini."

AMONG the contents of the latest parts of the *Morphologisches Jahrbuch* (vol. xxxiii., part iv., and vol. xxxiv., part i.) may be mentioned an article by Mr. E. Göppert on the brachial artery of the Australian spiny anteater (Echidna), with special reference to the arterial system in the fore-limb of mammals in general, and a second, by Dr. O. Grosser, on the existence of a distinct segmental arrangement in the superficial vascular system of the human chest. In the second of the two volumes Dr. E. Küster describes the so-called *tastfeder* (sensory feathers) found at the base of the beak in owls and other birds, which are shown to be provided with sensory corpuscles, and are correlated by the author with the "feelers" or vibrissæ of mammals.

ALL the articles in the two concluding parts (iii. and iv.) of vol. lxxix. of the *Zeitschrift für wissenschaftliche Zoologie* deal with the anatomy and development of invertebrates. The minute structure of the eye receives the attention of two writers, Mr. H. Merton discussing the retina in nautilus and other dibranchiate cephalopods, while Mr. M. Nowikoff describes the eye and frontal organs of the branchiopod crustaceans. The spermatozoa of the common intestinal round-worm (Ascaris) receive attention at the hands of Mr. L. Scheben, of Marburg, Mr. K. Thon treats of the excretory organs of the hydrachnid family Limnocharidæ, while Mr. Stoffenbrink records the effects of special nutrition on the histological constituents of the fresh-water planarians. Finally, Mr. A. Zwack discusses the minute structure and mode of formation of the "ephippium" of the fresh-water flea (Daphnia), while Dr. E. Martini devotes himself to observations on the amœba-like Arcella.

THE latest number of *l'Anthropologie* (vol. xvi., No. 3) contains a useful article on Paumotu fishing implements. The British Museum is singularly poor in specimens from these islands, and the "Album" of Edge-Partington and Heape only figures two or three fish-hooks. In the present article a dozen hooks are figured and described; the construction of the canoes and method of sewing the planks are also illustrated. An article on the musical instruments in French Congo is diminished in value by errors in the illustrations; the *bambour* on p. 289 is reproduced from a sketch, and the artist has omitted the pins to which the strings are attached, making it appear that there is no means of altering the tension of the cords.

THE Department of Agriculture in Jamaica has been at considerable trouble to effect the improvement of home-grown tobacco, and if the experiments carried out at Hope Gardens may be taken as a criterion, there is a promising future for Sumatra wrapper-tobacco grown in the open and for Havana leaf, both shade-grown for wrapper and outside-grown for filling.

THE South Orkney Islands, lying about 600 miles south-east of Cape Horn, were visited by members of the Scottish National Antarctic Expedition voyaging in the ship *Scotia* in February, 1903. The collections of mosses and lichens obtained by Mr. R. N. R. Brown, the botanist of the expedition, are described in vol. xxiii., part i., of the *Transactions and Proceedings of the Botanical Society of Edinburgh*. Mr. C. H. Wright has identified six mosses which are all Antarctic, except one previously known only from Tristan da Cunha. Dr. O. V. Darbishire has worked out the lichens and distinguishes twelve species, including one, *Placodium fruticulosum*, new to science.

THE explanation that plants have developed thorns to keep off the depredations of herbivorous animals does not lend itself to experimental investigation, as the development would be an exceedingly slow process. But the argument that thorns are merely xerophytic structures is more easily put to the test, and Dr. L. Cockayne describes in the *New Phytologist* (April) his experiments with the New Zealand shrub *Discaria Toumatou*, known popularly as Wild Irishman, which in ordinary circumstances is abundantly furnished with long pungent spines. The experiments consisted in removing plants, at the stage when spines were beginning to be formed, to a moist chamber, where they were grown, and there maintained the leafy spineless habit characteristic of seedlings.

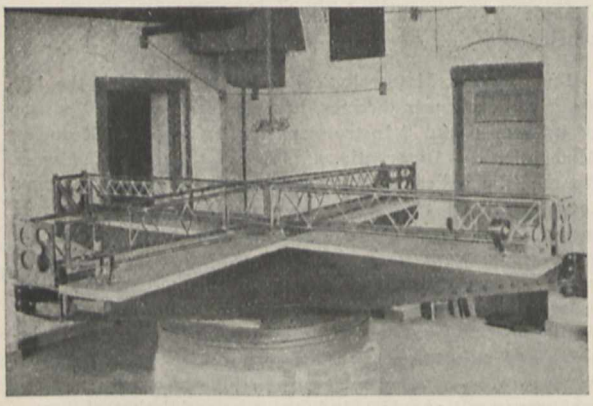
THE investigations of Prof. G. Haberlandt on the sense-organs of plants, which are of great scientific interest, form a suitable subject for popular exposition, and an account by Mr. G. C. Nuttall appears in the *Monthly Review* (September). The main result of Prof. Haberlandt's work was to show that where plants are sensitive to touch, at these points special adaptations of hairs or cells are found. The sensitiveness of tendrils and of the specialised leaves of Drosera and Dionæa is a matter of common knowledge, but the irritability of the stamens of such plants as Opuntia, the prickly pear, and Abutilon is less generally known. At certain spots the stamens of these plants are provided with papillæ which enable them to perceive contact stimuli. The concluding argument which is presented to the reader that plants are capable of experiencing sensations is by no means convincing.

THE German Meteorological Institute, of which the late Prof. v. Bezold was director, has published a second edition of its very useful "Instructions for Taking and Reducing Meteorological Observations." A great part of the work (as the title indicates) has been re-written and re-arranged to bring it up to date as regards the improvements in methods and instruments that have taken place in recent years. The work is divided into two volumes, dealing (1) with the requirements of stations of the second and third orders, and (2) with special observations and instruments; the latter part contains valuable explanations of the principles and adjustments of Richard's much used self-recording apparatus, of anemometers, sunshine recorders, and the nephoscope, all of which it is most essential that observers should thoroughly understand, but which are not always to be found in existing instructions. The aim of the work is to instruct observers in all parts of the operations required of them, from the choice of a suitable locality for a station, the erection of the instruments, and the method of taking observations, to the deduction of mean results, the most essential portions being printed in larger type. The work will certainly fulfil the intention of its author, viz. to render lighter the labours of observers and to ensure accuracy in their observations and calculations.

IN the *Memorie* of the Royal Institute of Lombardy (vol. xx.) Dr. Alessandri gives an account of the Regina Margherita Observatory at the summit of Monte Rosa, on the peak known as the "Signalkuppe," 4559 metres above sea-level. The station is under the control of the Central Meteorological Office at Rome, and it is intended (if possible) that observations should be made each year between July 15 and September 15. The difficulties encountered in the first year (1904) were so great that Dr. Alessandri states that the expedition can only be considered as a preliminary attempt, with the view of overcoming them in future years. The conveyance of instruments and materials from Alagna had partly to be done by mules and partly by men, at a cost of 62 centesimi for each kilogram

(2.2 pounds' weight), with the result that many of the instruments were broken in transit. Owing to the intense cold, the clogging of the apparatus by hoar-frost and violent snowstorms, together with the intense electrification of the atmosphere, rendered regular observations almost impossible with the means then available. The shade air-temperature at the summit of Monte Rosa is practically always below freezing point; the thermometers taken by Dr. Alessandri read to −20° C., but the extreme temperature often fell below that. The mean reading of the barometer during the summer of 1904 was 17·1 inches; water therefore boiled at about 85° C. The lightning conductors frequently appeared like steadily burning candles, and the observers experienced at times such unpleasant shocks that it became advisable to retire within the observatory.

ABOUT twenty years ago Messrs. Michelson and Morley concluded from the results of their well known experiments that the ether in the neighbourhood of the earth is not at rest in space, but is carried along with the earth in its motion. Prof. Fitzgerald and Prof. Lorentz subsequently suggested that the experimental results of Michelson and Morley might also be explained by the dimensions of the apparatus being modified by its motion through the ether. In order to test this assumption, Messrs. E. W. Morley and D. C. Miller (*Proceedings Amer. Acad. Arts and Sciences*, xli., No. 12) have repeated on a more elaborate



scale the experiments of 1887, using two modified forms of apparatus. The sandstone of the earlier experiments was replaced in one form of apparatus by a structure of white pine, whilst in the final and more complete experiments a steel framework was used to support a system of pine rods. The figure shows the steel cross-framework adopted, with the trusses supporting the distance pieces and the mirror frames and telescopes in position. The entire apparatus weighed 1900 lb., and floated in mercury. As a result of the experiments, a nearly similar conclusion to that previously formed is arrived at. If the dimensions of the pine are changed, the change is of the same amount as with sandstone; if the ether near the apparatus did not move with it, the difference in velocity is apparently less than 3·5 kilometres per second.

THE *Journal of the Royal Sanitary Institute* for September (xxvi., No. 8) contains an important paper by Prof. Woodhead on the water supply problem in rural districts, together with the discussion thereon.

IN the *Century Illustrated Monthly Magazine* for October Prof. Chittenden gives a popular account of his researches on the amount of nitrogenous food required to maintain physiological equilibrium, which, should his results stand the test of time, will mean great economy in the future.

General Horace Porter writes a graphic account of the investigations which led to the search for the body of Paul Jones and its ultimate recovery in the forgotten cemetery of Saint Louis, its identification, and removal to the United States.

