THURSDAY, MAY 17, 1906.

THE MECHANISM OF THE UNIVERSE.

History of the Planetary Systems from Thales to Kepler. By Dr. J. L. E. Dreyer. Pp. xii+432. (Cambridge: University Press, 1906.) Price 10*s.* 6*d.* net.

BY the publication of this masterly account of the development of cosmogonic ideas and the history of planetary systems from the early dawn of Greek philosophy to the final establishment of the Copernican system, Dr. Dreyer has rendered a great service to those who take an interest in the fascinating history of astronomical science. Throughout the work we have reason to admire his lucid exposition, based on profound historical studies, of the manifold views formed by the thinking minds of antiquity and of the middle ages on the mechanism of the universe, his definite conclusions on many controversial points, and, above all, his endeavour to trace out, as much as possible, the influences of the philosophic and religious tendencies of the time on the cosmological conceptions under view.

The opening chapters describe the development of astronomical ideas among the Greeks. After a brief review of the cosmogony of the early atomistic school we are introduced to the more distinct teachings of the Pythagoreans. To their conception of the revolution of the earth round the central fire, notwithstanding its crudeness, distinct merit must be attributed, if judged by the favourable influence which the teaching of Philolaus exerted on the propagation of the Copernican system among those "who could only admire philosophers of classical antiquity." Complicated and erroneous as the Pythagorean idea was, it nevertheless paved the way for the true conception of the earth's rotation, but not, as was often believed, for the heliocentric system. The chapter on the primitive geocentric cosmology of Plato may, at first sight, appear somewhat too prominent. Considering, however, the various controversies to which Plato's astronomical system has given rise, a clear statement of his natural philosophy on the basis of an exhaustive analysis of the Dialogues is of importance, even apart from the author's apology that "there is a charm in the poetical conception of the 'soul of the world' which makes the study of the *Timaeus* peculiarly attractive."

With Eudoxus and Kalippus astronomy has started on its career as a science. Eudoxus is the first to go beyond mere speculative reasoning; he distinctly bases his system of the homocentric spheres on the demand of satisfying the observed motions. The possibilities of this mathematically elegant system, recently pointed out by Ideler and Schiaparelli, were, however, not much appreciated by the ancients, although Aristotle had accepted it in the improved version of Kalippus.

Dr. Dreyer's criticism of Aristotelian metaphysics is severe.

"His careful and critical examination of the opinions of previous philosophers makes us regret all the more that his search for the causes of phenomena was often a mere search among words. This tendency, which to us is his great defect, appealed strongly to the medieval mind and helped to retard the development of science in the days of Copernicus and Galileo."

The attempts of finding the physically true system of the world terminated with Herakleides, who taught the rotation of the earth, and Aristarchus, who proposed, as a way of "saving the phenomena," that the earth performed an annual motion round the sun. But the rapid rise of practical astronomy in the Alexandrian school had so enormously increased the knowledge of the complexities of the planetary motions, which none of the proposed systems could explain, that henceforth the idea of grasping the physical truth was altogether abandoned, and attention became concentrated upon a purely geometrical interpretation of the celestial phenomena.

The subsequent exposition of the theory of the epicycles and their utilisation in the Ptolemaic system naturally forms an important part of Dr. Dreyer's work. We cannot enter here upon his valuable account of the work of Apollonius, Hipparchus, Eratosthenes, and Ptolemy; nor can we dwell upon his fascinating picture of the advances in astronomical knowledge during the Alexandrian era, including, as they do, the discovery of the precession by Hipparchus, the mensuration of the earth by Eratosthenes, and general conclusions as to the dimensions of the universe. The chapter closes with a graphic account of the rapid decline of Hellenic culture after the destruction of the Alexandrian library, when "the curtain went down for ever on the great stage where Greek science had played its part so well and so long."

The return to archaic cosmology in Europe under patristic influence and the supreme sway of Aristotelian metaphysics in scholasticism, mark an epoch of scientific decadence in gloomy contrast to the flourishing period of Hellenic culture. But the same epoch is distinguished by the intense cultivation of Greek astronomy among the Arabs, whose labours, devoted to the further development of the Ptolemaic system, are expounded in chapter xi. Although no direct advance in cosmic ideas accrued from their work, they influenced the subsequent advancement of European astronomy in a most important manner by their invention of the trigonometric calculus.

The description of the revival of astronomy in Europe brings us face to face with some interesting philosophers of the pre-Copernican period. The vague and often mystic speculation of Cusa is contrasted with the practical merits of Peurbach and Regiomontanus, who successfully endeavoured to utilise the Ptolemaic system for the purposes of astronomical calculation, while we also find an interesting account of the hopelessly complicated attempts made by Fracastoro and Amici to revive the theory of solid spheres, and thereby to prove the physical truth of the Alexandrian system.

The three closing chapters dealing with Copernicus, Tycho, and Kepler are naturally those which command our special interest. They contain far more than mere statements of the works of these great heroes of astronomical science. They define clearly the specific *rôle* played by each of these actors in the revolution of scientific thought. In following the author through his analysis of "De revolutionibus," we realise not only the great mental power but also the heroism of the "quiet student at the shore of the Baltic," and we feel the importance of the moment when his work is ushered into the world with Osiander's apologetic introduction. We must agree with the author's endeavour to show how little Copernicus could have been influenced by Philolaus and the vague ideas of Aristarchus, whose anticipations detract nothing from the originality of his own thoughts. On the other hand, the exposition of the defects of the system is so lucid that it requires no intimate technical knowledge of astronomy to recognise the necessity of modification, which so immediately urged Tycho to the invention of his ingenious compromise between the geocentric and heliocentric conception.

How far Tycho's all-important work as an observer has paved the way for the final recognition of the true system by Kepler is admirably shown in the last chapter, where the author opens before us the successive paths along which, through a labyrinth of errors and failures, the never tiring genius of Kepler was finally led to the "golden portal of truth." The long and weary road he had to go before he finally broke away from the time-sacred idea of circular motion and the Ptolemaic *punctum aequans*, and proved conclusively the elliptic character of the Martian orbit, is brought before us by an exhaustive analysis of his works, the study of which is so highly instructive, not only from the scientific, but also from the psychological point of view. The reproach, often levelled against the author of the "Mysterium Cosmographicum," of having filled his books with all sorts of mystic fancies, is, in Dr. Dreyer's opinion, founded on a misconception of Kepler's object in making his investigations. "There is the most intimate connection between his speculations and his great achievements; without the former we should never have had the latter."

We cannot attempt to enter upon the author's review of the opinions of science and church on the Copernican system during the time between Kepler and Newton, with which, on the whole, the student of history is familiar, though it is particularly interesting to hear on this matter the verdict of an historian who has derived his knowledge so directly and completely from an exhaustive study of the original prints and manuscripts.

It is difficult to emphasise sufficiently the specific merits of a work of this kind in a brief review. Doubtless not the least of its many meritorious features is the lucidity and conciseness of exposition. In its endeavour to grasp the essence of the cosmogonic ideas the mind is nowhere impeded by an unnecessary accumulation of cumbersome detail. At the same time the non-mathematical reader is supplied with sufficient technical information to secure his acquaintance with the principal geometry of the cosmic systems under discussion. This latter advantage is important in the case of a work which is clearly not written for a limited circulation among the small section of astronomical experts, but may justly claim to appeal to all who are interested in the history of the general development of scientific culture.

PROF. EHLERS'S "FESTSCHRIFT."

Zeitschrift für wissenschaftliche Zoologie. Vols. lxxxii. and lxxxiii. *Festschrift zur Feier seines siebzigsten Geburtstages am* 11 *Nov.* 1905, *Herrn Geheimen Regierungsrat Prof. Ernst Ehlers.* Band i., pp. iv+692; Band ii., pp. 741; and plates. (Leipzig: Engelmann, 1905.) 2 vols., price 5*l.*

THE distinguished zoologist in whose honour these volumes are issued is widely known as an indefatigable worker and one of the most genial of men. Together with the late von Kölliker, Prof. Ehlers has for many years edited the journal which now celebrates his seventieth birthday. As a testimony of the inspiring character of his teaching and of the regard in which he is held this "Festschrift" gives abundant witness. With no less clearness it indicates the diverse activities of modern zoologists and the particular problems upon which they are engaged.

With such a varied content, the volumes are difficult to review. The systematic work, admirable as it is, and coordinating or expanding as it does our knowledge of annelids, starfish, and flat-worms, can only be mentioned; nor can we do more than indicate the purport of a few of the many anatomical and physiological papers.

The place of honour is appropriately given to von Kölliker's paper on the histogenesis of the vertebrate nervous system, the last contribution of the master of histology, whose amazing vitality at eighty-seven years enabled him to conduct research and to discuss difficulties of fact and interpretation with unabated zeal. The month in which this latest defence of the neuron-theory was published brought the tidings that von Kölliker had ceased from work.

A long and exquisitely illustrated memoir by Vejdowsky gives a minute account of the structure and mode of origin of the annelidan vascular system. The nature of this system in the lower animals has been of late the goal of much research. Under the influence of the trophocœl theory, as stated by Lang on the basis of Bergh's work upon annelids, the vascular system has come to be regarded generally as a mesodermic structure, its cavities as a schizocœl, and not, as had often been suggested, a blastocœlic structure. The results of Vejdowsky's work have led him to a very different conclusion. First he proves, what had often been denied, that annelids possess a vascular endothelium. He finds that this "vasothelium" arises in the following way. Blood-vessels are intimately associated with the gut. Their cavities are at first simply a space between the outer ends of the gut-cells and their basal membrane. Into this space cells are budded off from the endo-

derm. Some of these become differentiated into epithelio-muscle elements that constitute the vaso-thelium, and others into blood-cells. Thus the study of annelids leads Vejdowsky to conclude that their hæmocœl is a hypoblastic structure *sui generis*, not comparable to that of arthropods or of molluscs, but rather to the cardiac vasothelium in vertebrates. Such a result emphasises that relation of vascular system to the alimentary tract which topography has insisted upon.

In his article on the morphology of the cestode body, Prof. Spengel stoutly supports the monozoic theory. He regards the Bothriocephalidæ as the most primitive tapeworms, and considers that in the highly modified Tæniidæ we have simply a coincidence of somatic and gonidial segmentation areas. Incidentally he suggests the comparison of the scolex with the hinder end of segmented worm, and emphasises the singular nature of the cestodes by pointing out their entire lack of true regenerative power.

The remaining anatomical papers deal with the modifications of clasping organs in arboreal mammals, with the head of collembolous and culicid insects, the nervous system of leeches, and certain abnormal gasteropods.

Of the embryological memoirs, the accurate and laborious research of Wierzejski on the cell-lineage of Physa will be welcomed as a topographical paper of the first rank. Prof. McIntosh contributes a well illustrated account of the life-history of the shanny, and then follow memoirs on the early development of the blind-worm, on the breeding habits of Rhinoderma and of the salamanders.

The physiological papers are of more general interest. Prof. Häcker continues his illuminating work on the skeleton of the Radiolaria by treating the Tripylaria from the same ecological standpoint which he adopted in his paper of last year. Häcker is the most active of a band of workers who are putting new life and new significance into the merely geometric descriptions of earlier students of these skeletal products. Dr. Rhumbler gives a further instalment of his work on the mechanics of streaming movement in Amœbæ, and shows some interesting stream figures produced by dropping chloroform water upon shellac. He fully recognises the inward and autogenous control that dominates those displays in organisms that we cannot parallel in not-living matter, but he holds that in Amœba the phenomena of movement and feeding are capable of mechanical explanation in terms of the aggregation theory which he has formulated elsewhere.

Dr. Jordan contributes an essay on the origin of species in Lepidoptera. His main thesis is to the effect that geographical subspecies, and no other variations, are the material out of which new species have been evolved. Much of the paper is summarised from his earlier work, and represents a line of research to which several naturalists are applying themselves. The work of Petersen on the Fritillaries in particular pursues the method employed by Dr. Jordan, but in a more comprehensive manner, and it is to be hoped that these important results may be rendered more available to the student of evolution than they now are by a new mode of presentation, graphic, tabular, or other than textual description.

Lastly, the memoir of the Baroness von Linden on the influence of heat, cold, and gases upon the coloration of Vanessid butterflies constitutes a further instalment of the author's prolonged investigation. The general conclusion drawn from these experiments is that whatever lowers the rate of pupal metabolism increases amount of black imaginal pigment and diminishes the extent of red colour in the butterfly.

F. W. GAMBLE.

THE BIRDS OF TUNISIA.

The Birds of Tunisia. Being a history of the birds found in the Regency of Tunis. By J. I. S. Whitaker. 2 vols. Royal 8vo. Pp. xxxii+294 and xviii+410. Plates and maps. (London: R. H. Porter, 1905.) Price £3 3s. net.

THE two handsome and beautifully illustrated volumes containing the history of the birds of the Regency of Tunis form a fitting crown to the years of work in the field, the museum, and the library which their author has devoted to the ornithology of this until recently little known country. They form too a valuable contribution to the avifauna of the western Mediterranean region; for although the present work purports to be merely a history of the birds noticed in Tunisia, and of their lives as observed in that country, the author has thought it advisable, when possible, to allude to the occurrence of the various species also in Algeria and Morocco, as likewise, in some cases, in Tripoli, and in the Mediterranean basin generally.

The articles on various warblers (especially the interesting remarks on their life-history), and other birds which are met with most commonly in that region, will be most welcome, even to those whose interests are restricted to the birds which figure on the British list. Tunisia, a long and somewhat narrow country, stretching from the Mediterranean back in the vagueness of the great desert, presents a great variety of natural features and climate; and the contrast between the well-watered, wooded and mountainous region north of the Atlas Mountains and the rainless, sandy and rocky desert country is very great. To these circumstances, and to the fact, pointed out by the author, that few countries are geographically so favourably situated as the Regency for the observation of the migration of birds, the wealth of the Tunisian avifauna is due. No less than 365 species and subspecies of birds are included in this work; and only about thirty-five of these have to be relegated to the roll of occasional and accidental visitors. Two beautiful photogravures give an excellent and most truthful idea of the character of the scenery and the traveller's mode of life in the south of the country; while other plates introduce the reader to some of those wonderful Roman ruins, so marvellously preserved in that dry, clear air, which so startle the inexperienced wanderer in the central parts of Tunisia.

Each species is fully described, and a careful account of its distribution in Tunis, with some observations on its range in the neighbouring Mediterranean countries, is followed by an interesting and graphic account of its nesting habits, song, and life-history generally.

The four natural divisions into which the Regency may be divided appear to have each certain species peculiar to it, or more abundant in it than in the other regions. Besides this, in the case of some resident species, such as the crested larks, for instance, different forms of the same species are to be found in the different regions, the variation of these forms being in some cases considerable, and not always limited to the coloration of the plumage alone, but occasionally extending to the structural parts of the birds. The crested larks, says the author, afford a striking example of the extent to which local variation may be carried by natural causes, and no country probably affords a better opportunity of observing and studying this subject than Tunisia. The author is naturally in favour of recognising subspecies, and the use of trinomials for them; and his remarks hereon and upon what constitutes a species and a subspecies may be read with great advantage.

Many noteworthy and peculiar birds may be studied in Tunisia, but probably the families of larks and chats are better represented than any other; of the former twenty-one and of the latter eleven species and subspecies are treated, and the fifteen beautifully executed coloured plates which adorn these sumptuous volumes are largely devoted to illustrating these two families. Tunis is indeed especially rich in larks; and years of study, a long series of specimens collected by himself, and an examination of the various types in museums and the literature of the subject, added moreover to his having had the advantage of observing the birds in life, have enabled the author to clear up many puzzling points respecting the specific and subspecific value of the numerous forms of larks. We have here a very clear and lucid exposition of the larks of the western Mediterranean basin; and especially of the crested larks (the most puzzling of them all), of which the author considers that there are two distinct groups, viz., one including the common crested lark of Europe, the other the small-billed crested lark of Southern Spain, each with its allies.

The necessity for protective colouring is undoubtedly great in a country like Southern Tunisia, where the scanty vegetation affords but little shelter to its feathered denizens. Hence it is that the plumage of most of the species resident in the desert and semi-desert region harmonises with the sandy coloration of the soil. This is especially remarkable in the larks. But the author points out that although at first sight it may appear curious that the chats, except in a few instances, are more or less conspicuously coloured, it will, however, be found that the conspicuously attired chats frequent, as a rule, rocky and broken ground full of dark clefts and fissures, where the rocks are sometimes black and in other cases of a glittering white, and in such situations a strongly marked plumage is really far less conspicuous than a uniform light coloured one would be. The ravens also remain as black as ever, but they, too, frequent cliffs and rocks for the most part, and their case seems analogous to that of the rock-haunting chats. Two good maps enable the reader unacquainted with the country to follow the author's remarks on its topography. O. V. APLIN.

AMŒBÆ AND THEIR ALLIES.

British Fresh-water Rhizopoda. Vol. i. By James Cash, assisted by John Hopkinson. Pp. x+148+xvi plates. (Ray Society, 1905.) Price 12*s.* 6*d.* net.

THE important discoveries that have recently been made on the morphology of Protozoa have revived the interest in British fresh-water amœbæ and their allies, and a monograph on the subject has been regarded for some time as a special need of the zoologist.

Mr. James Cash has been known for some years as an ardent microscopist with a special knowledge of the forms and habits of the species of fresh-water rhizopoda in the north of England, and he has given us in this volume the benefit of his experience in this line of work, illustrated by many beautiful original drawings of the living organisms. As a work of reference for the names of species, and in so far as it suggests to the young amateur naturalist exercises for his amusement and instruction, it will be useful; but as references to important details of structure and reproduction are in general meagre, often misleading, and in many instances omitted altogether, it will not supply the need that is felt. The description of the cell (p. 3) as "physiologically, a minute vesicle, or closed sac, the enveloping membrane or cell-wall enclosing the protoplasmic substance in which the functional phenomena reside," appears to us singularly unfortunate in an introduction to the study of the Protozoa.

The description of the nucleus is very short, but long enough to contain considerable extracts from the work of Calkins, whose views the author adopts, but there is no reference to the chromidial network which the recent papers of Hertwig, Schaudinn, and others have shown plays such an important part in reproductive phenomena of many rhizopoda. It is disappointing to find no reference, either in the introduction or in the systematic part, to the evidence of a developmental cycle in the life-history of Amœba, based on the researches of Scheel and Calkins.