WE have received the results of meteorological observations for 1900–2, and of rain, river, and evaporation observations for 1901–2, made in New South Wales. The latter work contains valuable statistics of rainfall for each month for the years in question, and various returns for other periods, *e.g.* the mean annual rainfall at all stations with three and up to fourteen years' records from 1889 to 1902 inclusive, and records for the whole of Australia for individual years since 1840. In the years 1901–2 severe and almost unprecedented droughts were experienced. The average fall for the whole colony for thirty-two years (1871–1902) is 24.15 inches, but in 1901 the amount was only 18.15 inches, and in 1902 14·09 inches, the lowest average on record with the exception of that for the year 1888, when it was only 13·40 inches. The effect on sheep grazing was disastrous; the number of sheep in the western division during seven years ending with 1901 dwindled from about 16 millions to 5 millions, representing a loss to the State of about 30 millions sterling.

IN the current issue of the *Journal of the Franklin Institute* the first instalment is published of an elaborate monograph on mica by Mr. G. W. Colles. The subject is dealt with chiefly from an industrial point of view, the present, past, and probable future of mica mining being discussed.

A SECOND edition of the second volume—dealing with the chemistry of manufacturing processes—of "Chemistry for Engineers and Manufacturers," by Messrs. Bertram Blount and A. G. Bloxam, has been published by Messrs. Charles Griffin and Co., Ltd.

MR. OSCAR GUTTMANN, 12 Mark Lane, London, E.C., intends to publish a facsimile reproduction of all ancient pictures and engravings dispersed in libraries all over the world referring to the invention, early manufacture and examination, and first use of gunpowder. It is to be a work of art, printed by hand on the finest hand-made paper, with an imitation fifteenth century binding, and limited to about three hundred numbered copies.

WE have received from Messrs. J. J. Griffin and Sons, Ltd., 20–26 Sardinia Street, Lincoln's Inn Fields, W.C., their "T" list of thermometers and pyrometers for measuring temperatures between −200° C. and 4000° C. The list is a fairly complete one, and comprises ordinary, technical, and standard thermometers, as well as the principal forms of electrical resistance, thermoelectric, and optical pyrometers.

MESSRS. PHILIP HARRIS AND CO., LTD., of Birmingham, have issued their diary intended for the use of teachers and others during the session 1905–6. A very complete calendar of the examinations to be held by the chief public examining bodies during the coming educational year is provided, and there are spaces for daily notes, general memoranda, addresses, and cash accounts.

WE have received from Messrs. Williams and Norgate a copy of a new work published by Herr H. A. Ludwig Degener, of Leipzig, entitled "Wer ist's?" The volume is similar in its scope to "Who's Who," and is edited by Herr H. A. L. Degener. In addition to the particulars given of distinguished Germans, the book also includes

biographies of famous living Austrians, Frenchmen, Englishmen, and celebrities of other nationalities. The Englishmen noticed in the volume appear to be politicians as a rule, and, so far as we have tested the book, the men of science and of letters selected for inclusion are neither numerous nor particularly representative.

WE have received from Messrs. W. M. J. Brooks and Co., Letchworth, Herts, a set of five templates, or curves, accurately cut in celluloid, representing respectively the parabola, ellipse, hyperbola, cycloid, and cubical parabola. When such curves are required it seems better that a student should make them for himself, but failing this Mr. Brooks's curves may prove useful in special cases. The price is 1s. each curve.

OUR ASTRONOMICAL COLUMN.

FURTHER RESULTS OBTAINED BY THE FRENCH ECLIPSE EXPEDITIONS.—In No. 12 (September 18) of the *Comptes rendus* MM. Deslandres and Andoyer give brief summaries of the results obtained by them on their respective expeditions to observe the recent total solar eclipse.

M. Deslandres directed the Bureau des Longitudes mission to Burgos, where the actual duration of visible "totality" was curtailed by clouds to one minute, which did not include either the second or the third contacts. The proposed photographing of the chromosphere spectrum was therefore impossible. Photometric observations of the corona were obtained, and M. d'Azambuja was able to measure the coronal radiation, obtaining figures which were decidedly lower than those obtained by M. Charbonneau in 1900. M. Kannapell obtained four photographs of the corona polarised by reflection. M. Blum obtained two photographs of the corona through coloured screens so arranged as to transmit only the gaseous radiation of the prominences. By comparing these with the ordinary photographs it will, probably, be possible to determine whether or not the prominences emit a more intense continuous spectrum than that emitted by the surrounding regions.

At El-Arrouch, 32 km. from Philippeville, M. Andoyer simply attempted to obtain as many direct photographs of the phenomena as possible. His instrumental equipment consisted of a photographic objective of 14 cm. (5.6-inch) aperture and 60 cm. (24-inch) focal length, mounted with two enlarging cameras which increased the diameter of the image by three and eight times respectively.

Altogether forty-four plates were exposed, eleven of them during totality. A negative exposed two minutes before totality shows a reversed image, due to over-exposure, and a silhouette of the corona.

ELEMENTS OF COMET 1886 VIII.—From eighty-six observations of comet 1886 viii., made by various observers between January 24 and May 20, 1887, Herr E. Fagerholm, of Upsala, has calculated a set of elements for the orbit of that object. These, as given below, appear in No. 4047 of the *Astronomische Nachrichten*, together with the details of the computation and of the planetary perturbations taken into account:—

$$\left.\begin{array}{ll} T = 1886\ \text{Nov. } 28\ 44284 \pm 0{\cdot}00267\ (\text{M.T. Berlin}) & \\ \infty = 31^\circ\ 55'\ 34''{\cdot}53 \pm 18''{\cdot}25 & \\ \Omega = 258^\circ\ 13'\ 1''{\cdot}35 \pm 4''{\cdot}43 & 1887{\cdot}0 \\ i = 85^\circ\ 35'\ 17''{\cdot}33 \pm 3''{\cdot}84 & \end{array}\right\}$$

$$\log q = 0{\cdot}1704712 \pm 0{\cdot}0000214$$

THE FIGURE OF THE SUN.—In No. 2, vol. xxii., of the *Astrophysical Journal*, Mr. C. Lane Poor publishes the results of an investigation, carried out by him at the Columbia University Observatory, which seem to indicate a periodical variation in the figure of the sun agreeing in phase with the sun-spot curve. On measuring the equatorial and the polar diameters of the solar images on twenty-one plates taken by Mr. Rutherfurd in 1870, 1871, and 1872, he found indications that during this period the equatorial diameter was first increasing and then decreasing with regard to the polar diameter. To check this result he re-investigated the measures made by the German observers whilst adjusting, and determining the constants of, their heliometers for the transits of Venus in 1874 and 1882. The 1873–5 results showed a progressive change similar to that indicated by the measures of the Rutherfurd photographs taken in 1871–2, whilst the 1880–3 heliometer measures confirmed the photographic results of 1870–1. Yet another confirmation was found on measuring five solar negatives taken at Northfield (Minn., U.S.A.) during the years 1893–4, the change in figure being the same as in 1871–2 and 1873–5.

Plotting the differences between the polar and equatorial diameters in conjunction with the sun-spot curve, it is seen that the two agree, not only in point of time, but also of intensity, the excess of the equatorial diameter occurring at sun-spot maximum.

From these results it appears that the sun is usually an oblate spheroid, but at times of sun-spot minima the length of the polar axis increases in regard to that of the equatorial diameter, and the solar figure becomes prolate.

Mr. Lane Poor incidentally suggests that this variation of the solar figure may explain the anomalies in the motions of Mercury, Venus, and Mars.

BIBLIOGRAPHY OF HALLEY.—No. 14 of the Bulletin of Bibliography Pamphlets, issued by The Boston Book Company, contains the material for a bibliography of Dr. Edmond Halley, the second Astronomer Royal, and will be found a useful adjunct to any astronomical library. Reading through the numerous items, one is struck anew by the range and number of Halley's writings. The pamphlet is an extract from No. 4 (July), vol. iv., of the Bulletin of Bibliography published by The Boston Book Company, and costs 25 cents.

OBSERVATIONS OF JUPITER'S SATELLITES.—In No. 4045 of the *Astronomische Nachrichten* Profs. A. A. Nijland and J. van d. Bilt publish the results obtained from a large number of observations of Jupiter's satellites.

These observations were made with the 26 cm. Utrecht refractor during the period June 30, 1904–February 17, 1905, and in the tabulated results the time of the eclipse, transit or occultation of the particular moon is given, together with the difference between these and the calculated times.

A LOST DOUBLE STAR.—A remarkable chapter of coincidences is recorded in No. 7, vol. xiii., of *Popular Astronomy* by Prof. Doolittle, of the Flower Observatory, U.S.A. In Sir John Herschel's first catalogue of double stars, No. 165 was described as a 3″ pair with a position angle of 330°, its position being given as R.A. = 10h. 26·8m., dec. = +12° 32′ (1825). In 1878 Prof. Burnham directed his attention to the pair, and recorded its position angle as 205°·3, and its distance as 2″·59. Again in 1901 he observed the double with the 40-inch refractor, and obtained a measure agreeing with Herschel's record; but in 1902 he could find no trace of the pair observed in the previous year, nor of the star measured by him in 1878. Observations made this year with the 18-inch refractor of the Flower Observatory failed to reveal the double given by Herschel, but showed a very wide faint pair in the exact position given by him.

Thinking that Prof. Burnham in 1901 might have confused the sign of the declination, Prof. Doolittle turned his telescope to the same R.A. in declination *minus* 12°, and there apparently found exactly the pair that was wanted. This seemed to have cleared up the mystery; Prof. Burnham had in 1901 observed the wrong star.

A letter from that observer showed, however, that this is not the correct explanation.

The truth is that Herschel made a mistake of exactly one hour in recording the right ascension of H. 165, and Prof. Burnham had, unwittingly, made precisely the same mistake in 1901. Thus the latest observation of Herschel's No. 165 shows its position to be R.A. = 9h. 31m. 13s., dec. = +12° 25′ (1880), and its position angle and distance, at the epoch 1905·38, were 333°·1 and 2″·04 respectively.

In 1878 Prof. Burnham, observing in the position given by Herschel, saw a pair which was not identical with H. 165, and in the year 1902 was too faint for him to see. In 1901, repeating Herschel's mistake in the R.A., he observed the true H. 165, whilst in 1905 Prof. Doolittle found a similar pair to H. 165 in the same declination *south* and in the R.A. given in mistake by Herschel.

TYPE-WRITING BY TELEGRAPH.[1]

ONE of the most interesting papers read during the last session of the Institution of Electrical Engineers was that by Mr. Donald Murray on setting type by telegraph. Strictly speaking, the title of the paper is something of a misnomer, as the apparatus described by Mr. Murray was constructed for type-writing rather than type-setting; but as the principle is equally applicable to the latter process, it is unnecessary to be too critical. This is specially the case as the instruments and method were originally designed for the automatic telegraphic operation of linotype machines, and it was only because commercial considerations indicated the greater importance of the solution of the problem of telegraphic type-writing that attention was more particularly devoted to this question.

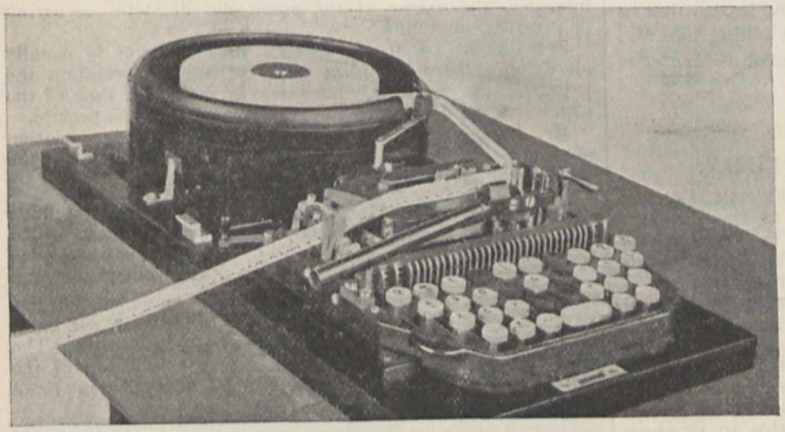


FIG. 1.—Keyboard Perforator with cover removed.

The problem which has to be solved is one of considerable complexity, as will readily be realised when its essential characteristics are considered. A message handed in at the transmitting station has to be translated into a series of signals which can be telegraphically transmitted over a single telegraph wire. These signals, on arriving at the receiving station, must actuate a receiving mechanism in such a manner that a particular set of signals produces a certain definite movement of the mechanism; thus the signals corresponding to the letter "a" must cause the striking (or equivalent) of the type-writer key "a," the signals corresponding to a notification of the end of a line must cause the shifting of the type-writer carriage ready for a new line, and so on. Now it is obvious that the signals as they are transmitted over the telegraph wire can only differ from each other by virtue either of their time arrangement or their magnitude. Each set of signals (corresponding to a letter) must be made up of one or more pulses of current, and one letter can only be distinguished from another by virtue of the pulses for the one being different in magnitude from those for the other, by their following one another at different intervals of time, or by their lasting for different periods of time; of course, also, a combination of any two or of all three of these may be used. It is not possible for the telegraphic signals to be differentiated in space unless more than one wire is used to connect the two stations. It is equally clear that the distinction between the signals in their final form is one of space, and this is so whether we consider the ultimate result, that is to say, the printed letter, or merely the alterations produced in the space relationship of the various parts of the printing mechanism which causes that mechanism instantaneously to print a particular letter. Thus we may say that what a type-writing telegraph has to do is the following:—it has to receive a message and translate it into a series of time or magnitude signals, to transmit these signals electrically over a wire, and to re-translate them into a series of space signals.

We have had occasion during recent years to describe several systems of telegraphy which aim at doing much the same thing as the Murray telegraph attempts, and it is of interest to compare the transmission methods used in these. Thus in the telautograph (see NATURE, vol. lxiv. p. 107) the actual handwriting of the original message is transmitted and reproduced, and this is done by a combination of space and magnitude signals. Two wires are used, and current pulses of varying magnitudes sent along them which reproduce at the receiving end the motion of a pen at the transmitting station. Here the time element of the signals has no effect, and a letter is reproduced equally if it be traced in one second or in one hour. In the Pollak-Virag system (see NATURE, vol. lxiv. p. 7) the telegraphic signals produce the motion of a beam of light which records in Roman letters the message transmitted. In this system the telegraphic signals differ from one another in their space relation and their duration. In the Murray system the signals differ from one another in their time relation.

We have pointed out that the first process is the translation of the message into a series of time signals, and for this purpose a time signal alphabet has to be chosen. Though this may at first sight seem a matter of secondary importance, it is in reality hardly too much to say that upon the suitability of the alphabet selected will depend, more than upon anything else, the chances of success of the system. This fact has been thoroughly realised by Mr. Murray and others who have worked upon this problem, with the result that an alphabet has been finally devised which seems to possess in the greatest degree possible all the more important advantages. In it every letter or other signal which has to be transmitted is represented by a series of five time signals; the alphabet is therefore an "equal letter alphabet," that is to say, each letter is composed of the same number of signal units (five in this case). The average number of units per letter is, of

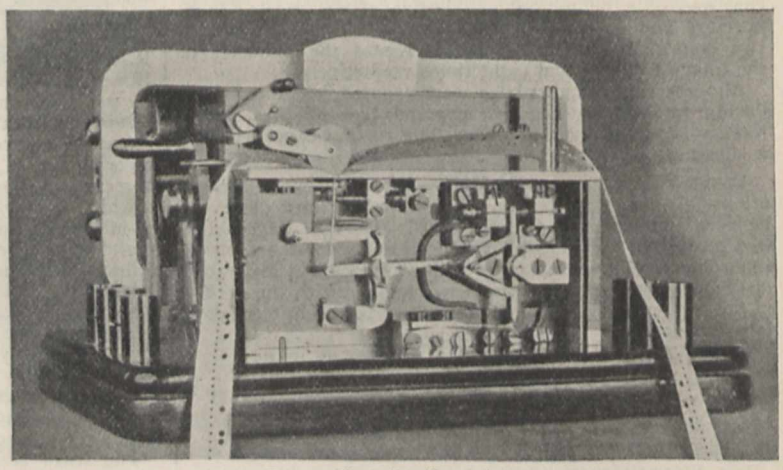


FIG. 2.—Single-line Transmitter.

[1] "Setting Type by Telegraph." By Donald Murray. (*Journal of the Institution of Electrical Engineers*, vol. xxxiv., pp. 555. 1905).

course, five; in the Morse alphabet the average number is thirteen; there is therefore an apparent advantage in time over the Morse code, but this may be more apparent than real, as the unequal length of the letters in the Morse code enables the shorter ones to be chosen for those letters occurring with the greatest frequency (such as E and T), so that the average number of units per message may be less than in an equal letter alphabet having a smaller average number of units per letter. Thus experience has shown that the actual average number of units per letter with the Morse code is only eight instead of thirteen. It must be remembered, also, that the Morse code is intended primarily for hand signalling, and consequently when time intervals are used the difference between any two which have to be distinguished manually or by ear must be fairly great. Thus the Morse dot consists of one unit, the Morse dash of three; were two units used for the dash instead of three, the distinction between the dash and dot would not be sufficiently marked. With machine telegraphy, on the other hand, there is no need to make such a great differentiation between the signals, as time intervals of one, two, three, and more units can all be distinguished, and in consequence it is possible to devise a shorter alphabet than the Morse code. It is not to be denied, however, that the use of a new alphabet is undoubtedly a disadvantage from the practical point of view, as it has to be learnt by the operators. This drawback is minimised by the fact that the operator does not print each signal separately as in operating a transmitting key; but it is nevertheless desirable, if not essential, that he should be able to read the message when printed on the transmitting tape.

To turn now to the apparatus used in the Murray system; the first operation, as in all automatic telegraph systems, is to punch the message to be transmitted on a paper strip or "tape." This is done by means of a key-board instrument of the ordinary type-writer form shown, with the cover removed, in Fig. 1. On the tape will be noticed a double row of holes, which can be seen more distinctly in Fig. 4; the row of small holes serves only to feed the tape forward, both in this machine and in the transmitter; the larger holes are the signals punched in the tape. The actual perforator can be seen in front; it is worked by an electromagnet which punches the necessary holes on the forward stroke and moves the tape one letter space (five holes) forward on its back stroke. On the right can be seen a lever which enables the tape to be pulled back letter by letter to make corrections; these are made by punching five holes, thus blotting out all the holes already punched, this signal (of five holes) leaving the receiving mechanism unaffected. It is thus possible to wipe out any part of the message incorrectly written on the tape, and so produce a tape which will give an absolutely correct message when transmitted; this is facilitated by the fact that the operator can see the tape as it is perforated, letter by letter. The speed at which this perforator can be worked is about 120 letters (twenty words) a minute. The transmission can be carried on five or six times as rapidly, so that five or six operators working at these perforators can produce enough tape to keep the transmission line full.