In the very brief account of the reproduction of Arcella, again, although Hertwig's important paper published in Kupffer's *Festschrift* is included in the list of references, the statements made are incomplete and misleading. Many other criticisms similar to these could be made, but the critic is disarmed by the confession in the preface that the author has not "investigated very closely the physiological problems associated with the life-history of these organisms." With this confession before them, it seems difficult to account for the action of the council of the Ray Society in undertaking the publication of this mono-

graph without previously enlisting the services of a trained morphologist, with special knowledge of the group, to correct and revise the introduction and the morphological details in the description of the genera.

A monograph written by Mr. Cash, with the co-operation of a good morphologist, might have been one of really first-rate importance. As it now appears, however, useful as it may be in some respects and valuable in others, it is not complete, and does not constitute a serious advance of knowledge.

OUR BOOK SHELF.

Physikalisch-chemisches Centralblatt. Band i. and ii. (in parts). (Berlin: Borntraeger, 1903–1905.)

WE have received the first two volumes of the above serial, the first number of which was issued on December 15, 1903, twenty-four parts and authors' and subject indexes appearing annually. Besides the German title, the cover bears the titles "Physico-Chemical Review" and "Revue physico-chimique," and the abstracts of French and English papers are given in the respective languages, all others being in German.

The periodical is edited by Dr. Max Rudolphi, of Darmstadt, with the collaboration of chemists and physicists in various parts of the world, London being represented by Sir W. Ramsay. Most, if not all, of the papers abstracted would doubtless be found to be noticed in other publications, and although the multiplication of such serials is not to be commended, this one may appeal to physical chemists who prefer to find abstracts on their own subjects separated from those of general physics and of inorganic and organic chemistry. In order that the serial should be useful to workers, it is necessary that the abstracts should be given as soon as possible after the publication of the original papers from which they are taken. It would not be just to criticise a serial in its infancy, but some of the abstracts mght have appeared earlier; possibly their publication has been unavoidably delayed, and as time progresses the cause of this reproach will be removed. The periodical is well printed and contains many tabulated results.

The Philosophy of Martineau in Relation to the Idealism of the Present Day. By Prof. Henry Jones. Pp. 37. (London: Macmillan and Co., Ltd., 1905.) Price 1*s.* net.

THIS thoughtful and eloquent address, originally delivered at the celebration of the Martineau centenary, contains much more about absolute idealism than about the philosophic system of the great Unitarian preacher. Prof. Jones, after pointing out the close agreement between Martineau and the Idealists in several respects, finds his text in the division made at the beginning of "Types of Ethical Theory" between systems that start with nature or God, and those that start with the spirit of man. Absolute idealism, of course, ranks under the former head, and the idiopsychological ethics of Martineau under the latter. So in the remainder of the paper the doctrines of absolute idealism are re-stated in a form such as might rob Martineau's chief objections of their force—the objections, in particular, that ethical interests are not conserved, and that a refusal to sever man from nature and God means that man is merged into them and lost within them. Whether the reader will think this re-statement absolutely convincing or not will probably depend on his previous sympathies. Prof. Jones takes occasion, in passing, to notice the similarity of Dr. James Ward's "activity" and Martineau's "free will" as philosophic explanations, and takes occasion, too, as in many other recent utterances, to have one or two clever flings at the Pragmatists.

The Romance of the South Seas. By Clement L. Wragge. Pp. xv+312, with 84 illustrations. (London: Chatto and Windus, 1906.) Price 7*s.* 6*d.* net.

IN connection with Mr. Wragge's work as Government Meteorologist of Queensland, he paid a visit to New Caledonia, with the view of establishing a weather-observing station there. In this book he gives an account of his visit to the island, and also to Rarotonga and Tahiti. We wish there were more information in the book about the meteorological results of his journey. The volume contains instead simply a chatty account of the islands; and the most interesting matter is the author's visit to the convict prisons in New Caledonia. At Tahiti he paid a pilgrimage to Point Venus, where Cook on June 3, 1769, observed the transit of Venus. The author is enthusiastic over the scenery in both islands, and the only thing that justifies the mention of "romance" in the title is the spell of their scenery. The author's style is very discursive, and the book is full of smoke-room gossip and snatches of sailors' songs. It is illustrated by some good photographs, and in an appendix is a list of some shells and corals which the author collected in the Society Islands.

The Wild Fauna and Flora of the Royal Botanic Gardens, Kew. Kew Bulletin of Miscellaneous Information, additional series v. Pp. vii+223. Edited by Sir William Thiselton-Dyer. (London: H.M. Stationery Office, 1906.) Price 2*s.*

THIS volume is the combined work of a number of well-known zoologists and botanists, each of whom has made a special section the subject of his own investigation; it ought, therefore, to be exhaustive and trustworthy, as indeed it appears to be. The chief interest attaching to a catalogue of this nature is in relation to the important evidence it will afford in the future as to how a country fauna and flora become gradually modified as their surroundings become altered with the incoming of suburban conditions. Many such changes have already taken place in the animal and vegetable products of Kew; and many more are likely to take place in the near future. One of the most remarkable instances of adaptation to new conditions in the London parks and gardens generally is afforded by the wood-pigeon, which in the country is one of the wildest and shiest of all birds. A conservative spirit—possibly in the case of the mammals a little too conservative—we are glad to see, obtains in the matter of nomenclature. R. L.

Physical Chemistry, and its Applications in Medical and Biological Science. By Dr. Alex. Findlay. Pp. 68. (London: Longmans, Green and Co., 1905.) 2*s.* net.

THIS little book makes its appearance at an opportune moment, for no one engaged in biological work can now neglect the teachings of physical chemistry, and the great influence which this branch is exercising on the development of the biological sciences. It is just the sort of work the physiologist, pathologist, bacteriologist, and scientific medical practitioner need—brief and at the same time dealing in a simple manner with fundamental facts. The author thus reviews diffusion, osmosis, cryoscopic methods, and the study

of osmotic pressures in plants and animals, chemotaxis, the theory of ionisation and its application to the germicidal action of disinfectants, the permeability of membranes and the influence of this on secretion, the velocity of reactions, catalysis, colloidal solutions, and the bearing of physical chemistry on serum therapy, in which connection the work of Ehrlich, Arrhenius, and Madsen is briefly reviewed. Altogether this book supplies a decided want, and can be thoroughly recommended.

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.]*

Osmotic Pressure.

IN the issue of NATURE for May 3 (p. 19) appeared an abstract of a recent paper by Prof. Kahlenberg on "Osmosis and Osmotic Pressure." In Prof. Kahlenberg's paper, and also in the abstract, it is claimed that his experiments invalidate van 't Hoff's theory of osmotic pressure, by which the concordance between the pressure of gases and the osmotic pressure of dilute solutions was established. As the basis of that theory seems sometimes to be misunderstood, may I be allowed to recall the principles on which it is founded?

In a paper published in the *Zeitschrift für physikalische Chemie* for 1887, van 't Hoff showed that, from the well-known experimental relation between the solubility of a gas and the pressure, it followed by a simple application of the second law of thermodynamics that the osmotic pressure of a dilute solution must possess the same value as the ordinary pressure of a gas at the same concentration. The solution must be so dilute that the dissolved systems, each made up of a particle of solute as nucleus, and the portion of solvent which it influences, are beyond each others' spheres of action. The proof has been put in a modified form by Lord Rayleigh (NATURE, 1897), and Prof. Larmor has obtained the same result by using the fundamental conceptions of the molecular theory as a basis, instead of the experimental solubility relations of a gas (Phil. Trans., A, 1897). In all these proofs no assumption is made as to the nature of osmotic pressure. It may be due to molecular impacts or to chemical affinity, or to some other undiscovered cause. The strength (and weakness) of a thermodynamic proof lies in this very independence of assumptions as to the mechanism by which the effects are produced. Prof. Kahlenberg and his followers seem to consider that the thermodynamic theory of solutions stands or falls with the hypothesis that the pressure is due to molecular bombardment.

If the conditions assumed in the proofs are realised, the whole authority of thermodynamics goes to support the result. The importance of experiments on osmotic pressure, such as those of Prof. Pfeffer, Lord Berkeley and Mr. Hartley, and Prof. Kahlenberg, lies in the question how far the assumptions made in the thermodynamic proofs can be realised experimentally. This is a much humbler *rôle* than that assigned to the experiments by Prof. Kahlenberg, who claims that the application of gas laws to solutions is based on the few observations of Pfeffer and others by which those laws have been verified directly. Nevertheless, the experiments are of great interest. The gas value for the osmotic pressures measured by Pfeffer shows that the conditions laid down in the thermodynamic theory are realised in practice: (1) that for sugar solutions in water an approximately perfect semi-permeable membrane has been obtained; (2) that no selective action such as could be produced by a Maxwellian dæmon is in operation; (3) that the molecules of cane sugar in solution are the simple molecules indicated by the chemical formula, though they may or may not be combined with solvent molecules; (4) that a solution which is dilute in the thermodynamic sense can be realised at possible concentrations; (5) that a theory deduced for volatile solutes may be extended to other cases. When other solutions and different membranes are employed, one or more of these conditions may fail, and the theoretical value be beyond the reach of experimental attainment. Prof. Kahlenberg remarks that because a semi-permeable membrane does not exist, a theory which postulates one cannot be maintained. We might construct a parallel statement by saying that because a frictionless piston is not practically obtainable, in Carnot's engine and the science of reversible thermodynamics physicists and engineers have imagined a vain thing.

But I may point out that at least two perfect semi-permeable surfaces are probably known: (1) when a solution freezes to give the solid of the pure solvent, the solute is compressed into a smaller volume of liquid solution; the surface of the growing crystals is semi-permeable. (2) When a volatile solvent evaporates from the solution of a non-volatile solute, the free surface of the liquid is again a semi-permeable membrane. From these two facts follows the validity of the thermodynamic relations between the osmotic pressure on the one side and the freezing point and vapour pressure on the other. This is important, for it enables us to use measurements of freezing points or vapour pressures when it is not possible to realise the experimental conditions necessary for a satisfactory determination of the true osmotic pressure.

Osmotic pressure is a thermodynamic conception. The pressures observed in practice may or may not represent the same thing. We may define osmotic pressure as the excess of hydrostatic pressure it is necessary to exert on a solution in order that it may be in equilibrium with the solvent through a perfect semi-permeable membrane. With this definition we may use the conception of osmotic pressure as a basis for a Carnot's cycle and a thermodynamic theory of solutions. Prof. Kahlenberg writes that opponents of van 't Hoff's idea have generally held that the so-called osmotic pressure is an ordinary hydrostatic pressure, brought about by the entrance of liquid into the osmotic cell. It is delightful to find one point at least in which the supporters of van 't Hoff, and van 't Hoff himself, are in complete agreement with his opponents.

In the abstract of Prof. Kahlenberg's paper which appeared in NATURE we are warned that, among the general ruin of physical theories which is to follow his experiments, the hypothesis of ionic dissociation is involved. I confess that the warning leaves me unmoved. The idea that the ions of electrolytic solutions are dissociated from each other during their movement (though possibly or probably combined with the solvent) is required by the electrical phenomena. The abnormally great osmotic pressures of certain electrolytes dissolved in water indicate some kind of dissociation, but cannot tell us whether or not that dissociation takes place so as to give rise to electrified systems. In simple salts such as potassium chloride, which we know by their electrical properties to be electrically dissociated, it is difficult to see how a second kind of simultaneous dissociation could occur. But that non-electrical separation is sometimes found is indicated by some older experiments of Prof. Kahlenberg himself, who found that solutions of diphenylamine in methyl cyanide show abnormally low molecular weights, but are non-conductors of electricity. The theory of ionic dissociation rests upon electrical evidence, and by such evidence it must be tried.

W. C. D. WHETHAM.

Trinity College, Cambridge, May 12.

CONSIDERABLE importance seems to be attached to a recent paper by Prof. Kahlenberg on "Osmosis and Osmotic Pressures" (*Jour. Phys. Chem.*, vol. x.), as is evidenced by a separate summary published in NATURE (May 3, p. 19). In these circumstances it may not be out of place to point out that the conclusions Prof. Kahlenberg deduces are not warranted.

On p. 142 he says "indirect measurements of osmotic pressures . . . from vapour tensions . . . involves the assumption that the gas laws hold for solutions." This is contrary to fact. We have shown experimentally (see vol. lxxvii. Proc. Roy. Soc.) that aqueous solutions of cane sugar give the same osmotic pressure whether observed

directly or deduced indirectly from their vapour pressures, and the relation connecting the osmotic and vapour pressures is quite independent of the "gas laws holding for solutions."

Leaving out of consideration the experiments made before the solutions were stirred—for on Prof. Kahlenberg's own showing these are not good—his conclusion that the gas laws do not hold for dilute solutions in pyridine is based on four experiments. If one may take No. 59 (p. 201) as a type of these, it is easy to show that the experiment is valueless.

The sugar solution used is 0·125 grm. mol. per litre, and a pressure of 98 cm. of mercury is reached, but the theoretical value is some 3 atmos. Now on p. 184 the diameter of his gauge is given as 0·5 mm., and he says that at the end of three days 0·115 grm. sugar has come through the membrane—this quantity represents 2·8 c.c. of solution. If we assume that this volume of solution came through the membrane at a uniform rate, a simple calculation will show that the rate is equivalent to a fall of 20 cm. *per hour* in the gauge. No wonder the theoretical pressure was never reached!

BERKELEY.

Foxcombe, near Oxford. E. G. J. HARTLEY.

Diurnal Variation of the Ionisation in Closed Vessels.

IN his letter on this subject published in NATURE of May 3 (p. 8) Mr. G. C. Simpson is, I venture to think, under a misapprehension regarding the conditions which determine the variations of the earth's electric field. His statement of the problem, which I have slightly abbreviated, is as follows:—"It is usual to accept that there is a negative charge on the earth's surface, and the corresponding positive charge is a volume charge distributed in the atmosphere. There is very little volume charge in the air close to the earth's surface, so the relation between potential gradient and charge on the earth's surface is given by $dv/dh = -4\pi\sigma$. Hence it follows that with a given charge on the earth's surface and the corresponding charge in the atmosphere above, the vertical distribution of the charge and the conducting state of the upper atmosphere do not in the slightest affect the potential gradient within a few metres of the earth's surface."

All this is very true, but it is equally true that *with a constant charge on the earth's surface* nothing whatever will affect the potential gradient close to it. Since the potential gradient is a constant multiple of the surface density, it is absurd to consider the variation of the one whilst the other is kept constant. The only assumption that it seems safe to make about the state of the earth's surface is that, owing to the relatively high conductivity of the earth's crust, for purposes of atmospheric electricity it may be treated as an equipotential surface. The charge in any particular region will be determined by the distribution of electrification and ionisation in the atmosphere, and will readjust itself almost instantaneously when any change takes place in the external conditions. It will not, as an incautious reader might gather from Mr. Simpson's letter, behave as if it were glued to the surface of the earth.

In my letter of April 22 I illustrated my point by considering the analogy with the case of ionised air between two parallel plates maintained at a constant difference of potential. As this comparison is inaccurate, I shall take the liberty of putting the case in another way, in the hope that it may prove more convincing. The earth is to be regarded as a conducting sphere which is continuously receiving a negative charge in certain areas—probably those in which rain is falling—and losing it again by conduction through the atmosphere from all the rest of its surface. Since the observations on the earth's field only refer to fine-weather regions, we need only consider what happens over them. There will be an earth-air current which, under specified conditions, will have attained a steady value, the charge on the earth's surface being that required to give the necessary potential gradient to drive the current. Suppose that by some means the ionisation at some distance from the surface suffers a permanent increase locally, whilst the air close to the surface is unaffected. It is clear that, whatever view is taken of the distribution of the charges producing the earth's field, the increase in the ionisation will produce a local increase in the earth-air current; but by hypothesis the conductivity of the air close to the earth is unaltered, so that the increase in the current must be accompanied by an increase in the potential gradient close to the surface. This is, of course, produced by negative electricity flowing from other parts of the earth.

The above, I imagine, is an exaggerated but otherwise trustworthy picture of the effect an ionising radiation from outside would have on the earth's electric field. The conductivity produced by the rays in the upper atmosphere must be enormous compared with the effects close to the earth. Even if the rays were homogeneous, only a mere trace would remain after passing through a layer of air roughly equivalent in absorbing power to 76 cm. of mercury. But it is far from probable that they are homogeneous, and any want of homogeneity would exaggerate the effect. Other factors conspire to this end: the presence of dust near the earth loading the ions and the smaller rate of recombination at low pressures; whilst the increase in the mobility of the ions at low pressures would just compensate for the feebler absorbing power of the upper atmosphere.

It will be observed that the effect on the earth's field of an increase in the ionisation of the atmosphere depends entirely on where that increase takes place. If the conductivity increases in a greater ratio close to the earth's surface than it does further away, the result ought to be a fall in the potential gradient. Mr. Simpson rightly points out that such a relation between the potential gradient and the leakage of electricity near the earth's surface has been shown to exist. From my point of view this indicates that the bulk of the ionisation near the earth's surface is not caused by radiation from an external source.

O. W. RICHARDSON.

Trinity College, Cambridge, May 12.

Defects in Ostrich Feathers in South Africa.

THE domestication of the ostrich on a practical basis was undertaken in Cape Colony about 1867, and since then ostrich farming has become one of the most important industries in the eastern province. The census of 1904 gave 357,970[1] tame ostriches in the colony, while the export of feathers reached 470,381 pounds, practically the whole of which came from tame birds; the estimated value of the feathers was 1,058,988*l*., giving about 3*l*. 10*s*. per bird of feather-producing age. During the forty years of domestication the instincts of the ostrich have apparently undergone no change, though its habits are much altered. The feathers cut from the tame bird are shorter, weaker, and not so fluffy as those taken from wild birds, but probably these differences are to be correlated with the greater frequency of plucking, and not with any constitutional change resulting from domestication.

Within recent years much concern has arisen from the prevalence of a defect in the growth of the feather, which seriously reduces the value of the plumes to the farmer. The imperfection, technically known as "barring," takes the form of a series of narrow, chevron-shaped bars or malformations across the whole feather. The general appearance of a moderately affected plume is shown in the accompanying photograph (Fig. 1). Examined closely, it is seen that the regularity of the individual barb is much disturbed at the bars, and that the barbules are there defective and only partly differentiated from the barbs. The appearance is such as to suggest that the barbs have been constricted at these particular regions, and that in the development of the feather the barbules have failed to become differentiated and open out, though with a needle their separation can sometimes be effected. Occasionally several barbs will remain joined together at the bars, they also having failed to differentiate. In many cases some of the barbs are shortened, the missing part having broken

[1] The statistics are taken from a paper by the Hon. Arthur Douglass read before the recent meetings of the British Association at Cape Town. Mr. Douglass is the author of a well-known work, "Ostrich Farming in South Africa," and was one of the pioneers in the domestication of the ostrich, and probably the first to hatch the chicks by artificial incubation. His death, shortly after the meetings of the Association, is a great loss to the agricultural and political life of Cape Colony.

off at one or other of the bars, showing these to be places of weakness.

The extent of the barring varies much on different birds and according to locality and season. Sometimes all the wing, tail, and covert feathers are affected, while in others only a few plumes exhibit the imperfection. Again, the number of bars on different feathers varies greatly; frequently they occur at fairly regular intervals along the entire length of the feather, or only a few are present and the rest of the feather is perfect. Where the barring is close, a single barb will be irregular at five or six places along its length. The deficiency can be overcome to a large degree by juxtaposition in the process of "dressing" before the feathers are retailed, but buyers estimate that, as a result of the presence of the bars, the value of the feather to the farmer is frequently diminished from 20 per cent. to 50 per cent., probably an average of about 25 per cent. As the trouble is very general over all the ostrich-farming districts in South Africa, it is manifest that the subject is one which calls for thorough scientific investigation.

The development of the ostrich feather has not yet been

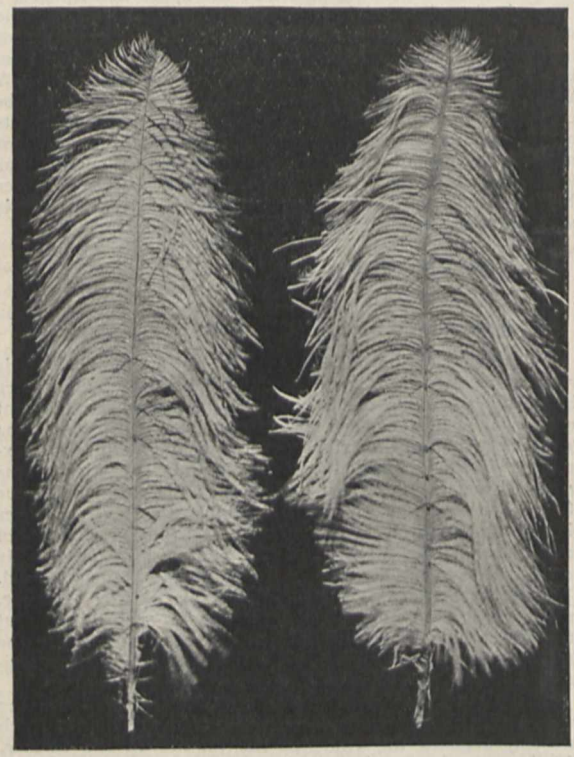

FIG. 1.—Ostrich feathers showing barring.

worked out, but from our knowledge of that of feathers generally there can be no question that the barring represents some interference with the normal growth of the plume at an early stage, an interference which prevents the proper differentiation later of the feather into rachis, barbs, and barbules; moreover, these must recur from time to time during the growth of the feather. As to the cause, the evidence mainly points to impaired nutrition of the feather germ during its early stages. Farmers universally acknowledge that an insufficiency of food during the time the feathers are forming, as from a drought, will result in a plucking full of barrings, breakages, and other malformations. In a general way it is recognised that the better fed the bird the less likely are its feathers to show any defects. Furthermore, from correspondence with Dr. R. M. Strong, of the University of Chicago, who has been engaged upon a study of the development of feathers for years, I learn that experiments have been conducted by Prof. C. O. Whitman and himself upon malformations in other birds exactly similar to those of the ostrich. Ring-doves, after hatching, were alternately starved and fed for some days at a time when the feather was in process of formation, with very remarkable results. On the feathers developing, similar bars were produced in very striking fashion and in great profusion. The results of the experiments were such as to leave no doubt that the barring in this case was due to malnutrition or some disturbance in the metabolism of the bird.

The ostrich farmer, however, is convinced that insufficiency of food is not the only factor involved. Frequently bars appear on the feathers of birds which apparently have been well fed all the time. A general opinion prevails that the ostrich fly, *Hippobosca struthionis*, is often responsible for the trouble, and also the ostrich mite, *Pterolichus bicaudatus*, both of which sometimes infest the birds in large numbers. It is difficult to see how these external parasites can act directly upon the feather germ, but it is undoubted that the progressive farmer who dips or sprays his birds against the pests produces a plumage much less subject to imperfections, and consequently of higher value. Whether the fly or mite can affect the feather directly or only indirectly by lowering the general condition of health of the bird is a subject for investigation, as is also the influence of the tape-worms and thread-worms (*Strongylus douglassi*) which frequently infest the animals. The influence of in-breeding and heredity will also have to be considered. It is significant to find that a similar barring occurs on the ostrich farms in Pasadena, California, among birds which have been ill fed, and the trouble is general on the ostrich farms in Florida, where conditions are not so favourable for birds. A much rarer defect is where the parts of a feather have failed to differentiate along one or more vertical lines extending the whole length of the vane. This irregularity is in all probability the result of some permanent injury to the feather germ or its socket, and occurs independently of the nutritive condition of the bird.

The production of these irregularities in the growth of feathers as epidermal derivatives is of much zoological interest in connection with pathological conditions of epidermal structures generally. As is well known, the enamel of the teeth of children is frequently grooved or pitted in transverse rows, a condition which can usually be traced to some error in feeding, congenital disease, or ailments affecting the general nutrition of the body during the time the teeth were forming; the finger nails are often transversely grooved after an illness or injury, pointing to a response to malnutrition; hair frequently breaks, falls off, or changes in character after an illness from the same cause; the horns of cattle and antelopes occasionally show one or more narrow constrictions representing a diminution in the amount of horny material. All these defects can be correlated with some low condition of health of the animal at the time, and serve to establish that the imperfections in the feathers of ostriches are not an isolated phenomenon, but, *mutatis mutandis*, can be compared with imperfections in the epidermal products of other vertebrates.

While it may be rash to predict before the experiments in hand are completed, yet from the facts already known there seems good reason for expecting that the trouble will be found to rest very largely with the farmer, and that the remedy will be mainly a question of a proper and regular supply of food—not an easy matter in time of droughts. Without question there exists an extremely sensitive relationship between the production of a perfect feather and the proper nutrition of the bird; artificial selection in breeding may also assist towards the production of a strain in which the feathers are less influenced by constitutional changes in the bird.

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Origin of the Term "Metabatic."

My attention has been directed to the word *metabatic* as relating to the transfer of energy. I should be much obliged if anyone could give me information as to the author of the term, the date of its introduction, or any scientific paper in which it occurs in such form as to betoken its exact meaning.

ROBERT E. BAYNES.
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THE PEARL FISHERIES OF CEYLON.[1]

THE important series of reports on the pearl-oyster fisheries and on the marine biology of Ceylon, prepared under the direction of Prof. Herdman, which is being published by the Royal Society at the request of the Colonial Government, continues to grow both in size and value. Parts iii. and iv. have been recently issued, and although in the preface to part iii. Prof. Herdman expresses the hope that the whole will be completed in four parts, this has not proved possible, and a fifth part is now contemplated, to contain the concluding sections of the pearl-oyster work, several more supplementary reports of a faunistic character, and a general discussion of the faunistic results.

The two parts of the pearl-oyster report now under review give a summary of the results of the more recent investigations and inspections carried out by Mr. Hornell on the banks in the Gulf of Manaar, together with an account of the pearl fishery of 1905, which proved to be far in excess of any recorded fishery, both in the number of men and boats engaged, and in the quantity and value of the oysters taken, the nearest approach to it being the fishery of the previous year, 1904.

Prof. Herdman and Mr. Hornell have been exceedingly fortunate in being able, so soon after the commencement of their investigations, to study the exact conditions under which these two most successful fisheries have been carried out, and although they state that it does not seem likely that the 1905 results will be rivalled by any prospective fishery of the oysters now in sight upon the grounds, yet the knowledge and insight into the nature of the factors leading to a great and profitable fishery which have been obtained will be of the very highest value in suggesting rational measures for the future control and improvement of the beds; and a careful perusal of Prof. Herdman's reports leaves little doubt that in the case of these pearl-oyster beds, practical measures carried out upon a sufficiently large scale under adequate scientific control will be capable of effectively preventing, in most years, such total failures of the fishery as have been so often recorded in the past, and of ensuring to those engaged in the work a much more certain and uniform return for the labour and capital employed.

The investigations already made show clearly that the different beds or "paars" are subject to very different conditions, and whilst some, which are specially favourable for the growth and development of the oysters, are liable to receive only a small and inadequate fall of "spat," others almost invariably become covered at the breeding season with an abundant supply of the young brood. Since, however, the latter beds are situated further seawards and close to the deeper water, the young brood is frequently, if not generally, destroyed by the action of currents or by being overwhelmed by sand, so that the oysters never attain maturity. These circumstances naturally suggest that the transplantation of young brood oysters in large quantities from the outer exposed beds to the inner ones, which are favourable for their growth and development, will be a highly profitable operation in those years when the inner beds do not receive a natural fall of spat. Such transplantation constitutes one of the principal recommendations which Prof. Herdman and Mr. Hornell make for the development of the fishery, and work on these lines has already been commenced, although in 1905 it was not particularly called for, excepting on the grounds actually cleared during the fishing of the year, owing to a very extensive natural fall of spat on all the beds which had taken place in the autumn of 1904.

Other practical measures which are recommended include "cultching," or the deposit of suitable solid material, such as shells or broken stone, to which the young oysters can attach themselves, the thinning out of overcrowded beds, and the cleaning of the oyster banks by means of the dredge, thereby removing in as large numbers as possible such enemies of the oysters as starfishes, and also other animals which would compete with the oysters for the available supply of food.

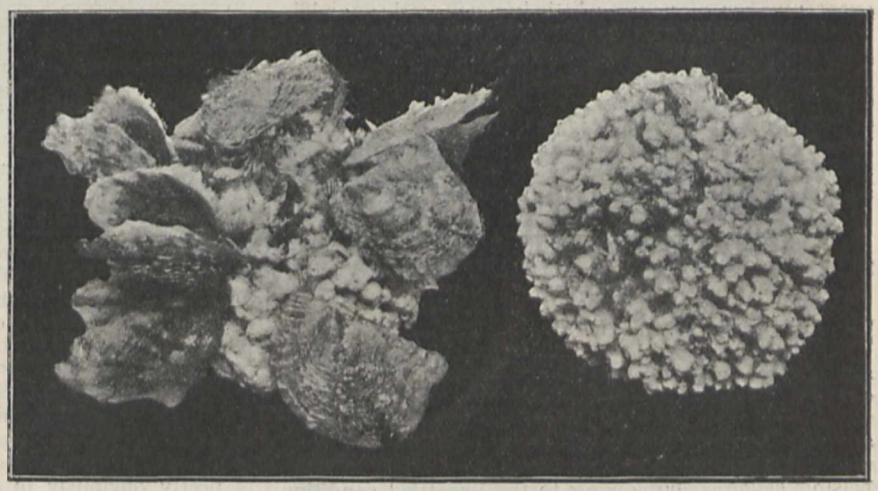

FIG. 1.—Natural cultch (Lithothamnion), and, to the left, a similar Nullipore ball with a dozen young pearl oysters attached. From "Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar."

If we may venture upon a word of suggestion, we would express a hope that in the concluding volume Prof. Herdman will furnish us with a concise and sufficient summary of the whole of the pearl-oyster reports, since from the nature of the circumstances in which the series has been produced it is a little difficult to extract from them the essential features of the valuable work accomplished. We wander along pleasantly enough with Prof. Herdman on his explorations in the Gulf of Manaar, and accompany Mr. Hornell with pleasure during his inspections of the pearl banks from year to year; we traverse many an agreeable by-way under Mr. Hornell's direction, and not infrequently retrace our steps along the same paths with Prof. Herdman for our guide; we are allowed to see, as it were, the ideas gradually developing in the minds of the two investigators, and we watch with interest the new facts and suggestions of Mr. Hornell's various letters and reports becoming gradu-

[1] "Report to the Government of Ceylon on the Pearl-Oyster Fisheries of the Gulf of Manaar." By Prof. W. A. Herdman, F.R.S. With Supplementary Reports upon the Marine Biology of Ceylon by other Naturalists. Part iii., pp. viii+328 and plates; and part iv., pp. xvi+242 and plates. (Published at the request of the Colonial Government by the Royal Society, London, 1905.)

ally assimilated into Prof. Herdman's general scheme—all of which would be entertaining enough on a warm afternoon in summer, when we lay on some grassy cliff within sound of the sea, but is, it must be confessed, a little trying to busy individuals anxious to arrive at the kernel of the business in hand.

Of the supplementary reports in parts iii. and iv. the most important is probably Prof. Dendy's monograph on the sponges, which occupies some two hundred pages and is illustrated with sixteen plates. Prof. Dendy describes 146 species from Prof. Herdman's collection, of which 77 are new, and he considers that the most striking feature of the sponge-fauna of Ceylon, next to its richness, is its close relationship with that of Australia and the adjacent islands. On the other hand, it differs considerably from the sponge-fauna of the Red Sea, as well as from that of the south and east coasts of Africa.

In the case of the Alcyoniidæ, on the other hand, Prof. Arthur Thomson notes that there is a great difference between the Ceylon collections and those made off the Maldives by Mr. Gardiner and off New Britain and New Guinea by Dr. Willey.

It is impossible to refer in detail to all the memoirs in these volumes, which contain descriptions of a great number of new or little-known species, and it would be premature to attempt to anticipate the general discussion on the fauna of Ceylon which Prof. Herdman promises for the concluding part of the report. All the memoirs are well illustrated with a number of lithographic plates, of which the very beautiful series accompanying Mr. E. T. Browne's account of the Medusæ may be specially mentioned as doing credit to artist and lithographer alike.

THE ABORIGINES OF UNEXPLORED NEW GUINEA.[1]

IN this work Mr. A. E. Pratt gives an account of the time he, with his son, a youth of seventeen, spent in New Guinea collecting zoological specimens during the years 1901–3. A short visit was paid to the Dutch settlement of Merauke, newly established among the Tugeri tribes of Netherlands New Guinea to check the raids into British territory of these enterprising savages, but owing to the unsettled condition of the country no attempt to leave the settlement was made. Mr. Pratt then shifted his quarters to Port Moresby, in British territory, whence moving to Yule Island he organised his expeditions to the mountainous hinterland of the Mekeo district of the Central Division, where almost the whole of his time was spent and where his collections were principally made. A large number of new Lepidoptera, a new fish, and a couple of new reptiles rewarded Mr. Pratt's efforts; but although the object of the expedition was to collect zoological and botanical specimens, Mr. Pratt devotes little space in his book to natural history, its bulk being given to a gossipy description of the author's journeyings, with remarks, too often inaccurate, on the natives he came in contact with.

Mr. Pratt on p. 291 points out that he "cannot pretend to be a trained ethnologist . . .," while his "notes, too, were fragmentary . . . owing to the stress of . . . journeyings and the pressure of work. . . ."

In these circumstances it is easy to forgive the omission of any mention of many problems of the greatest interest, *e.g.* the provenance of the Mekeo stone adze and "pineapple" club, upon which some light might have been thrown in the country visited by Mr. Pratt in his furthest journeys; but, reasonable as are these claims to consideration and forbearance, and difficult and trying as the present writer knows the Mekeo hinterland to be, they do not palliate the publication of such a mass of misstatements and inaccuracies as occur in this book, and are absolutely no excuse for such apparent "faking" of photographs or drawings as produce the ridiculous results shown in the plates facing pp. 168, 262, and 268.

Again, with a perversity that is as determined as it is misplaced, in the map given at the beginning of the volume a number of such well-known Mekeo villages as Aipiana, Inawi, and Rarai are bodily transferred from the right to the left bank of the St. Joseph River, to which Nara village is shifted some twenty miles northwards of its actual site.

Certain of the more glaring inaccuracies in print and picture may now be specified.

The description on p. 71 of Motu pot-making is inaccurate, nor are "several hundred large dug-out canoes brought together and moored side by side at the landing stages in groups of six or seven" (p. 72) to form the lakatoi used on the annual Motu trading expedition to the Papuan Gulf. The present writer has seen many Motu dances, and in 1903 watched the departures of a number of lakatoi from Port Moresby, but certainly never saw a Motu girl "spin round with a dizzying rapidity," and finds it difficult to believe that Mr. Pratt did; while Mr. Pratt's statement is not borne out by the plate, obviously a photograph, he quotes in support of it.

The plate facing p. 168, with its attached legend, "A piebald tribe: The Motu-Motu people of Hoods Bay . . ." constitutes perhaps the most grotesquely erroneous statement in the book, and is not unworthy of an imaginative traveller of the fifteenth century. The plate shows two natives, irregularly spotted with patches of white, wearing a form of perineal bandage which is not worn at Hulaa or anywhere on the Hood Peninsula; and the accompanying letterpress is scarcely less frankly imaginative; "the piebald people are one of the mysteries of New Guinea," says Mr. Pratt, "and their origin is unexplained." The origin of a piebald tribe in Hood Bay is pretty obviously in the fertile imagination of the author, who calls the tribe he has brought into existence the Motu-Motu, this as a matter of fact being the Motu name for the Toaripi of the Papuan Gulf living about 150 miles west of Hood Bay.

Of course "albinos," though they never have pink eyes, occur sporadically all over New Guinea, and are particularly abundant at Hulaa, where there are at least four of these "albinotic" individuals. But apart from elderly folk, in whom leucoderma of the hands and feet, spreading to the forearm and leg, is by no means rare all over British New Guinea, the writer, who has twice visited Hulaa, knows of but one case of partial albinism, a child of about eight years of age belonging to the Sinaugolo, a tribe in no way closely related to the Hulaa folk.

The astounding and wildly unnatural plates which face pp. 262 and 268 cannot be passed without remark. A glance at the latter plate will convince anyone that it represents no tropical jungle, while the whole story of the fishing-nets spun by spiders on bamboo loops erected for this purpose in the jungle, which these two plates illustrate, seems to be a far-off reminiscence of the kite-fishing with a bait of spider's web which skips along the surface of the water practised in the D'Entrecasteaux and other archipelagoes off south-eastern British New Guinea. There are many other inaccuracies and misstatements in the

[1] "Two Years among New Guinea Cannibals." By A. E. Pratt, with Notes and Observations by his Son, H. Pratt. Pp. 360; illustrated. (London: Seeley and Co., Ltd., 1906.) Price 16*s.* net.

book which for lack of space must pass unnoticed, but the above are probably the most glaring examples.