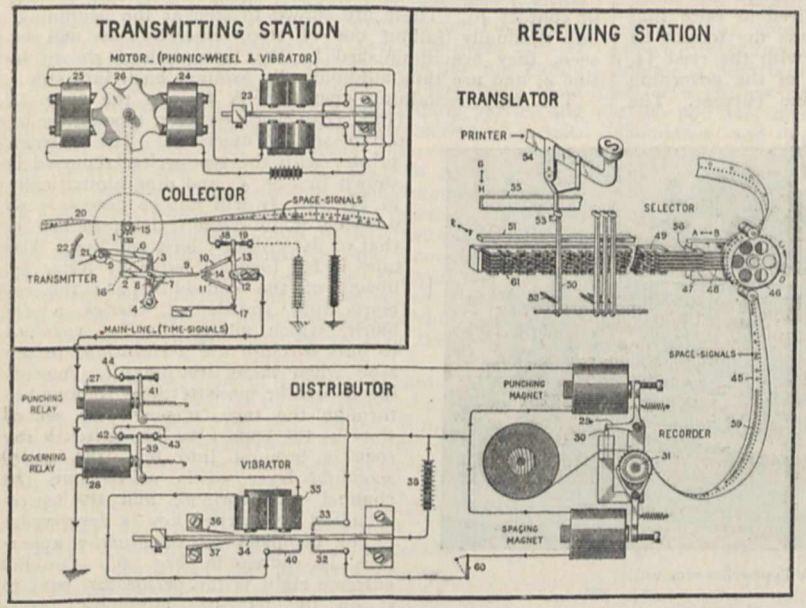


FIG. 3.—General Diagram of Murray Automatic Printing Telegraph System.

The automatic transmitter is shown in Fig. 2, and diagrammatically in Fig. 3 (collector). The tape is fed forward in the usual way by the star-wheel 15, passing across the end of an upright rod 1. This rod is pivoted as shown to the system of levers which oscillate about the centre 4, being kept in oscillation by the eccentric wheel 5, and making one oscillation for every unit on the tape. If this unit is a hole, the rod 1 enters this hole, the end 2 of the lever 2-9 is raised and the end 9 lowered, whereby the oscillation of the lever 3 brings the end 9 against the bar 11, thus pushing the contact lever 13 against contact 18. Here it remains until the next oscillation, and if this is the same as before, due to a second hole in the tape, it is not disturbed. It will thus be seen that successive signals of the same kind (either successive holes or successive spaces) are transmitted, not as intermittent, but as continuous signals. But if there follows a space in the tape the rod 1 cannot rise to its full height, the lever 2-9 is kept down at the end 2 and raised at the end 9, which comes in consequence against the rod 10 and forces the contact lever 13 over against contact 19, thereby breaking the punching current and sending spacing current into the line. The whole apparatus is driven by a phonic wheel motor in the usual way, the vibrating reed 23 sending currents alternately to the magnets 24 and 25, which keep the armature 26 in rotation. This is geared directly to the star-wheel 15, which has ten teeth, and is itself geared in the ratio of 10 : 1 to the eccentric wheel 5, so that the latter makes, as already stated, one revolution for every unit of the tape.

Now let us follow the message to its arrival at the receiving station, where the signals are caused to produce a second perforated tape, the exact duplicate of the first, by means of the mechanism grouped together in Fig. 3 under the title "distributor." The tape is fed forward unit by unit by means of the spacing magnet which operates the escapement 31, and holes are punched in the

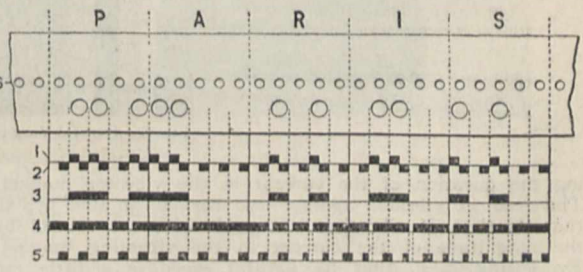


FIG. 4.

tape by the punch 30, which is operated by the punching magnet. If the circuits of these two magnets are followed out it will be seen that both are controlled by the vibrating reed 34 in such a way that they operate alternately according as the reed is against contact 32 or 33. It will further be seen that the punching magnet is also controlled by the punching relay 27, the circuit being open in the position shown, and closed when the reed 41 is against contact 44, *i.e.* when punching current is coming through the main line and punching relay. It will be noticed at once that the distributor cannot work properly unless the tongue 41 of the punching relay is in synchronism with the reed 34. To obtain this synchonism is the object of the governing relay 28, which is operated by the line current. The tongue of this relay vibrates between the contacts 42 and 43; when it is in contact with either the circuit of the vibrator magnet is closed, but during its passage from one to the other this circuit is opened. If this occurs whilst the contact 40 is open it can obviously have no effect on the oscillations of the reed, but if it occurs whilst this contact is closed it has the effect of diminishing the duration of the current in the vibrator magnet. The reed 34 vibrates against two springs 36 and 37, so that its time of vibration is capable of great control by the magnitude of the current in the vibrating magnet. By setting it so that its natural speed is a little too high, it is possible by means of the controlling action of the governing relay for perfect synchronism to be obtained. The action will perhaps be more readily understood by the diagram, Fig. 4. This shows a piece of the transmitting tape at the top punched with the signals for the word "Paris." In line 1 are shown the current impulses to the punching magnet due to the simultaneous closing of contacts 33 and 44. In line 2 are the regular intermittent current impulses to the spacing magnet due to the closing of contact 32. Line 3 shows the main line signals which, as pointed out in explaining the method in which the transmitter acts, are continuous and not intermittent. Line 4 shows the interruptions in the circuit of the vibrator magnet caused by the vibration of the reed of the governing relay which occurs at the beginning and end of every signal in line 3. In line 5 are the actual current pulses in the vibrator magnet due to the closing of contact 40. These are shown in step at the beginning, but gradually falling out of step, whereby, as will be seen, they are diminished by the interruptions shown in line 4, and are thus automatically brought back into step.

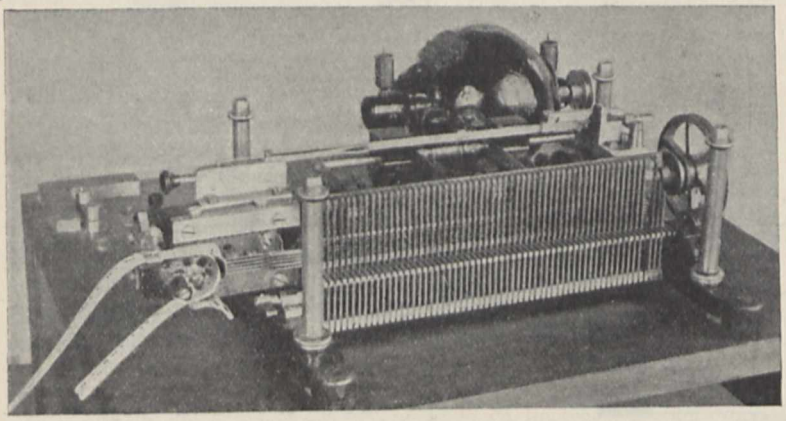


FIG. 5.—Murray Printer with Typewriter removed.

The only remaining operation is to use the tape 45 (Fig. 3) to work either a type-writer or a type-setting machine. The Murray printer with the type-writer removed is shown in Fig. 5, and diagrammatically in Fig. 3. It will not be necessary to describe it in detail; the principle is that of the ordinary lock and key. The tape is fed forward letter by letter by means of the star-wheel 46; the reciprocating shuttle 47 carries a die block, which allows the five rods 48 to pass through the perforations in the tape when these are present. According as one or more of these rods passes through the tape, a particular set of slots in the combs, 49, attached to the rods is brought into line, the corresponding lever 50 is pulled into the channel thus formed, and the corresponding type-writer key is depressed.

The complete set of Murray apparatus is shown in Fig. 6. On the extreme right is the perforator, next to it on the left the automatic transmitter, then on the same table the distributor in front and the relays behind. The translator and type-writer are on the small table at the left. We have only been able to give a brief description of the most important features of this very ingenious system; there are numerous points of detail which space does not permit us to describe. The system has been on trial for some time both in this country and abroad, and has met with considerable success; it is now in use on several English lines. There can be no question after the perusal of Mr. Murray's paper that it possesses many advantages over its forerunners which should enable it to survive. It is stated that the automatic part of the apparatus can be run perfectly up to 200 words (1200 letters) a minute, but that no type-writer will stand the strain of being run at this speed, a maximum of 120 words being all that is allowable. It is, however, obviously possible to run the automatic part at top speed if necessary, and use two type-writers at the receiving end in the same way as at the transmitting end.

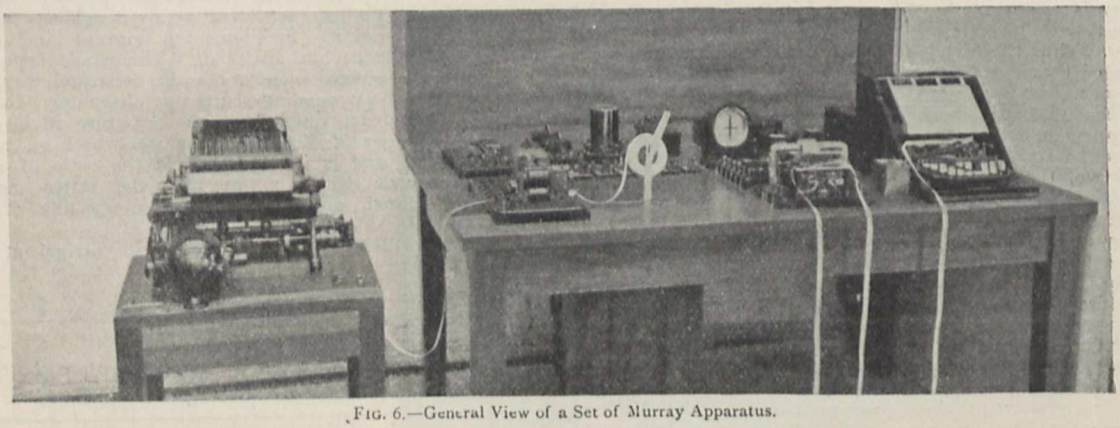


FIG. 6.—General View of a Set of Murray Apparatus.