After such defects as have been discussed it seems almost hypercritical to mention minor blemishes, but it may be pointed out that proper names are often misspelt, and this is the case even with the names of such well-known New Guinea worthies as the Rev. Dr. Lawes. The frequency with which such slips occur suggests that the author may again be travelling, or at any rate that he has not had the opportunity of revising his book. The get-up of the book is good, and where the plates are not imaginative they are often interesting, as is the case with those facing pp. 108, 120, 144, 176, 236, and 244.

C. G. SELIGMANN.

FIG. 1.—The native village of Dinawa. From "Two Years among New Guinea Cannibals."

THE ROYAL SOCIETY CONVERSAZIONE.

ON Wednesday of last week, May 9, there was a large assembly at the Royal Society on the occasion of the first of the two conversaziones held annually in the society's rooms at Burlington House. The guests were received by the president, Lord Rayleigh, and included, not only leading men of science, but also representatives of other branches of intellectual activity and national interests. There were numerous exhibits of objects and apparatus illustrating recent scientific work, and the following notes will give an indication of their character. Descriptions relating to exhibits belonging to the same departments of science have so far as possible been brought together. During the evening lantern demonstrations were given by Mr. G. W. Lamplugh, F.R.S., on the Batoka gorge of the Zambezi river, and by Prof. S. P. Thompson, F.R.S., on the electric production of nitrates from the atmosphere. For an account of the Batoka gorge reference should be made to a paper by Mr. Lamplugh in NATURE of November 30, 1905 (vol. lxxiii., p. 111); and the subject of Prof. Thompson's lecture will be found dealt with in NATURE of February 8, 1906 (vol. lxxiii., p. 355), and p. 65 of the present number. In several other cases descriptions of instruments and other objects exhibited have already appeared in the columns of NATURE, and references are given to them in the subjoined summary of the official catalogue.

Mr. T. E. Heath: Stereoscopic star charts and spectroscopic key maps.—*Rev. A. L. Cortie:* Photographs of the solar corona, 1905, August 30, taken at Vinaroz, Spain, with a 4-inch lens and 20-feet coronagraph.—*The Solar Physics Observatory, South Kensington:* (1) Photographs illustrating the eclipse camp at Palma, Majorca (August 30, 1905), and some of the results obtained. (2) Examples of stellar spectra taken with the 6-inch two-prism prismatic camera. (3) Some photographs taken with the spectroheliograph. These include a "disc" photograph taken on August 31, 1905, the day after the total solar eclipse of that year. (4) Curves to illustrate long-period barometric changes in operation in India, East Indies, Australia, and South America. They show the possible evolution of the nineteen-year variation in Australia from the eleven-year (about) variation in India, and the relation of the Australian to the South American changes. (5) Photographs and diagrams illustrating recent work done on the orientation of some British stone circles.—*The Royal Astronomical Society:* Six photographs of the Milky Way taken in 1905 by Prof. E. E. Barnard at Mount Wilson, California.—*The Astronomer Royal:* Photographic prints of the total solar eclipse of 1905, August 30, from negatives taken at Sfax, Tunisia.—*The Director, Meteorological Office:* (1) Antarctic meteorological records with charts and diagrams prepared in connection with the discussion of the results of the Antarctic expeditions. (2) Some recent meteorological results. (*a*) Meteorological charts of the Indian Ocean and Red Sea for the month of May, showing average winds, currents, and other meteorological information, including a reproduction of the chart for May of the tracks of hurricanes prepared by the late Mr. C. Meldrum, F.R.S. The chart is the first of a monthly series to be issued by the Meteorological Office for the use of seamen. (*b*) Diagram exhibiting the relation between Admiral Beaufort's numbers for wind force and the corresponding wind velocity and wind pressure.

Mr. R. Kerr: A torsion spring for transference of energy. (Exhibited on behalf of Prof. L. R. Wilberforce, of University College, Liverpool.)—*Mr. Joseph Goold:* Vibration experiments. Two distinct systems of vibration in the same steel plate are tuned closely to the same pitch. When either system is excited the other also becomes active; and their respective intensities go through a variety of fluctuations, producing remarkable disturbances of the compound node-lines.—*Prof. G. Forbes, F.R.S.:* Model of naval gun-

sight, giving correct elevation for any variations of muzzle velocity, air density, and time of flight, as arranged for the 6-inch B.L. gun, Mark XI., under construction at Elswick for trial on H.M.S. *Africa*.—*Sir James Dewar, F.R.S.:* Metallic jacketed vacuum vessels. In these metallic vessels filled with liquid air the vacuum is produced by the use of cooled charcoal. The envelopes may be made of brass, copper, nickel, or tinned iron, with necks made of a bad conducting alloy. The necks can be covered with silvered glass vacuum cylinders which act as stoppers and at the same time utilise the cold of the slowly evaporating liquid. The efficiency of the best metallic flasks is equal to that of the average silvered glass vacuum vessels now generally used in low temperature investigations. Vessels of this type may be useful in industrial cryogenic operations and for the storage and safe transit of liquid air and oxygen.—*Mr. C. V. Boys, F.R.S.:* A gas calorimeter (see vol. lxxiii., p. 354, February 8, 1906).

Mr. G. F. Herbert Smith: A refractometer for liquids. By means of this instrument the refractive indices of liquid and semi-liquid substances may be easily and quickly determined in sodium light to the fourth place of decimals.—*Prof. W. F. Barrett, F.R.S.:* Entoptiscope, for the self-examination of obscurities and defects within the eye.—*Sir William Crookes, F.R.S.:* (1) The ultra-violet spectra of the metals, photographed with a quartz train of five double prisms. The spectrum of pure iron used as a standard. (2) Stereoscopic photographs, taken by Sir W. Crookes on the occasion of the visit of the British Association to South Africa in the autumn of 1905.—*Lord Blythswood:* Photographs of certain arc spectra. The spectra were produced by means of a Blythswood concave diffraction grating, the work being undertaken as a practical test of the gratings. The radius of the grating was 10 feet, the first-order spectrum being photographed. The total length given was about 40 inches, from λ 2100 to λ 7400.—*Dr. W. Marshall Watts:* Binocular spectroscope. The instrument consists of a field-glass, or other form of binocular, in front of the object-glasses of which two exactly similar transparent diffraction gratings are mounted on optically-worked plane glass. As the instrument has neither slit nor collimator it is applicable, in the first instance, only to luminous objects of definite form, such as vacuum tubes. For ordinary observations of flame spectra, or spark spectra, a metal or ebonite plate, with a slit, in front of the Bunsen or spark is employed.—*Mr. Edwin Edser and Mr. Edgar Senior:* Specimens of colour photographs, and photomicrographs. The exhibit included (1) Lippmann spectrum photograph bleached after Neuhauss's method; (2) colour photograph produced by exposing Lippmann film successively to two continuous spectrums, the red end of one being superposed on the blue end of the other; (3) three-colour photographs of coloured objects, including crystals under polarised light; (4) photomicrographs obtained through red, green, and blue colour screens; (5) photomicrographs obtained by the aid of Zeiss apochromatic objective, and other objectives.

Royal Microscopical Society: Micro-Daguerreotypes of blood, milk, and crystals, made by Léon Foucault in 1844.—*Messrs. R. and J. Beck, Ltd.:* Ultimate microscope resolving power with light of different wave-lengths. A specimen of *Amphipheura pellucida* was shown under 1/12 oil immersion 1·25 N.A. A single filament Nernst lamp on a small optical bench was the source of illumination. The beam was split up into a brilliant spectrum by means of a Thorp replica grating, and any portion of the spectrum can be used for illuminating the object. The experiment showed that whereas the diatom is brilliantly resolved with green light, the whole structure is invisible with yellow light.—*Mr. Julius Rheinberg:* (1) Production of achromatic interference bands by the double grating method; (2) photographs chiefly of diatoms, taken by Dr. A. Köhler with the Zeiss apparatus for ultra-violet light.—*Mr. W. Rosenhain:* Improved metallurgical microscope designed for the examination of metal specimens. The base and limb are of particularly rigid construction, and the tube is rigidly attached to the limb. The stage racks on the broad flange of the limb, and is provided with a fine adjustment placed in the line of the optic axis of the microscope. The internal reflectors employed for obtaining "vertical" illumination, instead of being carried on a detachable fitting, are inserted into the tube of the instrument, and are provided with adjusting movements which allow of complete control of the lighting. Special devices for the easy attachment and adjustment of oblique and other illuminators for low-power work are provided, while a detachable bridge can be fitted to the stage so as to adapt it for work with transmitted light. For purposes of photomicrography a focusing motion is provided whereby the eye-piece may be moved relatively to the objective.—*The Director of the National Physical Laboratory:* (1) Photomicrographs of the polished and etched surface of specimens of iron and steel taken during the progress of alternating stress tests, Dr. T. E. Stanton. (2) Photomicrographs, Dr. H. C. H. Carpenter. (3) An apparatus for tests on the strength of materials at very high temperatures, Dr. J. A. Harker. (4) *a*, Picou permeameter (by kind permission of Mr. J. H. Agar Baugh), *b*, Bifilar galvanometer free from zero creep, Mr. A. Campbell.

Dr. P. E. Shaw: An electrical measuring machine (see May 3, p. 22, and vol. lxxii., p. 495).—*Sir Oliver Lodge, F.R.S., and Dr. Alexander Muirhead, F.R.S.:* Wireless telegraphy apparatus for military field purposes. (1) A portable pack-transport set of wireless telegraphy apparatus for military field purposes, available for communications across country for distances up to fifty miles, or 150 miles over sea; with electric valves employed to accumulate the impulses of a small coil and battery, or small dynamo, so as to give discharges of energy only otherwise obtainable from a large and heavy source of electric supply. The arrangement needs no earth connection, nor must it have any when it is required to work over long distances with the greatest efficiency. (2) A vibrating needle point-oil-mercury coherer with telephone receiver.—*Mr. W. Duddell:* Some mechanical and electrical phenomena occurring in the telephonic transmission of speech. The apparatus is intended to demonstrate as curves on a screen the simultaneous movement of the microphone transmitter diaphragm, the current flowing into the telephone line, the current received at the far end of the line, and the movement of the receiver diaphragm when sounds or speech are being transmitted. The similarity of and the difference between these four curves can be examined by the aid of the apparatus, and the distortion and attenuation produced by the resistance, capacity, and self-induction of the line can be demonstrated, as well as the distortions produced by the diaphragms of transmitter and receiver. The characteristic shapes of the curves corresponding to the different vowel sounds and their dependence on the pitch on which they are sung can also be exhibited.—*Mr. L. H. Walter:* New magnetic detector, giving both alternating currents for telephonic reception and continuous currents for recording or visual signals. The detector is a form of differential dynamo in which electric oscillations are made to act upon one armature core only.—*Mr. K. J. Tarrant:* Photographs of electrical discharges, at atmospheric pressure and *in vacuo*.—*Mr. E. G. Rivers:* A new electric heater. The principle of construction departs from that usually adopted. The object in view is to secure a large heating surface at a moderate temperature, and the method exemplified is the use of silicated carbon upon a terra-cotta base, forming an "element." These "elements" assembled together constitute the heater.

Mr. J. E. Stead, F.R.S.: A triple alloy of tin-antimony-arsenic, polished and etched, showing bright curved crystals embedded in a soft matrix or eutectic.—*Dr. G. T. Moody:* Specimens illustrating the indifference of oxygen towards iron in presence of water and the effect of the admission of carbonic acid.—*Messrs. Wallach Bros.:* Oxygen rescue apparatus and other appliances. (1) The "Evertrusty" oxygen apparatus, used by the rescue parties at Courrières, consisting of two oxygen cylinders filled with oxygen, two regenerators through which the vitiated air passes and is regenerated, and which at the same time serve the purpose of ascertaining if the apparatus is in working order prior to use. (2) "Evertrusty" oxygen first-aid case for use in case of carbonic oxide poisoning, or after inhalation of smoke, poisonous fumes, &c., consisting of oxygen cylinder, reducing valve, pressure gauge, bag and mask, with back-pressure valve.—*Dr. O. Silberrad and Mr. H. A. Phillips:* A series of picrates. The salts of picric acid are of interest as having been the probable cause of some of the most

disastrous lyddite explosions on record. The specimens exhibited were in many cases prepared in the course of an exhaustive investigation recently carried out at the research laboratories of the Royal Arsenal. Several of the salts exhibited have never before been prepared, and the majority have never previously been obtained pure or correctly analysed.

Director of the Geological Survey of Great Britain: Geological maps, recently issued by the Geological Survey and Museum.—*Prof. John Milne, F.R.S.:* Seismograms of recent earthquakes. (1) North-south and east-west components of the Formosa earthquake of March 16, 1906. (2) Two components of the Colombian earthquake of January 31, 1906. (3) An enlargement of the terminal vibrations of the upper part of Fig. 2. It shows the extinction of an earthquake in wave groups. Each group has a duration of about 2·5 minutes to 3 minutes, and contains about seven waves. One set of groups may approximately resemble another set of groups. (4 and 5) Open diagrams of the same earthquake. The pendulum which recorded the upper part of Fig. 4 weighs 80lb., and has a period of twenty-five seconds. That which recorded Fig. 5 weighs a few ounces, and has a period of fifteen seconds. Both have recorded the period for the large waves as seventeen seconds. (6 and 7) Open diagrams of the San Francisco earthquake of April 18, 1906.—*Royal Observatory, Edinburgh:* Seismograph records. (1) Indian earthquake, April 4, 1905; (2) earthquake in Siberia, July 23, 1905; (3) earthquake in Calabria, September 8, 1905; (4) earthquake in Greece, November 8, 1905; (5) San Francisco earthquake, April 18, 1906.—*Mr. J. Stanley Gardiner:* Dredged rocks off Providence Coral Reef, 844 fathoms (H.M.S. *Sealark*). These rocks were obtained off the outer slope of a coral reef, half-way between the Amirante Bank and Madagascar. They consist of (1) volcanic ash in various stages of consolidation; (2) manganese nodules round nuclei of ash; and (3) coral rock coated with manganese.—*Prof. Wyndham Dunstan, F.R.S.:* (1) New or rare minerals from Ceylon. Many of the minerals exhibited have been collected during the progress of the mineral survey now proceeding in Ceylon in connection with the Imperial Institute. Others have been found in river gravels sent for examination to the Imperial Institute. These minerals illustrate the wide distribution of thorium in Ceylon. (2) Minerals from Canada.—*Dr. A. S. Woodward, F.R.S.:* Hind limb of the gigantic extinct marsupial *Diprotodon australis* from Lake Callabonna, South Australia.—*Mr. F. J. Lewis:* Late Glacial and post-Glacial plant remains from the Scottish peat deposits and from Cross Fell. The remains were met with during an investigation of the peat deposits in Scotland and on Cross Fell, Cumberland. All the deposits so far examined show definite stratification—each layer has its own set of plants, and very different conditions are frequently shown by strata at different horizons in the same peat deposit.

The Director, Royal Botanic Gardens, Kew: (1) Precocious flowering of plants (exhibited by Mr. W. B. Hemsley, F.R.S.). (*a*) Seedling mahogany tree in flower when about 6 inches high. Leaves simple instead of pinnate; flowers very similar to those of the adult tree. (*b*) Seedling *Ailanthus glandulosa* in flower when about 3 inches high. Leaves trifoliolate instead of multifoliolate; flowers male. (*c*) Lilac flowering from the young suckers, with or without leaves; flowers normal in structure, fragrant. (*d*) Coco-nut flowering on its appearance from the shell of the seed. (2) Exalbuminous grass-seeds (exhibited by Dr. Otto Stapf). The structure of the seed is very uniform throughout the Gramineæ, the presence of a very copious farinaceous endosperm or "albumin" being characteristic of it. A remarkable exception (*Melocanna bambusoides*, which is exalbuminous and at the same time viviparous) was recently described by Dr. Stapf, who has since discovered three more examples of exalbuminous grass-seeds, all in Bambuseæ.—*Prof. Wyndham Dunstan, F.R.S.:* Cyanogenetic plants. The specimens illustrated an investigation conducted by Prof. Dunstan and Dr. T. A. Henry to throw light on the origin of the prussic acid which is produced by certain plants. All the plants shown contain the same cyanogenetic glucoside (dextrose ether of acetone cyanhydrin), which has been named "phaseolunatin." Accompanying it in each plant is an enzyme capable of effecting its decomposition.—*Mr. J. Stanley Gardiner and Mr. H. P. Thomasset:* Photographs illustrative of the vegetation of the Seychelles Islands.

The Marine Biological Association: The habits of some fishes from the inshore waters. A small collection of living fishes from the shore and from shallow water was shown to illustrate the differences in habit and mode of life adopted by different species.—*Mr. Cecil Warburton:* Berlese's apparatus for capturing minute insects and arachnids.—*Prof. W. C. McIntosh, F.R.S.:* Thirteen coloured plates (original) for part iii. of the "British Annelids," to be published by the Ray Society, 1907. These are drawings, from life, of specimens procured from Shetland to the Channel Islands.—*Mr. J. E. S. Moore and Mr. C. E. Walker:* Recent researches in cell-division. (1) Leucocytes lying in cytoplasm of tissue cells in early stage of cancer. (2) First maiotic (heterotype) division in cancer of breast. Division figures in this form of cancer have been supposed to be rare. (1 and 2, joint research with Prof. Farmer, F.R.S.) (3) Specimen showing characteristic permanent forms in chromosomes of first maiotic (heterotype) division. (4) Specimen showing pluripolar mitoses and amitoses in myeloplaxes (bone marrow). (5) Specimen showing division figures in germinal area of lymphatic gland. (6) Specimen showing cells destined to become foot-cells in testis of embryo guinea-pig.—*Dr. Albert A. Gray:* Series of stereoscopic photographs of the membranous labyrinth illustrating the comparative anatomy of the organ. The examples shown were illustrative of Amphibia, reptiles, birds, and Mammalia.—*Dr. G. C. Chubb:* Yolk-nucleus in the oocyte of Antedon. The yolk-nucleus of Antedon was shown to be merely a region of the egg-cytoplasm on to which has diffused a part of the material discharged from the nucleolus throughout the growth of the oocyte.