MAURICE SOLOMON.

THE PERCY SLADEN EXPEDITION IN H.M.S. SEALARK. THE CHAGOS ARCHIPELAGO.

OUR arrival in Mauritius on August 5 completed the first half of our cruise in H.M.S. *Sealark*, together with all our work directly connected with the Chagos Archipelago. This work may be divided under two heads, oceanography and biology. The former has been carried out mainly by Commander Boyle Somerville and his officers in view of the scientific objects of the expedition, but at the same time it is all of practical value for navigation in these waters. In many respects it has been of a singularly arduous nature; surveys by camping parties and deep soundings from the ship have been carried on simultaneously, together with numerous observations on the tides, currents, sea temperatures, &c. To a considerable degree it and all the work has been hampered by the heavy weather, which, contrary to all expectation, we have experienced, winds from south to east with heavy, confused seas, partially induced by the comparatively shallow waters of the Chagos Archipelago, and partially due to the current, which set in an easterly direction (against the wind) during the whole time we were in the group.

It is almost too soon to attempt to summarise any of the results of the cruise, but the soundings taken on our course from Ceylon to the Chagos and from the latter to Mauritius show that the archipelago is closely surrounded, both to the north and west, by the 2000-fathom line, and that there is at the present day no trace in the topography of the Indian Ocean of any former connection of the group with either the Maldives or the banks on the Seychelles-Mauritius line. The Chagos Archipelago appears, indeed, to stand by itself, being built up on a plateau rising to a depth of 800 fathoms in an ocean of an average depth of 2300 fathoms. Previously there were no bottom soundings between the banks and shoals of the group, but now a large series (more than 100) have been run, showing depths of 400 fathoms to 800 fathoms between the individual banks; from most of these a sample of the bottom has been obtained.

Broadly speaking, the Chagos group may be said to consist of three atolls to the north (Salomon, Peros Banhos, and Blenheim), the Great Chagos Bank in the centre (60 miles by 90 miles), and to the south two atolls, Diego Garcia and Egmont, besides certain submerged banks both to the north and south. Of these, H.M.S. *Sealark* has re-charted Salomon and parts of Peros Banhos, while Cooper and I have in addition examined the southern atolls. Salomon was very carefully surveyed, our intention being to make a comparison between its condition at the present time and when Powell's chart was made in 1837. The latter chart, however, proved to have been so carelessly drawn that any close comparison is, I fear, useless, but the new chart should be of great value when it is possible to re-examine the atoll at some future date. Its section lines show that it arises in the last 400 fathoms by similar slopes to those of Funafuti, but it is a much simpler atoll, having only one passage, and more than half its reef crowned by land. Our numerous soundings and dredgings on its slopes leave no room for doubt but that its present reef is extending outwards on every side on its own talus, in fact, that the steep found round it (and, indeed, most atolls) is, *in this instance*, simply the slope at which coral and other remains from the reef above come to rest in the water. Its face was everywhere singularly barren; Lithothamnion, Polytrema, and, of course, reef-corals were not obtained below 50 fathoms. Further out, at 250 fathoms and over, the bottom was smooth and barren; the lead constantly failed to bring up any samples, while the somewhat broken and dented, but almost empty, dredges gave the idea of bare rock with a little muddy sand here and there. Indeed, our evidence points to the impossibility of any upward growth being in progress between the different Chagos banks, and to the probability of considerable current being felt even at 500 fathoms.

The reefs of the Chagos are in no way peculiar save in their extraordinary paucity of animal life, to which I referred in my last letter. Green weed, too, of every sort is practically absent. However, this barrenness is amply compensated for by the enormous quantity of nullipores (Lithothamnia, &c.), incrusting, massive, mammillated, columnar, and branching. The outgrowing seaward edges of the reefs are practically formed by their growths, and it is not too much to say that were it not for the abundance and large masses of these organisms there would be no atolls with surface reefs, &c., in the Chagos. The lagoon shoals of Egmont are covered by them, and alone reach the surface; having once done so they die and become hollowed out in the centre, finally resembling miniature atolls.

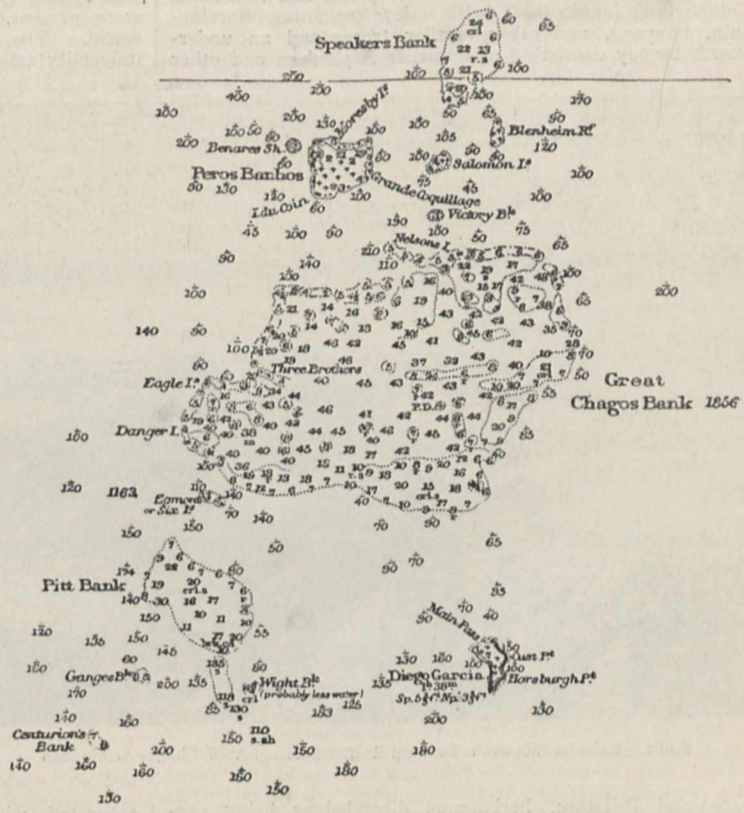


FIG. 1.—Chart of the Chagos Archipelago.

In such a large group the conditions of the encircling reefs against the lagoons naturally vary very considerably. In general their inner edges reach the surface, and in the more open atolls the lagoon slope to 10 fathoms closely resembles the seaward slope. The bottoms of the lagoons are bare, rock, hard sand or mud, with shoals arising precipitously here and there, built up by a few species of coral, but largely covered by Xenia and Sarcophytum (as also are the only two submerged banks, Wight and Centurion, which we examined). Diego Garcia lagoon differs somewhat owing to its being almost completely surrounded by land. It has perhaps the most varied fauna in the group, and alone gives definite evidence of enlarging in every direction. Everywhere the land is entirely of coral origin. Diego Garcia shows signs of a recent elevation of a few feet, the present single island having been formed by the joining up of a series of separate islets on an elongated reef. The kuli or barachois (large shallow lakes) of the same island owe their origin to the same elevation, though elsewhere in the group they are generally due to

the successive washing up of beaches from the sea, enclosing areas of the reef. On the whole, there is singularly little change since the survey in 1837, and my impression is that Chagos has been for a long time an area of rest, and that the *present* condition of its reefs is mainly due to agencies still in action.

We have now examined the marine fauna in Salomon, Peros Banhos, Diego Garcia, and Egmont, and I would again lay stress on its comparative paucity and lack of variety as compared with the Maldives, Fiji, or even Funafuti, though many of the forms are very common. In short, its general character is rather that of the temperate than of the tropical zone.

The land fauna is largely dependent on the flora, and the latter, except on small isolated islets and selected positions, has been destroyed to allow of cocoanuts being planted. The shores are everywhere fringed with *Scaevola koenigii* and *Tournefortia argentea*, both covered with a climbing bean. Behind these there was originally a forest formed of immense mapon (*Pisonia capidia*) and takamaka (*Calophyllum inophyllum*), with a few cocoanuts, Barringtonia, banyans, and other smaller trees, and an undergrowth largely consisting of immense Asplenium and other

FIG. 2.—Lithothamnia on the Seaward Reef of Salomon Atoll, Chagos Archipelago

ferns and Psilotum, herbaceous dicotyledons being confined to the more open, dry, sandy, and stony parts; mangroves and Pandani are, curiously enough, not found. With the assistance of Dr. Simpson, we have collected the flora of each of the atolls, obtaining more than 600 specimens, about 140 species, of which probably only half are indigenous.

Of mammals there are only rats and mice, but there are traditions of dugong as well. Of birds the cardinal, sparrow, and mina have doubtless been introduced; noddies, frigates, and terns were breeding in enormous numbers on certain islands, though it was mid-winter; crab-plover, curlew, whimbal, and a sandpiper were common, and in the north-west monsoon buzzards, kites, and crows are said to be regular visitants. The green and shell turtles (*Chelone mydas* and *C. imbricata*) abound, the former coming on shore to deposit its eggs at night and the latter in the daytime. The only other reptiles are a marsh tortoise, perhaps introduced from Madagascar, and geckoes; there are no Amphibia. There is only one land shell, and arachnids and myriapods are scanty; the land crustacea are similar to those of the Maldives, but the coco crab (*Birgus latio*) is also abundant. Mr. Bainbrigge Fletcher has sorted the insects and finds about 110 species, most of which are probably indigenous; but the best season for the group would be in the rather hotter and damper north-west monsoon. On the whole, the land fauna and flora is much what one would expect to get, regarding the Chagos as a group of purely oceanic islands.

We expect to leave Mauritius toward the end of August for Cargados, Agalegas, and the submerged banks towards the Seychelles. Our cruise will be largely a dredging one, but the examination of Agalegas should be interesting. Meanwhile, Cooper and I hope to see some of the reefs round Mauritius.

J. STANLEY GARDINER.

IRON AND STEEL INSTITUTE.

FOR the first time the autumn meeting of the Iron and Steel Institute was this year held in Sheffield. An elaborate programme of visits to works and social functions was arranged, and no less than 1500 members and ladies were present, including members from all parts of the world. The opening meeting was held at the new university on September 26 under the presidency of Mr. R. A. Hadfield. Addresses of welcome were delivered by the Lord Mayor, the Master Cutler, the Vice-Chancellor of the University, Colonel Hughes (chairman of the reception committee), and by the president of the Sheffield Trades and Labour Council on behalf of the working men. Mr. Hadfield, in reply, thanked the reception committee for the admirable work it had done, and gave an interesting historical review of the Sheffield steel trade. Incidentally, he mentioned that the membership of the Iron and Steel Institute had now risen to 2200. After the reading of the minutes of the last meeting by the secretary, Mr. Bennett H. Brough, and the transaction of other routine business, the papers submitted were read and discussed. In the first paper taken Prof. J. O. Arnold described the department of iron and steel metallurgy at the University of Sheffield. The main object borne in mind in designing the laboratory was the erection on a manufacturing scale of plant producing steel by the crucible, Bessemer, and Siemens processes.

Prof. J. O. Arnold and Mr. A. McWilliam next contributed an important paper on the thermal transformations of carbon steels. For the research three steels were selected, saturated with 0.89 per cent. of carbon, unsaturated with 0.21 per cent. of carbon, and supersaturated with 1.78 per cent. of carbon. In the case of the unsaturated steel, the authors find that above Ar 3 (810° C.) the ferrite and hardenite are in mutual solution as a homogeneous mass. The Ar 3 change is accompanied by a segregation of the two constituents, which, if the cooling be slow, is probably completed in the Beta range of temperature. After a fairly rapid cooling from 950° C. the 0.21 per cent. carbon steel when quenched at 730° C. micrographically registered a segregation of ferrite so far advanced as strongly to suggest that such segregation must have begun at Ar 3 and not at Ar 2. In other words, hardenite is insoluble in ferrite in both the Beta and Alpha ranges of temperature. It however still retains its identity as hardenite whilst falling through, say, 30° C. or 40° C. of temperature in the Alpha range, namely, from the end of Ar 2 at about 720° C. to the beginning of Ar 1 at about 680° C., at which latter temperature it begins to decompose into pearlite. The heating transformations of this steel are substantially as follows:—At Ac 1 (about 710° C.) in the Alpha range the pearlite begins to change into hardenite, hence the carbide is soluble in the

Alpha range. The change to hardenite is somewhat advanced when Ac 1 merges into Ac 2 at about 720° C. owing to these points always overlapping in the heating curve. The hardenite areas probably remain unchanged on the sites previously occupied by the pearlite until the Gamma range Ac 3 is reached (at about 810° C.), when the hardenite and ferrite dissolve into each other, forming a homogeneous molecular mixture. In a saturated steel there is, on heating, a single absorption of heat at the change point Ac 1, 2, 3, the amplitude of which ranges from about 710° C. to 730° C. This change marks the transformation of the whole mass from pearlite into hardenite. On cooling, there is a very considerable evolution of heat at the single point Ar 1, 2, 3, the amplitude of which ranges from about 690° C. to 660° C. This recalescence marks the transformation of hardenite into pearlite. The particular phase of pearlite obtained depends upon the rate of cooling from 660° C. to atmospheric temperature. The emulsified phase is produced by very rapid cooling, normal pearlite by ordinary cooling, and laminated pearlite by very slow cooling. Pearlite, in which the carbide is emulsified or "sorbitic," may also be produced by tempering hardenite. The micrographic and thermal transformations of a supersaturated steel are as follows:—At Ac 1, 2, 3 the sectional ground mass of pearlite changes to hardenite, the cementite slowly segregates into larger masses until a temperature of about 900° C. is reached, then the cementite and hardenite dissolve one into the other, and a homogeneous mass of hardenite and cementite is obtained. On cooling, at about 900° C. the cementite falls out with a faint evolution of heat, and is completely segregated long before the point Ar 1, 2, 3 is reached, hence the micrographic transformations of cementite and hardenite are quite unconnected with the three thermal critical points or any of them, and are due entirely to the influence of temperature.

Mr. A. W. Richards and Mr. J. E. Stead, F.R.S., read a paper on overheated steel, describing experiments supplementing their previous work on the subject, and showing that re-heating overheated good steel can be relied upon to restore good properties to brittle material. Steel initially bad, brittle, and dangerous owing to irregularity in the distribution of the elements cannot, however, be made good by any kind of heat treatment.

Mr. L. Guillet (Paris) contributed a paper on the special steels used for motor-car construction in France. Steels with low percentages of carbon and nickel are used for parts which require case hardening and quenching. Steels with medium percentages of carbon and low percentages of nickel are used after quenching and re-heating for a large number of parts. Steels low in carbon and high in nickel are used for valves. Chromium steels with high carbon and low chromium are used for bearings. Silicon steels are used for springs and for gearing. Nickel chromium steels are used for numerous parts requiring resistance to shock.

Mr. Guillet also submitted an exhaustive paper on the use of vanadium in metallurgy. Vanadium improves the properties of alloys. In normal steel it increases the tensile strength and elastic limit, and in quenched steel it acts in the same way without increasing the brittleness. Vanadium is certainly the element which, together with carbon, acts with the greatest intensity in improving alloys of iron. .

The paper read by Mr. B. Talbot (Middlesbrough) on segregation in steel ingots was one of great interest, as, although attention has been directed to the effects of segregation, little has been published as to means of lessening the amount of such segregation. The author's investigations, in which parallel tests have been made on ingots from the same heat with and without the addition of a small amount of aluminium, are of special value. The ingots were obtained from both acid and basic open-hearth furnaces, and were 5 feet 6 inches in height, the drillings for analysis being taken over the whole surface of the divided ingot. When no aluminium was added excessive segregation down the central line of the ingot occurred from 6 inches from the top to about half way down the ingot. Sulphur is the element that tends to segregate most, phosphorus next, then carbon, and finally manganese. With the use of aluminium, a billet of much more regular composition is obtained.

Mr. Douglas Upton (Jarrow) described an ingenious mechanical device for handling steel bars during the process of manufacture.

Mr. L. Dumas (Paris) read a lengthy paper on the reversible and irreversible transformations of nickel steel. The starting point of the investigation was Prof. John Hopkinson's well known experiment in 1889. Nickel, manganese and carbon, introduced into a steel, the author finds, determine alike the appearance of the same phenomenon, irreversible transformation, which is the more intense the higher the proportions in which they are present. They must also be in solution, a state which is often, as regards carbon, impossible of attainment without the aid of chromium. The nickel steels which have not undergone transformation, although too costly to be of industrial use, are of great interest as showing the result of adding nickel to steel. The homogeneity is increased, and the proportion of β-iron intensified.

Mr. G. B. Waterhouse (New York) submitted a paper giving the results of the investigation of a series of steels of constant nickel with varying carbon percentages. The results showed that nickel raises the tenacity without materially lowering the ductility. Annealing lowers the tenacity without greatly raising the ductility. Nickel lowers the transformation points Ar 3, 2 and Ar 1 about 20° for every 1 per cent. of nickel.

Captain H. G. Howorth, R.A., contributed a paper on the presence of greenish coloured markings in the fractured surfaces of test-pieces. The attention of the Ordnance Committee was directed to defects of this kind in test-pieces from tubes for guns, and the object of the paper was to ascertain to what extent the presence of such defects should weigh in accepting or rejecting the forgings for this purpose. The flaws appear to be due to slag, and in any forging subject to violent alternating stresses these flaws in prolongation may easily develop into cracks. Interesting contributions to the discussion were made by General O'Callaghan, president of the Ordnance Committee, and by General Sir J. Wolfe Murray, Master-general of the Ordnance.

Mr. Thomas Andrews, F.R.S., contributed a paper on the wear of steel rails on bridges. He received from a railway company the fractured portions of an acid Bessemer steel rail which had broken in main line service after eleven years and five months' service on a bridge. It had borne 148,000,000 tons of passing traffic, and had lost 0.69 lb. per yard per annum in weight. One of the chief causes of the fracture has been the defective segregated chemical composition of the rail. The percentages of combined carbon and manganese, found in the top of the rail head and in the bottom flange, were in excess of what should obtain in good rail steel. The chemical composition was an undesirable one, and such as is liable to lead to brittleness and sudden fracture in rail service. The high-power microscopic examinations confirmed the results arrived at by the chemical analyses and physical tests, and they demonstrated the non-uniformity of the physical and crystalline structure of the rail. The microscopic examinations have also shown the undesirability of employing rails having too high a percentage of combined carbon and manganese, and they have indicated that great care should be exercised in the thermal treatment of rails, from the ingot to the finished rail, in order to obtain a suitable microcrystalline structure resulting in a good durable rail.