NOTES.

MME. CURIE has been nominated by the council of the University of Paris to succeed her husband, the late Prof. Curie, in the chair of general physics held by him at the time of his death. The nomination has been accepted by the Minister of Public Instruction.

DR. A. C. HADDON, F.R.S., university lecturer in ethnology, Cambridge, has accepted an invitation to give a course of Lowell lectures in Boston, Mass., during November next. He will discourse on racial problems, distribution of culture, and social and religious evolution in Melanesia.

THE Croonian lecture of the Royal Society will be delivered on Thursday, May 24, by Prof. J. N. Langley, F.R.S., "On the Presence of Special Excitable Substances in Striated Muscle and in Tissue Cells."

THE Cleve memorial lecture will be delivered at the Chemical Society by Prof. T. E. Thorpe, C.B., F.R.S., on Thursday, June 21.

PROF. J. B. FARMER, F.R.S., who is giving special attention to parasitic growths, would be glad to receive specimens of such growths. The specimens should be forwarded to Claremont House, Wimbledon Common, Surrey.

MR. R. MCG. DAWKINS, fellow of Emmanuel College, Cambridge, has been elected director of the British School in Athens, in succession to Mr. R. C. Bosanquet, lately appointed to the chair of archæology in the University of Liverpool.

ON Thursday next, May 24, Prof. W. J. Sollas will begin a course of three lectures at the Royal Institution on "Man and the Glacial Period." The Friday evening discourse on May 25 will be delivered by Mr. Leonard Hill, on "Compressed Air and its Physiological Effects."

A COMMITTEE has been appointed to make arrangements to commemorate the distinguished services rendered to archæology by Dr. Arthur Evans, F.R.S. It is proposed to place a portrait of Dr. Evans in the Ashmolean Museum, Oxford, of which he has long been keeper. The world-famed discoveries at Knossos have made Dr. Evans well known to students of archæology everywhere, and it may be expected that the plan suggested will meet with wide approval. Subscriptions may be paid to the hon. treasurer, Mr. G. A. Macmillan, St. Martin's Street, W.C., to the account of the "Arthur Evans Portrait Fund," London and County Bank, Henrietta Street, Covent Garden, W.C., or to Messrs. Barclay and Co., Old Bank, Oxford. The hon. secretaries of the movement are Messrs. D. G. Hogarth and C. F. Bell, Magdalen College, Oxford.

THE German chief burgomasters, burgomasters, and councillors who are paying a visit to England as the guests of the British committee for the study of foreign municipal institutions were entertained on Monday at a banquet over which Lord Avebury presided. Mr. Haldane proposed the toast of "The German Emperor and the German Empress and the other Members of the German Royal Family."; and in the course of his remarks he said that the present Kaiser united in himself the thinker and the man of action, and has organised his empire on an educational basis, paying great attention to technical and scientific instruction and investigation. Such institutions as that at Charlottenburg are instances of what is being accomplished in Germany to-day. The toast was acknowledged by the Ober-Bürgermeister of Berlin, who said that Mr. Haldane possessed a deep knowledge, not only of German history, but also of the German heart.

THE eleventh annual congress of the South-Eastern Union of Scientific Societies will be held at Eastbourne on June 6–9. The president-elect, Dr. Francis Darwin, F.R.S., will give his presidential address on June 6 at the Town Hall. The following papers will be presented:—Nature near Eastbourne, J. H. A. Jenner; the birds of Sussex compared with the list for Great Britain, W. Ruskin Butterfield; the educational value of museums, Dr. Jonathan Hutchinson, F.R.S.; sea erosion and coast defence, E. A. Martin; the geology of the Upper Ravensbourne valley with notes on the flora, W. H. Griffin; the flora of the Eastbourne district, Dr. Whitney; bird architecture, E. J. Bedford; nature-study, W. Mark Webb. The hon. general secretary is the Rev. R. Ashington Bullen, from whom all information can be obtained. The museum secretary, Mr. E. W. Swanton, Educational Museum, Haslemere, will have charge of the congress museum at the town hall. The photographic surveys of Surrey, Kent, and Sussex will be represented by a large series of photographs of scientific and antiquarian interest.

BARON TAKAKI, the Director-General of the Medical Department of the Japanese Navy, delivered last week a series of three lectures on the preservation of health amongst the personnel of the Japanese Navy and Army at St. Thomas's Hospital, at which medical school he was formerly a student. The subject of kak'ke or beri-beri was dealt with exhaustively. This disease was formerly very prevalent in the Japanese Navy, and, as the result of observations, Baron Takaki had come to the conclusion that its prevalence was largely due to a disproportion between the non-nitrogenous and nitrogenous elements of the food. By adding a larger proportion of nitrogenous elements to the food the disease has now almost disappeared from the Navy. Other diseases, such as typhoid, dysentery, and cholera have also almost disappeared in consequence of careful hygienic measures.

SINCE the discovery of a spirillar organism, the *Spirochaeta pallida*, in syphilitic lesions, a great deal of work has been done on the transmission and prophylaxis of this malady. Whether or no this microbe be the ætiological agent of the disease, and it cannot yet be said to have been proved definitely, its discovery has undoubtedly stimulated research, and it is now certain from a number of experiments, both in this country and abroad, that syphilis can be inoculated on the higher apes. Recently Prof. Metchnikoff, of the Pasteur Institute, demonstrated that the application of an ointment composed of calomel ten parts and lanolin twenty parts to the point of inoculation will prevent the development of the disease. This was proved by inoculating apes and also a healthy medical student (who offered himself as a subject for experiment) with syphilitic virus, and an hour later rubbing the inoculated spot with this ointment in the case of the student and of one ape. Neither man nor monkey suffered any evil effect, whereas the other inoculated monkeys which were untreated contracted syphilis. In the case of monkeys the ointment must be applied within twenty hours after inoculation, otherwise infection follows, but if this time limit be observed immunity is complete. It is noteworthy that Prof. Metchnikoff will shortly be visiting this country in order to deliver the Harben lectures at the Royal Institute of Public Health, 37 Russell Square, W.C. The lectures, which are delivered at 5 p.m., are as follows:—May 25, the hygiene of the inner tissues of organisms; May 28, the hygiene of the intestinal tract; May 30, syphilis.

THE proceedings on Commemoration Day at Livingstone College, Leyton, E., on Thursday, May 31, will include an address by Mr. James Cantlie, editor of the *Journal of Tropical Medicine*, whose opinion as to the necessity for the training given at the college is of special value, owing to his experience of the conditions of living in tropical countries. Cards of invitation may be obtained by writing to the principal of the college.

ON the morning of May 2, in the dynamite factory of the Nitroglycerine Company, Ltd., of Vinterviken, near Stockholm, there occurred three explosions in quick succession, which were heard all over the town, and resulted in the total wreck of the factory and the death of many of the workers; the cause of the explosion is at present unknown.

THE prize of 3000 francs offered by the International Medical Congress at the Paris meeting has been awarded by the Lisbon meeting to Prof. P. Ehrlich, of Frankfort-on-Main, for his researches on leucocytosis. British physiologists will approve of this recognition of the work of the great experimentalist and worker on the borderland of physiology and chemistry.

THE opinion has been frequently expressed that Scandinavia, with its huge waterfalls, will before very long be one of the most suitable places for large chemical works; indeed, it is claimed that with the future developments of electrochemical technology the greater part of the world's supply of soda, chlorates, nitrates, calcium chloride, and iron will be produced in the northern peninsula. Hence it is easy to understand the action of the Swedish and Norwegian Governments in protecting the falls against foreign capitalists. Sweden has passed a law that the use of the falls is reserved to the State, while a Bill is before the Norwegian Storthing in which it is prescribed that at least one-half of the capital laid out on the falls shall be Norwegian money, and the direction of the works be in the hands of Norwegians who are living in the land.

IN the *Chemiker Zeitung* for May 9 is an appreciative note from the pen of Prof. van 't Hoff on his conscientious co-worker and former student, the late Prof. Wilhelm Meyerhoffer, who, at the early age of forty-one, died of heart disease on April 21 in Meran, where he had gone for the benefit of his health. Meyerhoffer, although born in Russia, was on his father's side of Austrian descent, and was educated in German schools until his seventeenth year; after passing three years in the gymnasium of Czernowitz, he studied first under Bunsen at Heidelberg and then under Fittig at Strassburg, going from thence to Leipzig, Amsterdam, Paris, Vienna, and Berlin. A few years ago he declined an invitation to go to Prague, and only a few months ago received a call as *ordinarius* to the University of Aachen. In recognition of Meyerhoffer's experimental developments of Guldberg and Waage's principle, he was elected a corresponding member of the Scientific Society of Christiania, and at a more recent date to a similar honour by the society in Rotterdam.

DR. W. N. SHAW'S third lecture was delivered at the University of London on May 15, the subject under consideration being the normal general circulation of the atmosphere at the surface and in the upper air, and, in connection therewith, the relation of temperature and rainfall to the general circulation and local disturbances. We can only refer here to one or two of the many interesting points brought forward, *e.g.* the diagrams of the distribution of barometric pressure at the surface of the earth and at a height of 4000 metres showed that the gradients were quite opposite in character, but it was explained that when these two pressure distributions were combined they produced the general circulation observed at the surface. Another interesting feature of the lecture was a lantern slide showing the easterly drift of the surface wind-current at the winter quarters of the *Discovery* in the recent Antarctic expedition, and the westerly drift of the upper air shown by the smoke at the summit of Mount Erebus, also the confirmation of the latter motion by the observation of the upper clouds.

GRASSHOPPERS and crickets (Locustidæ and Gryllidæ) from Paraguay, by Mr. A. N. Caudell, form the subject of No. 1450 of the Proceedings of the U.S. National Museum.

THE life-history of the warble-flies, *Hypoderma bovis* and *H. lineata*, the larvæ of which do so much mischief to cattle in this country, is discussed by Mr. A. D. Imms in part ii. of the first volume of the *Journal of Economic Biology*. Although "warbles"—the tumours in the skin of cattle produced by the grubs of these insects—have been familiar to stock-owners and butchers from time immemorial, it appears that we are still completely in the dark as to the mode in which the larvæ effect an entrance into their hosts, as it is still undecided whether they do so by penetrating the skin or by way of the mouth.

THE *Naturalist* for May contains an excellent portrait and biography of Mr. H. C. Sorby, in the course of which reference is made to the fact that the mechanical theory of slaty cleavage is due to him, and that he was the first to make microscopic rock-sections. The articles include one on chalk belemnites, by Mr. C. D. Sherborn, and one on the senses of bats, by Mr. A. Whitaker, both illustrated. In the latter it is stated that bats "are now ranked as the first suborder of the second great order Carnaria, instead of the last suborder of the first order Primates," which leads us to wonder what text-book the author is in the habit of using.

OF the five articles in the March issue (vol. iv., part iv.) of *Biometrika*, three are devoted to the subject of heredity. In one of these Mr. E. Schuster, dealing with hereditary deafness in man, points out, in the first place, that deaf-mutes generally marry with persons similarly afflicted, with the results that might be expected; and, in the second place, brings out the normal, or even more than normal, fertility of such unions. A paper on Shirley poppies, by several workers, affords additional evidence of heredity in plants. On the other hand, Messrs. Barrington and Pearson, in discussing the heredity of colour in cattle, as exemplified in shorthorns and certain shorthorn crosses, do not find that this comes under the Mendelian law, at least in the shape of any simple formula.

PARASITIC invertebrates, or nearly related free-living forms, constitute the subject of the three articles in the April issue (vol. l., part i.) of the *Quarterly Journal of Microscopical Science*. The life-history of one of the Gregarinida, *Cystobia irregularis*, a species infesting the holothurian locally known in this country as the "cotton-spinner," has recently been investigated by Dr. H. M. Woodcock, who in the communication before us states that he has brought to light several interesting points in the life-cycle of the group in general. The hope of adding to our knowledge of the nature of the "cœlom" and the "nephridea" appears to have been the inducing cause which led Mr. F. H. Stewart, I.M.S., to take up the study of the free nematode worm *Oncholaimus* (or *Oncholaemus*) *vulgaris*. The author's conclusions are summarised at the end of his paper. In the third article Dr. Woodcock publishes the first part of a comprehensive review of the present state of our knowledge of the blood-parasites known as the hæmoflagellates, or trypanosomes. The author lays stress on the extreme rapidity with which investigations into the life-history of these minute organisms have been carried out, the realisation of the extreme importance of such knowledge in respect to the prevention of disease being mainly responsible for this advance.

CAPTAIN LAMB and Assistant-Surgeon Kesava Pai discuss the occurrence of Mediterranean fever in India (Sc. Mem. Gov. of India, No. 22). In seventeen cases carefully investigated, complete agglutination reactions (carefully controlled against normal individuals) were obtained, and, in addition, from eleven of these cases a coccus corresponding in all its characters with the *M. melitensis* was obtained by splenic puncture during life.

A CATALOGUE of microscopical slides, microscopes and accessories received from Messrs. Flatters and Garnett, Manchester, indicates that they are prepared to provide all requisites for microscopical work. The list of botanical and zoological slides is one of the most comprehensive and practical we have seen; a variety of articles for nature-study workers are also supplied.

WITH the view of helping visitors to appreciate the Royal Botanic Gardens, Glasnevin, a short guide, with plan of the gardens, describing the more important attractions, has been published by the director of the Science and Art Institutions, Dublin. In addition to the features of interest that the Glasnevin gardens show in common with similar institutions, the specimens of *Nepenthes distillatoria* raised from seed at Glasnevin, the original golden yew, and the fine collection of palms are especially worthy of notice.

DR. D. H. SCOTT paid a graceful tribute to a fellow-worker in fossil botany in presenting a sketch of the life and work of the late Dr. B. Renault as his presidential

address to the Royal Microscopical Society. Renault's work ranged over the field of fossil vascular cryptogams and gymnosperms, within which the real triumphs of fossil botany have been won. To Renault we owe the reconstruction of that unique family the Botryopterideæ, at present regarded as the most authentic group of Palæozoic ferns, also the extraordinarily perfect knowledge that we possess of the gymnospermous Cordaiteæ. Dr. Scott's address, together with a list of Renault's more important contributions, is published in the April number of the Journal of the society.

DR. R. PEROTTI, writing in the *Atti dei Lincei*, xv., 5, describes observations on the distribution of nitrifying bacteria in Italy. Samples of soil were taken from various districts, and cultures made by Beyerinck's method, and in every case nitrifying bacteria were found in greater or less abundance, the best results being obtained from Rieti, Messina, and Cerignola.

PROF. GIACINTO MARTORELLI has had the rare fortune to obtain a specimen, believed to be the first, of Ross's polar gull (*Rhodostethia rosea*, Macgill.) from the Mediterranean, killed in the neighbourhood of Sardinia. The specimen in question reached him on January 10 of this year in the flesh, though decomposition was setting in. It appears to be a young bird, being 30 centimetres in length, and possibly this may account for its being found so far from its northern haunts. The discovery is announced in the *Rendiconto del R. Istituto Lombardo*, xxxix., 4, and the specimen has been stuffed and given to the Turati collection.

DR. F. EREDIA, of the Central Meteorological Office at Rome, has published in the official reports an account of a fall of dust on February 6. The occurrence was considered to be of sufficient importance to issue circulars to various observatories requesting particulars of the fall; the reports show that the dust was observed in Sicily, Lower Calabria, and other places, accompanied by thunderstorms, rain or hail, and strong south-easterly and south-westerly winds. The cyclonic conditions existing at the time would favour the conveyance of dust from Africa over the Mediterranean in the upper regions of the atmosphere, and although no analysis appears to have been made, the distribution of barometric pressure and other conditions seem to confirm the African origin of the phenomenon.

THE director of the Mauritius Observatory contributed to the eighth International Geographic Congress a useful paper on the climate of Pamplemousses. The results of the observations at Port Louis for 1860–6 were communicated to the British Association in 1867 by the late Dr. Meldrum; those commenced at Pamplemousses in 1874 form the basis of the present paper. The following are the mean annual and absolute extreme values of some of the meteorological elements:—air temperature 73°·4, 94°·7 in December, 50°·8 in June; humidity 75·1 per cent., 98·5 per cent. in January, 34·0 per cent. in November; resultant wind velocity 9·2 miles per hour; the maximum velocity recorded in an hour was 103·3 miles (old factor 3) on April 29, 1892. Cyclones are said to be of immense benefit to the island, as one of the principal sources of rainfall. Taking an area of 20° square, of which Mauritius occupies nearly the centre, 237 cyclones were recorded in the years 1854–1903. The greater number occurred between December and March, and not one was recorded between June and September; their occurrence appears to be most frequent five years after, and least frequent one year before, the epoch of minimum solar activity.

THE principal article in *Concrete and Constructional Engineering* (vol. i., No. 2) is by Captain Sewell, of the United States Army. It deals with the introduction of reinforced concrete in the United States, and is a commentary on the various systems and methods of applying this material adopted in that country. The article is illustrated by views and details of important buildings.

AT the last meeting of the Institution of Mechanical Engineers an interesting paper was read by Mr. Louis Greaven on petroleum fuel in locomotives on the Tehuantepec National Railroad of America. It gives the actual results of a year's experience, and the information should prove of service to others who contemplate adopting oil fuel in railway working.

IN a paper read before the Birmingham section of the Institution of Electrical Engineers on April 25, Dr. D. K. Morris and Mr. G. A. Lister proposed a standard test for transformers and transformer iron. The method involves but one set of connections, three instruments, and the normal supply, and necessitates the use of two similar transformers. It is a modification of that first described in 1892 by Ayrton and Sumpner, and is an application of the Kapp-Hopkinson or differential method of testing direct-current machines. The behaviour of a transformer when loaded at various power factors is, they find, best considered by means of a regulation diagram which they have constructed. The short-circuit test can equally well be carried out with the transformer core excited. The three-point wattmeter method is probably the most accurate means of measuring power factor and current when carrying out single-phase tests on transformers or motors from a three-phase supply. By bringing the supply to the middle point in the testing transformer when carrying out the differential test, symmetrical conditions are obtained, thus permitting of a normal determination of the various losses. By varying the voltage only and taking wattmeter readings the core loss of a transformer may be separated into hysteresis and eddy-current loss by the method of the total index. Wattmeter readings in combination with the three-point method serve as the best means of measuring the temperature rise in heating tests. The method of constant induced voltage affords a ready means of finding the true hysteresis loss, and is probably the best way of testing iron samples.