The existence of troostite can no longer be questioned, but opinions as to its nature are divided. Dr. C. Benedicks (Upsala), in a paper on the subject, expressed the view that troostite is a pearlite with ultra-microscopically small particles of cementite. In all probability troostite is formed by a transformation *in situ* of martensite.

Prof. E. D. Campbell (Michigan University) contributed a paper on the occurrence of copper, cobalt, and nickel in American pig-irons. The percentages varied in the specimens analysed from 0.011 to 0.039 of copper, from a trace to 0.048 of cobalt, and from a trace to 0.072 of nickel. The only two irons containing any considerable amount of cobalt and nickel possess valuable properties for car-wheel castings.

ELECTRONS AND MATTER.

THE inaugural address on "Electronen en Materie," delivered by Prof. C. H. Wind upon taking the chair of mathematical physics and theoretical mechanics at the University of Utrecht on February 20 of this year, has lately been published (Leyden: A. W. Sijthoff). Beginning with a brief account of the gradual development of the conception of electrons, mainly through the works of H. A. Lorentz, and of its sudden corroboration after the discoveries made by Zeeman and Röntgen, the address goes on with an exposition of the notions of ether, electric displacement, electrons, and magnetic force in their present form, and traces the way to the idea of an electromagnetic mass of the electrons.

The measurements made by Kauffmann, though showing that these particles of matter probably do not possess any mass besides this electromagnetic one, of course do not prove that the same should be the case with all other particles of matter in our universe, as Wien had suggested. Yet they make this suggestion—the basis of what the author calls an electron theory *à outrance*—to some extent a plausible one. Several of the brilliant and fascinating views which this ultimate theory opens having been expounded by Mr. Balfour in his presidential address at the Cambridge meeting of the British Association, the present author directs attention to those concerning the structure of atoms, mechanism of radiation, and origin of chemical differences. He also enters into some more details, and, assuming for a while that an atom of hydrogen consists of a single positive and a single negative electron, calculates that in this system the two components would be separated by a distance perhaps 100,000 times greater than the diameter of the largest of them, and that there must be stored up in the atoms constituting one gram of hydrogen an amount of energy equivalent to that required by a mail steamer to cross the Atlantic ten times.

Poincaré has raised several serious objections against the theory. Some of these relate to the *temperate* electron theory only, and lose their weight as soon as the *ultimate* theory is adopted. To take an example. Poincaré does not feel satisfied with the changes of length in solid bodies owing to their motion through ether, as suggested by Lorentz and by Fitzgerald in order to explain the result of Michelson's experiments. Lorentz himself, however, has already shown that this hypothesis, though appearing rather bold at first sight, becomes plausible as soon as molecular forces and masses are supposed to be in the same way as electromagnetic ones affected by a translation through ether; and it is clear that this supposition is involved in that of all matter consisting of electrons, which therefore at once clears the way.

The second category of objections, those arising from the dependency of electromagnetic mass upon velocity and direction of motion, from so many instances of unequal action and reaction, from the violation even of the law of inertia, whenever electrons move with a higher speed than light, are, on the other hand, most serious in the light of the *ultimate* electron hypothesis, whereas the *temperate* theory has a way left open to dispose of them. The latter theory, indeed, does not deny the existence of matter apart from electrons, and considers electromagnetic mass as something secondary. By assuming as constituents of ether hidden matter, obeying the classical principles just as well as ordinary or coarse matter, this theory will be able to account for every apparent deviation from the principles which by mathematical reasoning should be deducted as occurring in coarse matter.

But if by progress of experiment and theory the electron hypothesis in its *ultimate* form should continue to gain ground, if it should finally prove unavoidable to accept the view that matter consists entirely of electrons, then mass and momentum would cease to be what they are now in our ideas, quantities strictly invariable. There is no denying that this would involve a serious change of our general conception of nature. For the predilection and confidence with which science has for centuries been aiming at a description of the physical universe in terms only of matter and motion were based chiefly—though half unconsciously—on the idea of mass and momentum being invariable elements of nature, images or pictures of invariable elements of reality itself. Now this idea, so fundamental to our whole mechanical conception of nature, would shrink into an illusion in the light of the new theory. Of course, there would be a great advantage also. Whereas it seems now almost hopeless to involve electromagnetic phenomena in a description in terms only of matter and motion, the unity desired in our picture of the physical world would then be secured by putting it in terms of electrons and motion.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WE learn from *Science* that an anonymous gift has been made to the Lebanon Valley College, Annville, Pa., of a hall of science to cost 16,000*l*.

MR. F. R. B. WATSON has been appointed assistant lecturer and demonstrator in engineering at the Merchant Venturers' Technical College, Bristol.

A REUTER message from New York states that the American General Education Board has received from Mr. John Rockefeller cheques to the amount of 2,000,000*l*., in pursuance of his promise last June to give that amount in cash or securities for the endowment of higher education.

A PRIZE of 50*l*. out of the Gordon-Wigan fund will be awarded at the end of the Easter term, 1906, for a research in chemistry, of sufficient merit, carried out in the University of Cambridge. The research may be in any branch of chemistry. The dissertation, with the details of the research, must be sent to the professor of chemistry not later than the division of the Easter term, 1906.

THE year-book of the faculty of engineering of the University of Liverpool (1905–6) shows that the courses of study are so arranged as to afford a general scientific training for those intending to become engineers. The honours course affords opportunities for specialisation in a selected branch of the profession. The university training, which extends over three years, is preliminary to or supplementary of pupilage under an engineer or apprenticeship with an engineering firm.

IT is announced in *Science* that the University of Pennsylvania will receive 12,000*l*. from the estate of the late Prof. Maxwell Sommerville, who held a chair of archæology in the university. President Thwing, of Western Reserve University, we learn from the same source, has announced that Mr. Andrew Carnegie has given 5000*l*. towards the establishment of a fund of 20,000*l*. for the endowment of a chair of political economy at Western Reserve University, to bear the name of the late Senator Hanna.

THE *Engineering and Mining Journal* publishes the presidential address delivered by Mr. F. W. McNair before the Society for the Promotion of Engineering Education, in which he shows that the American mining schools have amply proved the necessity for their existence. From statistics of the six largest mining schools in America, he shows that the ratio of graduation to enrolment is increasing, that there is an enormous percentage increase in students enrolled, and that the mining school product is gradually taking the place of the so-called practical man. Dividing the twelve years available for comparison into three periods of four years, it is shown that the schools under consideration graduated one man to 13·6 million tons of the total mineral production during the first period, one to 10·2 millions in the second period, and one to 9·4 millions in the last period.

IN connection with the department of geography of the University of Cambridge, special public lectures will be delivered in the Michaelmas term by Sir Clements R. Markham, K.C.B., F.R.S., and Sir Archibald Geikie, F.R.S. The following courses, which are open to all students, whether members of the university or not, have also been arranged:—A general course in geography (with practical work) will be given by Mr. H. Yule Oldham; courses on the geography of Europe, on the principles of physical geography, and on the history of geographical discovery will also be given by Mr. Oldham. Dr. J. E. Marr, F.R.S., will lecture twice weekly on geomorphology; Dr. A. C. Haddon, F.R.S., will give courses on ethnology and on anthropogeography; and Mr.

A. R. Hinks will lecture on geographical surveying (with field work). The duties of the board of geographical studies, which is responsible for the general administration of the department, include the promotion of geographical study and research within the university, the provision of instruction in the several branches of geographical science, the administration of the geographical education fund, and the publication of schedules defining the range of the geographical examinations for degrees and diplomas of the university in geography.

THE development and strengthening of the relation which the work of technical institutes and evening classes bears to the practice and commercial aspects of our industries are undoubtedly necessary parts of further industrial progress. For this reason we welcome a recent circular issued by the Board of Education to the inspectors of these educational institutions. The Board recognises the existence of a great variety in the character and amount of the cooperation between employers of labour on the one hand and the managers of technical institutions and evening schools on the other, and in its circular gives a short account of a few typical examples with a view of showing inspectors and others the kind of work which can be done with advantage in this direction. It is true that the details of such cooperation must vary from place to place in accordance with the special requirements of each important industry, but unless it exists in one form or another full advantage will not be derived from our expenditure on technical education. The circular proceeds to give a helpful *résumé* of what has been done to encourage artisans in their studies by means of the payment of fees and the award of prizes, by increases of wages, by allowances of time for attendance at classes, and by providing opportunities for higher instruction. The circular may be commended to all employers of labour who desire that the workmen of this country may be put into the way of competing on equal terms with those of other countries.

ON Friday last Lord Rosebery, as Chancellor of the University of London, opened the Goldsmiths' College at New Cross, formerly the Goldsmiths' Institute. The development of Polytechnics under the London County Council led the Goldsmiths' Company to reconsider the constitution of the institute, which had been carried on by the company since 1888; and last year the buildings were presented by the company to the University of London, with an unoccupied adjoining site of four and a half acres, and an endowment of 5000*l.* a year for five years. An additional sum of 5000*l.* was given by the company to enable the university to carry on evening classes during 1904–5, in cooperation with the London County Council. Under the new scheme the institution has become the Goldsmiths' College, University of London, and its functions are chiefly those of a day training college for elementary teachers. These students will take the ordinary two years' course provided by the regulations of the Board of Education, and will not prepare for a university degree; but the evening class work in science and engineering will still lead up to university degrees. In the course of his remarks at the opening ceremony, Lord Rosebery said:—"The University of London is spreading itself over the metropolis. It is not too much to say that, though we cannot say that it will soon spread itself over the Empire, we may at least say that it will very soon appeal to every portion of the Empire. It is a young university. It deals with comparatively new branches of learning. It deals with the practical and the concrete, rather than with the ancient and the abstract. In that respect there is a marked difference between it and those ancient universities to which some of us owe a loyal and filial allegiance which cannot be obliterated by any newer loyalty or allegiance. The newer universities must be content, and wisely content, with something which is not antiquity, and is not tradition, but may be more immediately useful and practical than either antiquity or tradition. We, placed in the largest community in the world, with our hands, so to speak, on the very heart of the Empire, living among new wants and new aspirations, meeting new needs and new acquirements, ready, as I hope, to face the exigencies of to-day and to-morrow, are the university of the future, though we cannot trace our antiquity back to the hoary past."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 8.—"The Synthesis of a Substance allied to Adrenalin." By H. D. **Dakin.** Communicated by Prof. E. H. Starling, F.R.S.

The paper contains an account of attempts to synthesise adrenalin—the physiologically active principle of the suprarenal gland. Adrenalin is commonly regarded as a secondary alcohol of the formula

$$C_6H_3(OH)_2.CH(OH).CH_2NHCH_3.$$

The corresponding ketone may be prepared by acting upon chloracetylcatechol with methylamine, and is a crystalline substance forming stable crystalline salts. The ketone may be reduced electrolytically, and the product may have the structure assigned to natural adrenalin. Although the synthetical base has many chemical and physiological properties in common with adrenalin, it probably is not the racemic form of the latter substance. The base forms extremely deliquescent salts which are unstable in hot solution; on addition of ammonia to aqueous solutions of the salts, the free base is precipitated in the form of a grey-white amorphous precipitate which is extraordinarily unstable in the dry state. Owing to experimental difficulties, satisfactory analytical and molecular weight determinations have not yet been made.

A close physiological relationship between the natural and synthetical bases is shown by the fact that, in the case of a rabbit, intravenous injection of less than 0·000001 gram is followed by a marked rise in arterial blood-pressure.

A base which is probably identical with the substance above described has been obtained by acting upon methylaminoacetylcatechol with aluminium and mercuric sulphate (D.R.-P. 157,300), and it is assumed to be a secondary alcohol. If this be correct, the formula for natural adrenalin will require modification, but more experimental evidence is needed before the question can be settled.

July 1.—"On the Influence of Collisions and of the Motion of Molecules in the Line of Sight, upon the Constitution of a Spectrum Line." By Lord **Rayleigh,** O.M., F.R.S.

Apart from the above and other causes of disturbance, a line in the spectrum of a radiating gas would be infinitely narrow. A good many years ago,[1] in connection with some estimates by Ebert, the author investigated the widening of a line in consequence of the motion of molecules in the line of sight, taking as a basis Maxwell's well known law respecting the distribution of velocities among colliding molecules, and he calculated the number of interference bands to be expected, upon a certain supposition as to the degree of contrast between dark and bright parts necessary for visibility. In this investigation no regard was paid to the collisions, the vibrations issuing from each molecule being supposed to be maintained with complete regularity for an indefinite time.

Although little is known with certainty respecting the genesis of radiation, it has long been thought that collisions act as another source of disturbance. The vibrations of a molecule are supposed to remain undisturbed while a free path is described, but to be liable to sudden and arbitrary alteration of phase and amplitude when another molecule is encountered. A limitation in the number of vibrations executed with regularity necessarily implies a certain indeterminateness in the frequency, that is, a dilatation of the spectrum line. In its nature this effect is independent of the Doppler effect—for example, it will be diminished relatively to the latter if the molecules are smaller; but the problem naturally arises of calculating the conjoint action of both causes upon the constitution of a spectrum line. This is the question considered by Mr. C. Godfrey in an interesting paper,[2] upon which it is the principal object of the present note to comment. The formulæ at which he arrives are somewhat complicated, and they are discussed only in the case in which the density of the gas is reduced without limit. According to the view of the

[1] *Phil. Mag.*, vol. xxvii., p. 298, 1880; "Scientific Papers," vol. iii., p. 258.

[2] "On the Application of Fourier's Double Integrals to Optical Problems," *Phil. Trans.*, A, vol. cxcv., p. 329, 1899.

present author, this should cause the influence of the collisions to disappear, so that the results should coincide with those already referred to where the collisions were disregarded from the outset. Nevertheless, the results of the two calculations differ by 10 per cent., that of Mr. Godfrey giving a *narrower* spectrum line than the other.

The difference of 10 per cent. is not of much importance in itself, but a discrepancy of this kind involves a subject in a cloud of doubt, which it is desirable, if possible, to dissipate. Mr. Godfrey himself characterises the discrepancy as paradoxical, and advances some considerations towards the elucidation of it. The present author has a strong feeling, which he thinks he expressed at the time, that the 10 per cent. correction is inadmissible, and that there should be no ambiguity or discontinuity in passing to the limit of free paths infinitely long. In connection with some other work he has recently resumed the consideration of the question, and he is disposed to think that Mr. Godfrey's calculation involves an error respecting the way in which the various free paths are averaged. A discussion of the subject is given in this paper.

PARIS.

Academy of Sciences, September 25.—M. Troost in the chair.—On the origin of the principle of virtual displacements: P. **Duhem.** Descartes proposed to found his system of statics on the proposition "It requires the same power (*puissance*) to raise a given weight a fixed height as to raise a weight K times as great to a height K times less." M. Duhem has found that this principle was first implicitly used by Jordanus de Nemore, in his *Tractatus de ponderibus*, dating from the thirteenth century, and traces its use by various writers down to the time of Descartes in 1637.—Observation of the total eclipse of the sun of August 30, made at Robertville, Algeria: M. **Salet.** The plan of work included (1) a search for the existence of a magnetic field in the neighbourhood of the sun by the observation of the deviation of the plane of polarisation of the coronal light; (2) the photographic study of the distribution of the polarised light of the corona; (3) the study of the atmospheric polarisation; (4) the spectro-polarisation of the corona; and (5) the photography of the ultra-violet spectrum of the corona. A *résumé* of the results, which were successful, is given.—On the observations of the total eclipse of the sun of August 30 made at Guelma by the commission from the Observatory of Algiers: Ch. **Trépied.** The results obtained include the confirmation of the supposed relationship between coronal structure and the state of solar activity, the photographic impression of the moon's disc on the corona apart from totality, the photographic registration of a very curious phenomenon of elliptical rings, and a negative exposed during the whole of totality permitting of the study of the greatest photographic extension of the corona during this eclipse and of contributing to the elucidation of the question of the intra-Mercurial planets.—New researches on the reproductive apparatus of the Mucorineæ: J. **Dauphin.** The formation of the mycelium has been followed with the microscope, day by day, up to the production of the reproductive organs. The effect of varying the nature of the carbohydrate present in the culture medium was studied, and observations made with raffinose, dextrin, starch, dulcite, erythrite, glycerin, ordinary alcohol, salicin, and quercite.—On the sensibility of the chlorophyll apparatus in ombrophobe and ombrophile plants: W. **Lubimenko.** The facts observed show clearly that the assimilating energy depends on the concentration of the pigment in the chlorophyll grains. The curve representing the assimilating energy may, according to the concentration of the pigment, rise to the upper limit of the natural radiation, as in ombrophobe plants, decrease before this limit, as in ombrophile plants, or may remain stationary, starting from a certain intensity, as in the yellow leaves of Taxus.—Spontaneous vegetation and the wholesomeness of drinking water: L. A. **Fabre.**

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part iii. for 1905, contains the following memoirs communicated to the society:—

February 25.—A. **Sommerfeld**: The electron theory, iii.; on electrons with velocities equal to or greater than the velocity of light. H. **Happel**: On the equation of condition of monatomic substances.

May 20.—W. **Holtz**: How rotation can begin in a planetary nebula. W. **Holtz**: The reason for the star-shaped appearance of the stars. C. **Runge**: On the numerical solution of total differential equations.

June 3.—H. **Gerdien**: A new apparatus for the measurement of the electrical conductivity of the air. H. **Gerdien**: Measurements of the density of the vertical electrical conductive current in free air during the balloon ascent of May 11, 1905.

June 24.—Wilhelm **Blitz**: Contributions to the theory of "lakes" in dyeing.

The Business Notices, part i. for 1905, contains a report on the Samoa Observatory, a long obituary notice of Ernst Abbe by Prof. Voigt, and an appreciation of Georg Meissner by Prof. Max Verworn.

NEW SOUTH WALES.

Royal Society, August 2.—Mr. H. A. Lenehan, president, in the chair.—The refractive indices, with other data, of the oils of 118 species of Eucalyptus: H. G. **Smith.** In this paper the author records the refractive index, the specific gravity, the specific refractive energy, and the solubility in alcohol of the oil of each species. The material was distilled at the Technological Museum, Sydney, and most of it had been prepared for the work "Research on the Eucalypts and their Essential Oils," by Mr. R. T. Baker and himself. The oils of those species which have been obtained since that work was published are also included.

CONTENTS.