OUR ASTRONOMICAL COLUMN.

COMETS 1906*b* AND 1906*c*.—A set of new elements for the orbit of comet 1906*b* is published by Herr M. Ebell in No. 4087 of the *Astronomische Nachrichten*. An ephemeris for alternate days is also given, extending from May 4 to July 7, and shows that this comet is still in the southern part of the constellation Leo, about half-way between τ and υ Leonis. It is moving very slowly in a south-eastern direction, its present brightness being about 0·5 of that at the time of its discovery.

A set of new elements for comet 1906*c*, computed by Miss Lamson, of the U.S. Naval Observatory, appears in No. 4086 of the same journal.

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA.—At the seventh annual meeting of this society, held in December last at New York, some forty papers on astronomical subjects were submitted.

Short abstracts of thirty-three interesting papers are given by Prof. H. Jacoby in No. 586 of *Science*, and amongst those which have not been noted previously in these columns may be mentioned the following:—A note on Prof. Burnham's forthcoming catalogue of double stars; a brief description of the vacant regions of the sky, by Prof. Barnard; an announcement concerning the publication

of the observations of sun-spots made by the late Dr. C. H. Peters, extending over the period 1860–1870, and including the determination of more than 13,000 heliographic positions of spots on more than 1100 days; a paper by Prof. W. H. Pickering on planetary inversion, which the author illustrated by experiments with a gyroscope; and an account of the foundation, and the partial destruction by fire, of the Philadelphia Observatory, by Prof. M. Snyder.

SOLAR PROMINENCES DURING 1905.—The usual annual summary of the prominence observations carried out at the Catania Observatory during the past year is published by Prof. Mascari in No. 4, vol. xxxv., of the *Memorie della Società degli Spettroscopisti Italiani.*

The results show that the mean daily frequency of prominences observed was greater in 1905 than in 1904 and 1903, but the increase was not so great as might have been expected. As in previous years, it is seen that the increase in mean daily frequency corresponds with a decrease in heliographic latitude. In 1904 the mean daily frequency was 2·90 and the mean latitude 36°·6, whilst for 1905 the corresponding figures were 3·05 and 30°·8. The mean altitude of the prominences during 1904 was 43″·7, and in 1905 it was 44″·1; the corresponding extensions of the prominences along the solar limb were 7°·27 and 8°·77.

The greater frequency of prominences in the sun's northern hemisphere still persists, the values for 1905 being 1·77 for the northern and 1·28 for the southern hemisphere.

THE PERIOD OF β LYRÆ.—Referring to the recent note by Mr. Roberts on the increasing period of β Lyræ, Prof. Schaeberle suggests another possible cause which may account for that phenomenon.

It is now generally accepted that incandescent bodies have the power of repelling fine particles of their component matter to great distances, and Prof. Schaeberle suggests that, at a certain stage in the life-history of such a body, the decrease in mass may be so rapid as to cause an increase in the periodic time of any other body belonging to the system. If part of the ejected mass afterwards returns to the parent body other changes will obviously occur (*Observatory*, No. 370).

THE SIXTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

WHEN the International Congress of Applied Chemistry, assembled at Berlin in 1903, chose Rome as its next meeting-place, the fear was expressed by some that the Italian chemical industry might not perhaps be of sufficient magnitude to ensure a large attendance at the next congress. The brilliant success of the meeting which has just terminated has shown, however, that these fears were entirely without justification, and the number of important communications from the Italian members of the congress proves the reality of the progress which Italy has made of late years in chemical industry.

The meeting was opened on April 26 under the most favourable auspices by the King and Queen in person, accompanied by the Minister of Public Instruction and other high officials. The place of meeting was the magnificent Palace of Justice, then brought into use for the first time; in fact, it is not yet wholly completed as regards the internal decorations. There being a large number of rooms in the building, space was easily found for the sixteen sections into which the congress was compelled to subdivide itself. The number of British members was more than thirty, and on the whole the attendance from other countries was very satisfactory, even China being represented. It is somewhat of a novelty to hear speeches in Chinese at European scientific meetings, and shows that the awakening of the Celestial Empire is becoming an accomplished fact. Such a congress is an interesting study in ethnology as well as philology. Officially only four languages are supposed to be used, namely, English, French, German, and Italian; but the greatest leniency is shown in this respect, and the reporters must sometimes rely on summaries made by the speakers themselves.

Among the papers read before the full meeting of the congress the most important was undoubtedly Dr. Adolph Frank's description of his process for the direct utilisation of the nitrogen of the atmosphere for the production of artificial manure and other chemical products. Dr. Frank's invention is not only ingenious, but its effects on the future of the human race will probably be of the greatest importance. The inventor is a veteran in agricultural chemistry; he it was who, more than fifty years ago, introduced the potash salts of Stassfurt to the notice of agriculturists. Now nearly three million tons of these salts are used annually by agriculturists all over the world. The problem of the fixation of atmospheric nitrogen has often been attacked, for the first time on a large scale during the French Revolution. At that time France, surrounded by her enemies, was cut off from the supply of saltpetre necessary for national defence. A committee of French chemists then established the saltpetre farms where the nitrifying organisms, with which we have since become more intimately acquainted, produced the necessary means of defence. We in Great Britain, however, are still entirely dependent upon foreign sources for the explosives necessary for our national defence, and it is only by the establishment of some such process as Dr. Frank's in Great Britain that we shall place ourselves in safety in this respect. The invention is not a complicated one, the difficulties consisting chiefly in the solution of new problems of chemical engineering. Calcium carbide is first produced and then heated with nitrogen obtained by the fractional distillation of liquid air. During this distillation oxygen is obtained as a by-product, and may be utilised for the production of nitric acid from ammonia, which, again, is one of the substances produced by Dr. Frank. The first raw material obtained is calcium cyanamide, and it is this that is used as a nitrogenous manure, numerous experiments having shown that the nitrogen which it contains can be easily assimilated by plants. For countries such as Italy, and more especially India, with large agricultural populations who do not possess sufficient cattle to supply the requisite nitrogenous manure, this direct utilisation of the inexhaustible nitrogen of the atmosphere cannot fail to be of enormous importance; but to the chemist the calcium cyanamide has other attractions. From it have been produced, not only ammonia and nitric acid, but also urea and guanidine. We are therefore on the high road towards the artificial production of the alkaloids, and the next step will probably be the building up of substances directly assimilable by human beings, in other words, artificial foods.

But while chemists revelled in these anticipations they did not forget more practical subjects. An excellent paper by Sir William Ramsay gave a clear and exhaustive account of the present state of the sewage question in Great Britain. Special attention was given by the author to the bacterial methods of sewage disposal which are now being so widely adopted. M. Moissan, whose work with the electric furnace is so well known, gave the results of his experiments on the distillation of metals. All metals, indeed all substances, are volatile at a temperature below 3500° C., therefore M. Moissan draws the conclusion that the temperature of the sun cannot exceed this; it must, indeed, be somewhat less, as the bulk of the elements of which it consists are volatile at a lower temperature than the maximum mentioned. No doubt the data with which Prof. Moissan has furnished chemists will be utilised for practical purposes, especially in the purification of metals.

Many of the papers read before the various sections contained matter of great scientific interest. The report of the International Committee on the Unification of Analytical Methods was presented by Dr. Lunge, and will be of great assistance to analysts in different countries who wish to secure uniform results. Prof. W. N. Hartley's paper on the use of the spectrograph in analysis aroused much interest in the photographic section. It is certainly a great advantage to be able to make a quantitative analysis of a rare object in metal without defacing it in any way, and the convenience of the method will no doubt ensure it general acceptance when it becomes better known. Another communication made to the inorganic chemistry section was of interest, inasmuch as it holds out hopes of a considerable reduction in the price of photographic and other glass of high quality. Hitherto such glass has been made in the expensive pot furnaces, but the author of the paper, Herr F. Heller, states that he has succeeded in making

such glass in the cheaper tank furnaces. In order to do this he divides the melting operation into three phases, each of which is carried out in a separate tank furnace at a definite temperature. The raw materials are first melted down at about 1400° C., the fused mass is then run into a second furnace at about 1200° C., in which the glass is clarified, and finally the clear glass is run into a working tank furnace of about 1000° C. The hope was expressed that the principle might be applied to optical glass of high quality. To the same section Sir William Ramsay contributed a paper on the Bischof process for manufacturing white lead, one of the chief advantages of which is that the workpeople are not exposed to the deleterious action of the dust which renders such stringent precautions necessary in other works. Messrs. G. Giorgis and G. Gallo contributed an essay on the hydraulic properties of various kinds of puzzuolanas, between some of which there are great differences both in time of setting and in the ultimate strength attained. The subject is of great importance in Italy, where puzzuolana mortars largely replace those made in other countries with Portland cement. Sands of the nature of puzzuolana are to be found in other volcanic countries, and merit more attention than they have hitherto received. The remarkable state of preservation of the old Roman buildings in Italy is largely due to the fact that the mortar used in their construction was hydraulic.

The sulphur industry being of such importance to Italy, it was to be expected that it would receive considerable attention. Mr. B. Reinitzer discussed the origin of natural deposits of sulphur, and Prof. N. Rossi described a new method of extracting poor sulphur ores by means of bisulphide of carbon. It was stated that there are very considerable quantities of sulphur ores containing less than 20 per cent. of sulphur, below which percentage it is not at present remunerative to work them. The author proposes to lixiviate these by means of bisulphide of carbon, and has designed plant for that purpose. It must be remarked, however, that similar efforts have hitherto resulted in failure, and the author's apparatus met with some adverse criticism by chemical engineers familiar with such subjects. It is to be hoped that a practical test may be made with the apparatus, as the Sicilian sulphur industry is being seriously threatened by the discovery of the Louisiana deposits.

Prof. L. Ricciardi, of Naples, communicated the results of a number of analyses of eruptive rocks, from which he draws the important conclusion that volcanoes at first emit rocks of an acid nature, but that subsequently the products are basic in their character. The author is of opinion that volcanic phenomena are similar throughout the world, and the rocks which give rise to them are granitic in their nature.

Prof. A. C. Vournasos, of Athens, reported the discovery of a large deposit of asphalt in Greece, which is already being worked on an industrial scale, and appears to be a valuable addition to our supplies of that useful substance. At the same time the author communicated a new method for testing asphalt which he had recently devised.

The section of the congress dealing with the industry and chemistry of sugar was the medium for the communication of a large number of papers, chiefly of industrial interest. Nearly every European country except Great Britain has now a large sugar industry; in fact, the International Congress of Applied Chemistry originated in a meeting of chemists engaged in the sugar industry. A paper by Mr. C. H. Neumann on the testing of the germinating power of sugar-beet seeds shows the amount of specialisation which has taken place. The author found that the best medium for ensuring the regular germination of the seeds was a damp mixture of sand and sawdust, the temperature being carefully regulated.

In the section on explosives Mr. R. Villanis presented a detailed memoir on the state of the explosives industry in Italy in which the various factories and their products were described, together with the regulations in force. The erosion and corrosion of firearms by smokeless powders gave rise to two communications by Dr. V. Reuhl and by Mr. Gey van Pittius. The former referred to the use of nitro-guanidine as an explosive, this being one of the products of Frank's discovery mentioned already.

Several authors dealt with the use of alcohol and petroleum products as sources of power. In Great Britain, where petroleum is admitted free of duty, there can be no doubt that it is at present the cheapest liquid in use for the production of power. Some Continental countries, however, in order to foster the alcohol industry and the important agricultural interests depending upon it, have imposed heavy duties on all competing liquids, and there is naturally continuous rivalry between the various interests thus created.

The section dealing with wine was also of more importance to Continental than to British members, and the same may be said of the agricultural chemistry section, in which matters connected with Continental husbandry were fully discussed. Prof. J. Stoklasa dealt with the enzymes which produce lactic and alcoholic fermentation in the tissues of plants. The author agreed with Messrs. C. Golenski and Mazé that such fermentation is in reality the intramolecular respiration of plants, and a number of experiments were described corroborating this view.

The final plenary sitting of the congress was mainly occupied in passing resolutions confirming recommendations by the sectional committees. Among these may be mentioned the appointment of a committee to elaborate uniform methods of testing explosives, the unification of methods of sugar analysis, especially between the Custom House officials of different countries, and the unification of methods for the analysis of malt in breweries. The transport of dangerous substances by rail was also referred to, and recommendations made as to the patenting of inventions by employees and upon international trade marks.

At the close of the meeting an invitation to the congress to meet in London in 1909 was given by Prof. Tilden, as representing the British Government, and Dr. L. Mond, Prof. E. Divers, and Prof. R. Meldola as representing a joint committee, consisting of practically every British society connected with chemistry, which had been formed on the initiation of the Society of Chemical Industry. The invitation was unanimously accepted.

During the session of the congress a number of social gatherings and excursions took place which afforded excellent opportunities for the delegates of the various nations to become acquainted with each other. The largest excursion was to Tivoli, where about 1500 members were present. The beauties of that lovely spot are too well known to require description, but the remarks of some of the electrochemists led one to believe that they considered a large amount of water-power was being wasted. It would be well, in view of the utilitarian character of modern industry, if the different States were to secure one or two of their most picturesque waterfalls before they have all been absorbed for the production of electrical energy. Many members of the congress visited the sad scenes in the neighbourhood of Vesuvius. One member who had collected the volcanic dust, soon after the eruption, at Addlestone, in the Thames valley, and again on a roof at Turin, was enabled to satisfy himself of the identity of these specimens with the Naples dust.

Excursions were proposed to Sicily and to Elba, but an inopportune strike of the sailors of the Italian Steam Navigation Company put an end to these. Many who were visiting Rome for the first time found many objects of interest, apart from the inexhaustible art treasures of the city. One naturalist collected three varieties of Helix on the walls of the castle of St. Angelo, while a botanist directed attention to the presence of pellitory of the wall on the same building. English tradition says that it was introduced into England by monks, and in some districts it is only found on old monastic buildings. In some rubbish that was being cleared out of the dungeons of St. Angelo numerous fragments of marble cannon-balls were found. During times of siege it is related that large numbers of statues were converted into cannon-balls, and the great variety of marbles to be found among the fragments lends support to this statement. Another enthusiastic lover of nature in all her forms collected a number of live scorpions in the Forum. He stated that they soon became tame, and took live ants from the fingers. His statements were accepted without discussion.

The meeting of the congress was brought to a close on May 5 by a state banquet given by the King of Italy at

the Quirinal to the delegates of foreign Governments and societies. Both the King and Queen received the visitors, among whom were six British delegates. After the banquet the King, who takes great interest in the industrial revival now taking place in Italy, held a reception, several of the Italian ministers being present. The next day most of the members of the congress departed from the beautiful and hospitable city which had been the scene of their labours, many with the intention of returning if possible.

THE SURVEY OF INDIA.

THE report[1] of the Indian Survey Committee recently received is contained in two volumes, the size of which should be sufficient testimony to the exhaustive nature of the inquiry. The result, on the whole, should be satisfactory to those who for years past have been protesting against the short-sighted policy of the Indian Government, which, under financial pressure, has often forced reductions on the Survey Department until its efficiency has become seriously impaired. There is hardly a reform suggested by the committee which has not been urged previously in India. Sir John Farquharson (president of the committee, whose death so soon after his return to England was almost tragic) but expressed the opinions of many who have been closely associated with the Indian Survey Department, modified more or less by his own experiences as chief of the Ordnance Survey in England.

The main results of the committee's recommendations are, first, the strengthening of the department in men and money, and secondly, the separation of the cadastral (or revenue) from the topographical and trigonometrical branches in order that proper supervision may be given to the latter, and that the general military maps of the peninsula and the frontier may be brought (and kept) up to date. Cadastral surveys will in future be relegated to local governments, who will be responsible for the maintenance of their own revenue maps; but scientific supervision of this local work will be provided from the department. This indeed is essential, as everybody knows who has had experience of the terrible results of local meddling with original survey mapping by half-trained, or wholly ignorant, native employees. Nor is the fact overlooked that all the extreme refinement of the most accurate geodetic triangulation has its final expression in these revenue maps. The larger the scale and the more restricted the area, the greater the necessity for a positively accurate basis for local traversing. Every little village plan must take its place accurately in the provincial map if titles to property are to be of any account.

The recommendations of the committee regarding the topographical mapping of India and the reproduction of maps appear on the whole to be excellently well adapted to the end in view, in spite of a certain amount of dissent in matters of detail recorded by the present Surveyor-General. Due acknowledgment is made to the late Surveyor-General (Colonel Gore) for the accuracy of his estimate of the amount of revision necessary, and the cost in time and money of carrying it out; and a most appropriate despatch from a former Secretary of State for India (1876) is quoted, in which the fallacy of expecting to effect economies by the reduction of well-trained survey parties is emphatically maintained. That fallacy was, however, supported by the then Government in India, and was supported by every Government since, until the arrival of a geographical expert as Viceroy in Lord Curzon. The topographical maps of all India, on the 1-inch per mile scale, are to be thoroughly revised and completed. It is something of a surprise that mapping on this scale was not completed long ago, as there has been nothing important missing from the general map of India for several years past. The method of reconstruction recommended by the committee is not altogether approved by the present Surveyor-General, who is in favour of more decentralisation in order to gain efficient supervision; but there was no dispute as to the paramount necessity of maintaining one standard map of the whole of India in a state of absolute completeness. Nor can the recommendations with reference to frontier mapping be regarded with anything but satisfaction. The appointment of a special superintendent on the frontier to rank with the superintendent of trigonometrical surveys, with five working parties under him, and three officers attached to each party, and with the headquarters office at Simla in touch with the Intelligence Department, is indeed a big concession to military requirements. A similar, but much smaller, scheme was suggested nearly ten years ago, in the days when two or three officers and one elastic party were considered ample to deal with the Indian borderland from the Indus to the Euphrates; but it was not entertained. Trans-frontier surveys, apart from political boundary requirements, were not recognised as of any importance. It depended entirely on the enterprise of the officer in charge of the frontier party whether any such work was carried out at all; it was regarded as rather beyond the scope of strict departmental business—to be permitted (if no complications with tribes-people were involved), but hardly to be approved.

Any effort to render frontier mapping more effective by ensuring its proper distribution amongst the military offices of the frontier was perhaps beyond the scope of the committee's proceedings, but it can hardly be denied that proper map distribution is only second in importance to map making.

The reproduction of maps has always been the great difficulty of the Indian Survey Department. Climate, material, and personnel are all against the reproduction of clear, readable, and artistic maps from the excellent material which is found in the original field-sheets. Dr. Stein's evidence on this point is very suggestive. Whilst condemning the printed maps, he paid a graceful tribute to the artistic value of the originals. Photozincography has had much to answer for; misplaced economy, resulting in inferior material and a staff absolutely inadequate to deal with the mass of work thrust upon it, has completed the tale of ultimate inefficiency. We doubt if the well-meant efforts of the committee will really do much to raise the low standard of Indian map publishing so long as cheap rates form the ruling motive of the publishing office. Partial engraving and heliozincography are steps in the right direction, however, but it has always appeared to us that the employment of a first-class firm in England to undertake all the finer work of the department is the real panacea for the ills that beset Calcutta map printing. There is no dealing with the inertness of the native by means of committees. Colonel Grant points out that one girl in England will do as much as two (native) men in the Calcutta office. It may be so (so long as girls do not subscribe to trades unions), but he ignores the effects of a climate that affects Europeans and natives alike.

The general report on the Indian Survey for 1903–4[2] serves as a useful commentary on the recommendations of the committee which was sitting at the time that this rather belated report was under compilation. From it we are able to gather an idea of the enormous expansion in the widely diffused work of the department which has occurred within late years, and of the mass of material which has been crowded into the over-weighted publication offices. The report deals with certain administrative changes (such as the amalgamation of the forest surveys) which are unimportant when considered by the light of the subsequent recommendations of the committee; and much of it is concerned with the progress of cadastral, or revenue, surveys, which will in future probably form but an insignificant feature in the general programme.

Referring to the developments that are proposed in topographical (or military survey) branches of the department, we naturally turn to the map published in the report to illustrate the actual position of these surveys at present. The completion and maintenance of a 1-inch per mile map of the whole peninsula area, and the extension of accurate surveys into extra-peninsula regions, is one of the main features of the revised programme. The map, however, for this purpose is rather misleading, for we find a great part

[1] "Report of the Indian Survey Committee, 1904–5." Part i., The Report, pp. vi+151. Part ii., pp. v+223. (Simla: The Government Central Printing Office, 1905.)

[2] "General Report on the Operations of the Survey of India administered under the Government of India dur'ng 1903–4." By Col. J. R. Hobday, I.A. Pp. iv+62+xlii. (Calcutta: Office of the Superintendent of Government Printing, 1905.) Price 3s.

of the Madras province left blank as if it had never been surveyed (whereas the old Madras revenue surveys furnish excellent material for any 1-inch reproduction), and a fairly wide area of Baluchistan territory near Quetta, which has been most carefully surveyed on the scale of 2 inches to the mile and has stood the test of a whole series of military manœuvres most successfully, classed as "geographical reconnaissance"—which it certainly is not, nor is the mass of ½-inch work which has been completed in that country.

The fact is that, for the completion of the 1-inch topographical map of all India, only a small portion of the Rajputana desert really requires first survey. There must, however, be an enormous amount of revision necessary.

During the year under review, 34,000 square miles of detail survey were completed, and (according to the general summary) about 24,000 square miles of geographical reconnaissance. Elsewhere we find records of 15,000 square miles of Seistan geography, no less than 58,000 square miles in Tibet, and the invaluable work of Colonel Wahab in South Arabia (of which we have heard so little and would like to know so much), amounting to 6000 square miles. Presumably the 24,000 square miles with which the summary deals is independent of these special outturns. The chief interest of the report lies in the appendix dealing with these special performances, and we cordially welcome a return to even this partial recognition of the absorbing interest which is to be found in the story of Indian surveying. The kernel of the report was extracted when the "narratives" went out of it. Even here we do not find the story of the death of that gallant native geographer and explorer Sheikh Mohiudin, whose determined (reckless, for a surveyor) search after information in Seistan led to his being found at last, dead, with his horse dead beside him—dead of thirst in that thirsty country; whilst his plane-table sheets had been stripped from the board and wound round the body of one of his native assistants, who was finally rescued by a friendly Afghan out of a far-away pool of water in which he was lying insensible. Such little incidents as this, or the death of Colonel Wahab's native surveyor, who was shot at his work in Arabia, excite little public comment in India.

In the scientific branches of the department there is much good work to record. The great arc of principal triangulation which terminates with the Dehra Dun base has been extended into the Himalayas, and connected with the peaks of the Snowy Range. Valuable results have been obtained from the comparison of geodetic with astronomic determinations for latitude, the tendency of them being to prove that large northerly deflections of the plumb-line continue to prevail in the heart of the Himalayas. Pendulum observations to determine the force of gravity have been resumed, and magnetic work has also been a feature of the scientific branch of the department supervised by Lieut.-Colonel Burrard, R.E., F.R.S. That officer has also added a useful chapter to the report on the value of principal triangulation and scientific surveying. All this is most valuable work, and should go a long way to satisfy financial critics that the Government of India gets its money's worth out of the scientific investigations of the Survey Department.

The official report of the observations made by Captain Wood, R.E., in Nepal to determine the position of the Everest peak relatively to the Gaurisankar group is included in this volume. It is hardly necessary to refer again to the conclusions which have been formed on a subject which has already been discussed in the pages of NATURE. A most useful map of part of Nepal, and the panoramic views which accompany Captain Wood's report should be convincing evidence of the isolated position of the highest peak in the world, if any further evidence were needed. A re-perusal of the exact conditions under which these observations were made is most interesting, and fully confirms the opinion expressed by Colonel Gore (the late Surveyor-General) that "those who trust to their appreciation of characteristic forms and their mountaineering instincts, as a means for identifying peaks from widely different points of view, are apt to be frequently misled."

THE IRON AND STEEL INSTITUTE.

THE annual meeting of the Iron and Steel Institute was held in London on May 10 and 11, Mr. R. A. Hadfield, the president, in the chair. The president referred to the loss the institute had suffered by the deaths of Sir David Dale and Mr. J. T. Smith, past-presidents, and votes of sympathy were accorded. The report of the council, read by the secretary, Mr. Bennett H. Brough, showed that the membership amounted to 2033, and that in 1905 the income was 6271*l.* and the expenditure 5257*l.* The Bessemer medal was awarded to Mr. F. Osmond, the eminent French metallurgist. Carnegie research scholarships of 100*l.* were awarded to Dr. C. A. F. Benedicks (Sweden), Mr. O. Stutzer (Germany), Mr. E. Hess (United States), and Mr. E. F. Law (London). Grants were also made to Mr. H. C. Boynton (United States), Dr. L. Guillet (France), Mr. W. H. Hatfield (Sheffield), Mr. E. G. L. Roberts (London), Mr. W. Rosenhain (Birmingham), Mr. E. A. Wraight (London), and Mr. A. Campion (Glasgow). The Carnegie gold medal for research was awarded to Dr. L. Guillet, and the silver medal to Mr. W. Rosenhain.

In the first paper read Mr. A. J. Capron (Sheffield) described a new method of compressing steel ingots in the mould which has been successfully adopted in Sheffield. The ingot moulds are placed inside the press, the steel being run into the moulds in this position, so that they have not to be transported with the liquid steel in them, and the press practically forms the casting pit.

Prof. T. Turner (Birmingham) gave the results of observations on the volume and temperature changes during the cooling of cast-iron. Apparatus was designed in order to measure the changes of length of a test-bar, whilst cooling curves were taken of the specimens at the same time with a Le Chatelier pyrometer. The curves obtained may be divided into four classes, depending upon the number of arrests observed in the normal rate of contraction of a cooling solid.

Mr. E. Adamson (Seaton Carew) read a paper on the influence of silicon, phosphorus, manganese, and aluminium on chill in cast-iron. The depth of chill is primarily dependent upon the percentage of combined carbon and the temperature of casting. Combined carbon 0·67 per cent. gives 1/16-inch chill, and combined carbon 0·88 per cent. gives ¾-inch and 1-inch, but the latter was cast at a much higher temperature. These figures are taken from the silicon and phosphorus tests. The manganese tests also show an increase in true chill with increasing manganese up to combined carbon 1·60 per cent. The tests described were made from coke irons, and suggest that under proper treatment coke irons are as good as charcoal irons for high mechanical tests and depth of chill.

On May 11 Prof. J. O. Arnold and Mr. F. K. Knowles (Sheffield) read a preliminary note upon the influence of nearly pure metallic manganese alloyed with varying proportions of nearly pure metallic iron. A series of alloys ranging in manganese from 0·3 per cent. to 36 per cent., and in carbon and silicon from 0·05 per cent. to 0·2 per cent. each, was prepared in special crucibles. In the finished bars, each 12 feet long, liquation of a remarkable character took place which rendered the completion of the research difficult. It is possible, but hardly probable, that some of these costly alloys may prove of practical importance.

Mr. C. de Schwarz (Liége) read an interesting paper on the use of oxygen in removing blast-furnace obstructions. The difficulties caused by the tap-hole of a blast furnace becoming closed up by solid iron have been overcome by the application of compressed oxygen. The process has been adopted at several works in England and on the Continent with satisfactory results. At the conclusion of the paper a practical demonstration of the process took place at the works of the Brin Oxygen Co. in Westminster.

Mr. E. F. Law (London) described an extended investigation into the causes which underlie the production of brittle and blistered tin plates. He showed that oxidised steel will give rise to blistered sheets, and that this defect is more liable to occur with Bessemer than with open-hearth steel. Steel high in sulphur and phosphorus will cause brittleness in sheets, especially if the sheets are rolled from

large and slowly-cooled ingots in which the maximum of segregation has taken place.

Mr. P. Eyermann (Benoit, Wisconsin) submitted a lengthy paper on the manufacture of solid rolled steel wheels and tyres. The average life of a cast-iron wheel is 56,000 miles in passenger service, while steel-tyred wheels have a life of 265,000 miles. The author considers it probable that before long the solid rolled steel wheel will replace the existing tyres in Great Britain.

Mr. E. Lelong (Couillet, Belgium) described a new method of manufacturing chains by machinery in which the successive convolutions of spiral links are continuous. Chains made by this process are 20 per cent. stronger than those made by the usual methods.

Mr. C. O. Bannister (London) discussed the relation between type of fracture and microstructure of steel test-pieces, showing that valuable conclusions may be drawn from the examination of the fractured surface.

The effect of copper in steel was discussed by Mr. F. H. Wigham (Wakefield). Copper is very difficult to alloy with steel so as to obtain a homogeneous mass containing more than 2 per cent. even with the addition of aluminium. In steel containing 0·5 per cent. or more of carbon it is not of practical value to use more than 0·6 per cent. of copper. The steel with 0·25 per cent. of copper and alloys up to 0·25 per cent. of copper with high carbon (0·70 per cent.) give, with or without a high percentage of manganese, a good quality of wire. In fact, copper to the extent of 0·25 per cent. is no disadvantage in the manufacture of the best classes of steel wire.

The reports of research work carried out during 1905–6 by holders of Carnegie research scholarships, which were submitted, represented a large amount of work of great interest. An exhaustive study of quaternary steels was submitted by Dr. L. Guillet (Paris). For the research 250 varieties of steel were prepared, including nickel-manganese steels, nickel-chromium steels, nickel-tungsten steels, nickel-molybdenum steels, nickel-vanadium steels, nickel-silicon steels, nickel-aluminium steels, manganese-silicon steels, manganese-chromium steels, and chromium-tungsten steels. The area for the commercial employment of these steels is considerably restricted, and is limited to the nickel-vanadium steels, the nickel-tungsten steels, and the chromium-vanadium steels containing comparatively low proportions of foreign elements.

The report by Mr. W. Rosenhain (Birmingham) on the deformation and fracture of iron and mild steel constitutes a continuation of his previous paper on the plastic yielding of iron and steel. He gives further observations on slip-bands, and deals with the modes of fracture under various conditions. In tensile fractures the break runs almost indifferently through ferrite and pearlite, owing to the fact that the previous extension of the metal has weakened, and in part even ruptured, the pearlite; in shock fractures the pearlite is able to assert its superior strength and is avoided by the fracture, while fissures are formed in the ferrite. The features of bending fractures are found to be of an intermediate character. The results of the examination of these fractures are discussed both from the point of view of the relative behaviour and interaction of ferrite and pearlite under breaking stresses and from the point of view of the general theory of deformation and fracture which is presented in the paper. In conclusion, the author points out the possibilities of practical application which his method of studying fractures opens up. This detailed study of fractures makes it possible to locate accurately the causes of weakness and strength in a given microstructure, and by comparing the behaviour of the constituents when broken in different ways to gain a deeper insight into their mutual interaction; while the study of "mysterious" fractures occurring in service—as rendered possible by this method—should make it easier to trace the causes of fracture—if any—which are present in the metal.

Dr. H. C. Boynton (Harvard, U.S.A.) dealt with the determination of the hardness of the constituents of iron and steel with the aid of Jaggar's microsclerometer. Reduced to a common unit, the hardness of pure ferrite, the average hardness of the constituents was found to be as follows:—

Constituent	Present in	Average Hardness	Ratio
Ferrite . .	Electrolytic iron	460	1
,, . .	,, ,, quenched .	990	2·15
,, . .	Average of all unhardened samples	610	1·03
,, . .	Commercial wrought irons . .	686–1643	1·5–3·6
Pearlite .	Series 0·13–1·52 per cent. carbon .	842–4711	1·8–10·3
,, . .	Series 0·35–0 86 per cent. carbon .	1745–2150	3·8–4·2
Sorbite . .	0·48 and 0 58 per cent. carbon steel	2400–24,650	5·2–53·6
Troostite .	Steel, 0·58 per cent. carbon . .	40,564	88·2
Martensite	Series 0·20–1·52 per cent. carbon .	17,896–120,330	38 9–261·6
Austenite .	White cast iron (3·24 per cent. carbon).	47,590	103·4
Cementite .	White cast iron (3·24 per cent. carbon)	125,480	272·8

Mr. J. D. Brunton (Musselburgh) submitted an elaborate report on the heat treatment of wire, particularly wire for ropes. He showed that the usual methods of obtaining the best wire by means of torsion and tensile tests are not altogether trustworthy for determining the best point for the wire to perform useful work. Annealing of the rod before the final annealing does not, in any way, produce better material, as it has been thought to do, and is, therefore, not necessary.

The research carried out by Messrs. E. G. L. Roberts and E. A. Wraight (London) comprised a series of 150 experiments and complete analyses, dealing with the constitution of ferromanganese and the efforts made to deprive this alloy of its carbon.

It was announced that the next meeting would be held in London at the end of July, when members of the American Institute of Mining Engineers would be the guests of the institute.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Prof. William Schlich, F.R.S., St. John's College, has been constituted by H.M. Secretary of State for India professor of forestry so long as he shall be continued in his present position and be resident within the University.

The first of two lectures on "The Teaching of Science in Schools" was given by Dr. Bevan Lean, headmaster of Sidcot School, on May 10 at the lecture room of the delegacy for the training of secondary teachers. The second lecture is to be delivered to-day.

CAMBRIDGE.—A Grace authorising the general board of studies to appoint, subject to confirmation by the special board for medicine, Mr. G. H. F. Nuttall, Christ's College, to be reader in hygiene in connection with the special board for medicine, the University lectureship in bacteriology and preventive medicine to terminate on his appointment as reader, will be offered to the Senate to-day.

Mr. W. J. Sell, Christ's College, has been approved by the general board of studies for the degree of Doctor in Science.

A university lectureship in mathematics will be vacant at Michaelmas, 1906, by the resignation of Mr. Whittaker. The general board of studies will shortly proceed to appoint a lecturer to hold office from Michaelmas, 1906, until Michaelmas, 1911. Candidates are requested to send their applications, with statements of the subjects on which they are prepared to lecture, and with testimonials if they think fit, to the Vice-Chancellor on or before May 31.

The Vice-Chancellor has been informed by the clerk to the Worshipful Company of Girdlers that the company is prepared to continue its grant of 100*l.* a year towards the teaching of economics for a second period of three years. The board of economics is of opinion that this offer should be gratefully accepted.

THERE seems every possibility of the Hamburg University being very quickly established. Three million marks have already been voluntarily subscribed, two millions of which have been given by Mr. Alfred Beit. It is proposed that only one-half of the lectures shall be given for direct preparation for any particular profession, while the other half are to be for the further extension of the general education of the inhabitants of the town.

HIGHER education is mostly left to take care of itself in this country, with the result that our statesmen and Governments do not know exactly where it is being carried on, or what provision has been made for it without their assistance. On the principle that what is everybody's business is nobody's business, no serious attempt has been made to take stock of our national resources as regards higher education, so it comes about that the committee recently appointed by the Chancellor of the Exchequer to advise the Treasury as to the distribution of the sum voted by Parliament for grants in aid to university colleges has sent an intimation to the public Press with the object of bringing the conditions under which grants are made under the notice of colleges which have not as yet communicated with the committee. It is obvious that if our higher education were properly organised by the State, the Minister of Education would have detailed particulars of institutions devoted to it, and such an announcement as that just issued, suggesting that there are many colleges unknown to the official mind, would have been unnecessary. The grants are given only to those institutions which afford education of a university standard in great centres of population in England. To qualify for a grant at present, a college is required to show that its local income for work of a university character is not less than 4000*l.*, and that of this sum at least 1500*l.* is derived from fees. Any college wishing to be included in the list of those receiving grants should send in an application not later than June 13. Applications should be addressed to the secretary to the committee, Mr. R. G. Hawtrey, at the Treasury, S.W.

PRESENTATION DAY was celebrated at the University of London on May 9, when Sir Arthur Rücker, the principal, read his annual report on the work of the University. An important event of the year was the recasting of the schemes of examination for the B.A. degree. Up to the present the course of study from the matriculation stage onward has been, with the exception of mathematics, entirely literary. The opinion that a mixed course of literature and science would be of the utmost value to many pass students has, however, for long been gaining in strength, and effect has now been given to it in the following manner. In future either Greek or Latin, but not both, will be compulsory both in the intermediate and in the final examinations for the B.A. degree. Another language will also be compulsory; while the other subjects required may be chosen from a list of languages, pure and applied mathematics, and the more fundamental sciences. The examinations in science will be identical with those for the corresponding subjects for the B.Sc. degree. It will thus be possible for a candidate for a pass B.A. degree to take either an exclusively literary course or a mixed course including Latin and one other language. Sir Arthur Rücker announced that the Senate has invited the University of Paris and the Collège de France to visit the University of London at Whitsuntide. This will be a unique event, no formal visit having hitherto been made by a French to an English university. A large number of distinguished guests are expected, and it is hoped that the occasion will bind closer the intellectual links which unite the two countries.

A DEPUTATION of the council of the Association of Technical Institutions was received by the President of the Board of Education on May 4. Sir William Anson, as president of the association, introduced the deputation, and stated that its object was to bring before the Board the importance of increasing the rate of grants to the day technical institutions and for instruction in the more technical subjects in evening classes. Sir William Anson referred to the importance of efficiently maintaining facilities for technical instruction, and pointed out the tendency of local authorities to devote their funds chiefly to elementary education, to the possible detriment of higher work. Sir Philip Magnus urged the importance of technological subjects in evening classes, and the great cost involved in their maintenance. Unless education authorities are encouraged to conduct such classes there is grave fear of their being neglected for subjects, not so important to the industries of the country, which receive higher grants. Sir William Mather spoke of the great importance of technical education for the maintenance of the industries of the country, and the need for watching that money intended by Parliament for the maintenance of such work should not be diverted for other work. He thought an appeal might well be made to employers to contribute towards the cost of technical education. Mr. Birrell, in reply, said that the deputation might rest assured that the Board has every sympathy with the request put forward for increased grants for work in day classes in technical institutes. The Board fully realises the importance of the work which is done. Mr. Birrell, however, reminded the deputation that there are many other important branches of education which are in need of increased grants. In conclusion, he cordially supported what Sir William Mather said as to the importance of employers contributing to technical institutes. Mr. F. G. Ogilvie dealt with the way in which the Board is trying to include technical subjects as eligible for their grants, and so far as possible at the same rate as science subjects.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 5.—"On the Distribution of Radium in the Earth's Crust, and on the Earth's Internal Heat." By the Hon. R. J. **Strutt,** F.R.S.

Summary of Conclusions.—(1) Radium can easily be detected in all igneous rocks. Granites, as a rule, contain most radium, basic rocks the least. (2) This distribution of radium is uniform enough to enable a fair estimate to be made of the total quantity in each mile of depth of the crust. (3) The result indicates that the crust cannot be much more than forty-five miles deep, for otherwise the outflow of heat would be greater than is observed to be the case. The interior must consist of some totally different material. This agrees entirely with Prof. Milne's conclusion drawn from a study of the velocity of propagation of earthquake shocks through the interior. (4) The moon probably consists for the most part of rock, and, if so, its internal temperature must be far greater than that of the earth. This explains the great development of volcanoes on the moon. (5) Iron meteorites contain little, if any, radium. Stony ones contain about as much as the terrestrial rocks which they resemble.

Challenger Society, April 25.—Mr. E. W. L. Holt in the chair.—*Exhibits.*—Four species of Cephalodiscus, of which three had recently been described by the author, who also referred to others from the *Discovery* and *Antarctica* expeditions: Dr. S. F. **Harmer.**—Charts of positions in the North Sea, where, by means of a heavy conical dredge with canvas lining, samples of bottom deposits had been taken by the Marine Biological Association's steamer *Huxley*: J. O. **Borley.** Mr. Borley showed in action a sifting machine, designed by Mr. Todd and himself, for grading these deposits; sieves of various mesh, hung in water, were made to vibrate horizontally at high speed by an excentric worked by an ordinary whirling-table. There were also exhibited specimens of the gravel, fine sand, and silt met with, charts of their distribution showing the extreme uniformity of bottom found over large areas in the eastern part of the North Sea, and diagrams indicating the very definite meaning attaching to fishermen's descriptive terms for the bottom.—Preliminary paper on Medusæ collected in H.M.S. *Research* by Dr. Fowler in the Bay of Biscay: E. T. **Browne.** The Trachomedusæ predominated over the other orders, three species forming about 85 per cent. of the specimens collected (*Aglantha rosea*, 42 per cent.; *Aglaura hemistoma*, 27 per cent.; *Rhopalonema coeruleum*, 15 per cent.). These were chiefly taken between 50 fathoms and 100 fathoms. A few rather rare species were taken below 100 fathoms; for example, *Colobonema sericeum*, one of the new deep-sea Medusæ discovered by the *Valdivia*. The most interesting find was a Narcomedusan, probably a new species of Cunoctacantha, which had a number of medusa-buds in all stages of development upon the stomach-pouches; the buds were not parasitic, as in other species of Cunoctacantha and Cunina, but develop directly from outgrowths of the stomach-wall. This forms a straightforward case of asexual gemmation, such as occurs in some Anthomedusæ.

Geological Society, April 25.—Dr. J. E. Marr, F.R.S., vice-president, in the chair.—Trilobites from Bolivia, collected by Dr. J. W. Evans in 1901–1902 : P. **Lake.** Several horizons are represented by these fossils. Descriptions are given of the new species and other forms mentioned. It is worthy of remark that, while the earlier forms show affinities with the contemporaneous European fauna, the Devonian species are much more closely allied to those of South Africa and North America.—Graptolites from Bolivia, collected by Dr. J. W. Evans in 1901–1902 : Dr. Ethel M. R. **Wood.** In black pyritic shales from three localities several specimens of Didymograptus were collected : one referable to *bifidus*, one of the type of *affinis*, and one of the *Nicholsoni* type. Phyllograptus, Glossograptus, Cryptograptus, and Diplograptus were also obtained. A pale, silky-grey shale shows also rare graptolites, belonging to a species comparable with *Climacograptus confertus*. These forms indicate that both the black and the pale shales belong to horizons in the Upper Arenig rocks (Lower Llanvirn of Hicks).—The Phosphatic Chalks of Winterbourne and Boxford (Berkshire) : H. J. Osborne **White** and Llewellyn **Treacher.** Data collected in the district dealt with in this paper suffice to show that the more or less Phosphatic Chalks above the Uintacrinus-band lie in a trough or basin, the formation of which antedates the deposition of the Reading beds. When the area of observation is extended, it is found that the Uintacrinus-Chalk of that tract itself lies in a structural depression. The Phosphatic Chalks of Winterbourne and Taplow evidently mark places on the sea-floor particularly liable to the impingement of strong currents, and may mark places above which the water commonly had a gyratory motion. In any case, their zonal range argues a marked degree of stability in the current-system of the body of water in which they were laid down.

Physical Society, April 27.—Dr. C. Chree, F.R.S., vice-president, in the chair.—Some simple questions on the images of microscopes and telescopes : W. B. **Croft.** It may have been noticed that when a microscope is focused visually, an image is formed on the focusing-glass of a camera, into which the microscopic eye-piece is inserted after removing the camera-lens. This image remains more or less in focus at variable positions of the camera-screen. Although it is not always perhaps true, yet it is surprising how often the pencil emerging from a microscope eye-piece behaves like a single concentrated line of light. Several photographs of microscopic details were exhibited to intimate how often the author had found, when projecting from an optical eye-piece, that no change can be detected in the definition of the image as the screen of the camera is moved. If a camera-lucida is placed on the eye-piece, the image of a stage-micrometer can be thrown on a scale at 10 inches distance or at 40 inches distance. The parallel rays emerging from the eye-piece give the image of a point along a direction, at no definite position. The image can be imagined at 40 inches distance as easily as 10 inches. Mr. Croft also showed some photographs taken from sections of the human eye ; he indicated that a divergent pencil from a small aperture or from a convex reflecting surface of large curvature will give the Purkinje figures as bright radiating lines, whereas the usual method of sending light through the side of the sclerotic gives them as shadows. Several different specimens were shown of magnetic oxide of iron and magnetic sulphides of iron. The power of nickel and cobalt to receive permanent magnetism was illustrated with a compass-needle of nickel.—The lateral vibration of bars subjected to forces in the direction of their axes : J. **Morrow.** Three cases of unloaded bars are dealt with, namely, those under the following end-conditions :—" supported-supported," " clamped-clamped," and " clamped-supported." Expressions are obtained from which the frequencies may be calculated, and the results are stated in a form such that the determination of stresses, terminal couples, &c., may be easily made. The case of greatest interest is that of a stretched bar clamped at each end. Approximate solutions of this problem have been arrived at by both Seebeck and Donkin. These are on the assumption that the vibration is but slightly affected by the rigidity of the material. An assumption of a very different character, and one generally fulfilled in structural work, is made in this paper, namely, that the longitudinal force is not very great. Solutions are thus found for the period of the fundamental or any harmonic.

Mathematical Society, May 10.—Prof. A. R. Forsyth, president, in the chair.—The substitutional theory of classes and relations : Hon. B. **Russell.** The object of the paper is to explain a solution of the contradictions discovered by Burali-Forti and the author. The solution is sought in the substitutional theory, sketched in a previous paper by the author, according to which statements apparently about a class are significant only when they can be analysed into statements about all or some of the members of the class. The substitutional theory is extended to propositions and relations.—The expansion of polynomials in series of functions : Dr. L. N. G. **Filon.** The question is that of expanding a function $f(x)$ in a series of functions of the form $\phi(\kappa_n, x)$, where the numbers $\kappa_1, \kappa_2, \ldots$ are the roots of a transcendental equation. The method is analogous to Cauchy's method of expansion of functions in Fourier's series, and depends upon the calculus of residues. In Cauchy's method a subsidiary function $F(\kappa)$ is introduced through a knowledge of the form of the coefficients of Fourier's series ; in the present paper a rule is given for determining this subsidiary function *a priori*, and the rule is shown to be applicable to many classes of functions $\phi(\kappa, x)$ when the function $f(x)$, of which the expansion is desired, is a polynomial. The subsidiary function $F(\kappa)$ being known, the coefficients in the expansion of $f(x)$ can be obtained explicitly.—The motion of a swarm of particles the centre of gravity of which describes an elliptic orbit of small eccentricity round the sun : Dr. E. J. **Routh.** It is proved that for a spherical swarm the period equation takes the Lagrangian determinantal form, and the conditions of stability can be completely exhibited. The problem of a swarm of unequal thicknesses in different directions is illustrated by a discussion of the case in which the boundary is ellipsoidal ; and the changes of length of two diameters in the plane of motion, one of which passes through the sun, are investigated in detail.—The theory of integral equations : H. **Bateman.** The partial integral equation

$$\int_a^b \kappa(s, x) f(x, t)\, dx = \int_a^b f(s, x)\, h(x, t)\, dx$$

is regarded as the characteristic equation of a transformation by which the properties of the function $h(s,t)$ are deducible from those of $\kappa(s,t)$. This transformation leaves unaltered the numbers λ_n for which the homogeneous equation

$$\phi_n(s) = \lambda_n \int_a^b \kappa(s, t)\, \phi_n(t)\, dt$$

possesses a solution different from zero. The numbers λ_n are important in the theory of the potential and in connection with a certain theory of the origin of spectral lines.—Linear differential equations of rank unity : E. **Cunningham.** The paper is concerned with an extension of Laplace's method of solution of linear differential equations by means of definite integrals. The proposed solution takes the form of a double integral involving a subsidiary function which satisfies a certain partial differential equation. Particular forms of this subsidiary function are developed, and the appropriate domains of integration determined.

PARIS.

Academy of Sciences, April 30.—M. H. Poincaré in the chair.—Diphenyl or alkylphenyl camphomethane and methylene : A. **Haller** and E. **Bauer.**—Simple relations between the " statical actions " of muscle with the energy which produces them : A. **Chauveau.**—The doubly infinite varieties of points of a quadric in space of four dimensions applicable to a plane : C. **Guichard.**—Contribution to the study of the infra-red spectrum : Milan **Stephanik.** In the study of the infra-red region of the spectrum three methods have hitherto been used, the thermometric method, the photographic method, and the utilisation of the phenomena of phosphorescence. In studying the eclipse of August 30, 1905, the author noticed that when a deep red screen was placed in front of the slit of the spectroscope a portion of the infra-red spectrum became visible. This

method has been followed up at the Meudon Observatory, various screens being tried. It was found that the best results were obtained when the screen absorbed nearly the whole of the luminous spectrum, leaving only the extreme red and infra-red rays. The ultra-red spectrum has been mapped out in this way down to 1 μ, and, in certain circumstances, a little further with some difficulty.—A theorem of J. Clark: Maurice **d'Ocagne.**—The result of the experimental study of a centrifugal ventilator: Henri and Léon **Bochet.** A study of the Capell ventilator, for which an abnormal yield had been claimed by the inventor. The results generally support the inventor's views.—A galvanometer with a movable needle for alternating currents: Henri **Abraham.** The instrument is of the d'Arsonval type, the permanent magnet being replaced by an electromagnet excited by an alternating current of the same frequency. In delicate measurements the best results are obtained by exciting the electromagnet by a small auxiliary transformer. Details are given of the sensibility obtainable.—The spectra of alloys: J. **de Kowalski** and P. B. **Huber.** Copper-magnesium and copper-zinc alloys were studied. By interposing self-induction in the discharge circuit a larger number of lines disappear from the spectrum when the electrodes consist of the pure metal than when an alloy is used. The lines which have disappeared in the spectra of the alloys are the same for the copper-magnesium and the copper-zinc alloys, and belong to copper. The results can be explained by Prof. J. J. Thomson's views, or by supposing that the mean temperature in the oscillating discharge between the electrodes is higher in the case of the alloy than with the pure metal.—The synthesis of $\beta\beta$-dimethyl- and $\beta\beta$-trimethylpimelic acids: G. **Blanc.** The starting point of this synthesis is the anhydride of $\beta\beta$-dimethylglutaric acid. This is reduced by sodium and absolute alcohol to a lactone, and the latter, treated by phosphorus pentabromide and alcohol consecutively, gives the ethyl ester of δ-bromo-$\beta\beta$-dimethylvaleric acid. The condensation of this bromo-compound with the sodium derivative of malonic ester leads to the desired $\beta\beta$-dimethylpimelic acid. The substitution of the sodium derivative of methyl-malonic ester in this condensation gives the trimethylpimelic acid.—The chemical composition of glauconite: Léon W. **Collet** and Gabriel W. **Lee.** The analysis of a fresh sample of glauconite from the collection of Sir John Murray, of the *Challenger* Office, showed that it is a ferric and not a ferrous silicate.—Overlapping strata in Sicily: Maurice **Lugeon** and Émile **Argand.**—The existence of phenomena of drift earlier than the Stephanian in the region of Saint-Etienne: P. **Termier** and G. **Friedel.**

DIARY OF SOCIETIES.

THURSDAY, MAY 17.

ROYAL SOCIETY, at 4.30.—Determinations of Wave-Length from Spectra obtained at the Total Solar Eclipses of 1900, 1901 and 1905: Prof. F. W. Dyson, F.R.S.—Some Stars with Peculiar Spectra: Sir Norman Lockyer, K.C.B., F.R.S., and F. E. Baxandall.—An Apparent Periodicity in the Yield of Wheat for Eastern England, 1885–1905: Dr. W. N. Shaw, F.R.S.—Some Physical Constants of Ammonia: a Study of the Effect of Change of Temperature and Pressure on an Easily Condensible Gas: Dr. E. P. Perman and J. H. Davies.

CHEMICAL SOCIETY, at 8.30.—The Relation between Absorption Spectra and Chemical Constitution, part vi., The Phenyl Hydrazones of Simple Aldehydes and Ketones: E. C. C. Baly and W. B. Tuck.—Aromatic Compounds obtained from the Hydroaromatic Series, part ii., The Action of Phosphorus Pentachloride on Trimethyldihydroresorcin: A. W. Crossley and J. S. Hills.—Studies of Dynamic Isomerism, part v., Isomeric Sulphonic-derivatives of Camphor: T. M. Lowry and E. H. Magson.—Studies on Basic Carbonates, part i., Magnesium Carbonates: W. A. Davis.

ROYAL INSTITUTION, at 5.—The Influence of Ptolemaic Egypt on Græco-Roman Civilisation: Rev. J. P. Mahaffy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes on Overhead Equipment of Tramways: R. N. Tweedy and H. Dudgeon.

FRIDAY, May 18.

ROYAL INSTITUTION, at 9.—International Science: Prof. A. Schuster, F.R.S.

SATURDAY, MAY 19.

ROYAL INSTITUTION, at 3.—The Old and New Chemistry: Sir James Dewar, F.R.S.

MONDAY, MAY 21.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary Meeting.—(1) Presentation of Medals and Awards; (2) Address by the President; (3) Annual Report and Election of President and Council.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Problem of the Electrochemical Fixation of Nitrogen: Prof. P. A. Guye.

VICTORIA INSTITUTE, at 4.30.—Biblical Astronomy, part ii., The Morning Star: Colonel George MacKinlay.

TUESDAY, MAY 22.

ROYAL INSTITUTION, at 5.—Glands and their Products: Prof. William Stirling.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—(1) Exhibition of Slides of Stone Monuments from India; (2) The "Genna" in Assam: T. C. Hodson.

WEDNESDAY, MAY 23.

SOCIETY OF ARTS, at 8.—The General Supply of Electricity for Power and other Purposes: J. N. Shoolbred.

GEOLOGICAL SOCIETY, at 8.—On the Importance of Halimeda as a Reef-forming Organism, with a Description of the Halimeda-limestones of the New Hebrides: F. Chapman and Douglas Mawson.—Notes on the Genera Omospira, Lophospira, and Turritoma, with Descriptions of New Species: Miss Jane Donald.

THURSDAY, MAY 24.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: On the Presence of Special Excitable Substances in Striated Muscle and in Tissue Cells: Prof. J. N. Langley, F.R.S.

ROYAL INSTITUTION, at 5.—Man and the Glacial Period: Prof. W. J. Sollas, F.R.S.

UNIVERSITY OF LONDON, at 5.—The Atmospheric Circulation and its Relation to Weather: Dr. W. N. Shaw, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.—Report of Council and Election of the New Council.

SOCIETY OF ARTS, at 4.30.—The Parsis of Persia: Major P. M. Sykes, C.M.G.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

FRIDAY, MAY 25.

ROYAL INSTITUTION, at 9.—Compressed Air and its Physiological Effects: Leonard Hill, F.R.S.

PHYSICAL SOCIETY, at 5.—Colour Phenomena in Photometry: J. S. Dow.—Exhibition of an Automatic Arc Lamp: H. Tomlinson and Rev. G. T. Johnston.—The Theory of Moving Coil and other Kinds of Ballistic Galvanometers: Prof. H. A. Wilson, F.R.S.—Exhibition of a Bifilar Galvanometer free from Zero Creep: A. Campbell.

SATURDAY, MAY 26.

ROYAL INSTITUTION, at 3.—The Old and the New Chemistry: Sir James Dewar, F.R.S.

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