THURSDAY, FEBRUARY 27, 1902.

BRITISH GEOGRAPHY.

Britain and the British Seas. By H. J. Mackinder, M.A., Reader in Geography in the University of Oxford. Pp. xvi + 378. (London: William Heinemann, 1902.)

THIS important contribution to geographical literature is, we believe, the first effort to present a complete geographical description of the British Isles in accordance with modern views, complete, however, rather in comprehensiveness of scope than in exhaustiveness of detail. The work strikes us as literature—clothing in dignified and continuous form the theories and conclusions of many workers—rather than science, which in the existing state of geographical knowledge demands more critical treatment of controversial matters and more direct contact with original data. The author excels in broad generalisations, and he has a happy knack of setting essential facts in striking lights, so that they are forced on the attention of the reader and remain fixed in his memory. It is impossible, of course, that any one man could be an independent authority on all the subjects which have to be dealt with in a geographical description; but Mr. Mackinder has got up his case so thoroughly that it is only by the smoother running of his chariot wheels where he enters on the domain of human, and especially of historical, affairs that we are led to suspect which are his most familiar studies.

A striking merit in the arrangement of the book, and it is a great one, is that no doubt can arise as to its purpose and plan. The development of the argument is preceded by an opening statement and clenched by a formal array of numbered paragraphs setting forth what is claimed as having been established. Unlike many books which are geographical in intention, this one is consistent throughout, tracing an unbroken chain of causation from the earliest hypothesis as to the existence of ancient land in the geological past to the latest forecast of thought in the political future. The chain is not equally strong in all its parts, and its extremities pass into regions of gloom which some faith is required to believe illumined.

The first chapter treats of the position of the British Islands (which we are glad to see gathered under the one word Britain), showing how in classical times they were at the end of the habitable world, with only ocean and ice beyond, while now they lie in the very centre. Mr. Mackinder speaks of the ice drift in the East Greenland current as "the physical boundary of mediæval Europe"; yet there is some evidence to show that the western voyages of the Norsemen met but slight obstruction from the ice, and the vanished settlements of East Greenland point to a comparatively recent increase in the severity of the climate. That the trade-winds blow over the Sahara we should not like to affirm, though Mr. Mackinder is doubtless correct in taking the southern boundary of the mediæval world of Europe as the Trades and the desert. But when the reign of terror of the half-known—cold and heat and the vacant spaces of ocean—was shattered by the voyagers from Iberia, Britain swung into the centre of the land hemisphere:—

"Seen thus in relation to earlier and to later history, Britain is possessed of two geographical qualities, complementary rather than antagonistic: insularity and universality."

The nature of the insularity is investigated in a chapter on the British seas, contrasting the Ocean with the Narrow Seas towards Teutonic Europe and the Narrower Seas towards France; and the remarkable coincidence that the narrowest channel, which separates Kent from the continent, lies opposite the terminus of the great Teutonic-Romance linguistic frontier of Europe is treated with a masterly completeness.

The movement of the waters, tidal and circulatory, receives a chapter to itself, and then on p. 46 the serious part of the book begins, and the general reader will meet with his first check, for he must enter on a hundred pages of fairly stiff geology. This is not the geology of the text-books; formations are scarcely referred to, and there is absolutely nothing of palæontology. It is a restatement, and in some particulars an extension, of the history of the rifted crust-blocks of Suess and the system of coastal-plain formation and river-development with which the name of W. M. Davis is usually associated. The theories are boldly and skilfully employed, and in their light the building of the British Isles stands forth with startling clearness; the author might have seen it all. We question whether any geologist intimately acquainted with the details and the infinite uncertainties of one department of his science would have dared to compress the history of the past into the few clear-cut episodes which are here presented in a manner which wins our admiration even if it fails to gain our entire confidence. We may quote part of the author's summary, bearing in mind that a much fuller statement is given in the pages:—

". . . . The fringe of headlands along the west coast of Scotland, and the lie of Glenmore and the Rift Valley, betoken a south-westerly rock-graining, to be interpreted as the wreck of a Caledonian mountain range, which once crossed the site of the North Sea.

"But the existing hills have not been shaped from the Caledonian peaks by uninterrupted erosion. The general equivalence of the higher summits, and the transverse, southerly trend of the consequent valleys where they breach the ridges, can only be explained by the interpolation of an epoch during which the mountains were reduced to a basal plain. Thence followed a fresh cycle of denudation when the plain was raised to a grained plateau spreading back from the British Uplands towards Iceland and Greenland.

"By what process the plateau of Atlantis collapsed and the uplands of its south-eastward face were transferred to developing Europe, may be imagined from the form of the ocean bed. Two abysmal pits, Atlantic and Arctic, gradually encroached upon the land until they merged across it, and the divide between them became the submarine isthmus known as the Scoto-Icelandic Rise. The southward belt of median uplands in Britain—Highland, Central and Cambrian—is in prolongation of this rise, and no doubt due to the same terrestrial stresses.

"Britain was differentiated from the rest of the slope of Atlantis by the formation of proto-Britain in advance of the Caledonian shore line. Against the resistance of this salient block the Hercynian pressures crumpled the strata into northward and westward folds, and these,

together with the earlier south-westward features, have determined the triangular outline of Britain.

"By their intersection the Hercynian axes also shaped the coal-basins of Great Britain; but Ireland, under the lee of proto-Britain, suffered less disturbance and has therefore been stripped of most of its coal, which was thus unsheltered from denudation.

"The posthumous Hercynian uplift which raised the Wealden fold, produced an organic connection between the Kentish promontory and the Rhine-Seine divide, and the English plain of softer rocks is, therefore, a segment of the coastal plain of Atlantis, preserved and brought into European relations by events of late geological date."

Here we have a kinematograph picture, with scarcely any flickering. Something like this has most probably happened; but few readers will, we fear, be in a position to understand that the events referred to can only be felt out in dimmest outline by very uncertain inferential methods, which in various hands have given different results. Mr. Mackinder goes on to connect the process of geotectonic history with human history, but the connection strikes us as in large part metaphysical if not fanciful. Unquestionably the relief of the land, and the climate—which, by the way, is treated with charming simplicity and fidelity to verifiable facts—exercise a powerful directive influence on the distribution of life and on the course of human history, and undoubtedly the land owes its relief to the processes of geological history; but we contend that no matter what the precise course of that history may have been, the surface-forms once produced, no matter how, would have exercised the same functions in controlling distribution. Whether a mountain is folded up by the puckering of a plain, or cut out by the carving of surrounding valleys, or poured forth as lava, or piled up as ashes, if it has assumed a given form and is covered by a particular soil its action upon life and man will be identical.

Our argument is that the same final result might be the outcome of any one of a number of causes; and that the latest Earth-movements, though slight, are more potent in their geographical aspect than early movements of far greater magnitude. In fact, we believe that actual landforms, not the processes of their formation, are the real elements of geography.

Such a book as this ought not to be criticised in detail, but judged broadly according to its plan, its scope and its methods. Still, we cannot help noticing some inequalities of treatment which exercise a warping influence on the framework of the argument. It is, from the geographer's point of view, a trifle of no importance that the Glacial and post-Glacial periods are classed as Tertiary, and it may be that the author is right in saying that Ramsay's views as to the origin of lakes by ice-action are now gaining ground—though we should like to hear him propound this theorem at a meeting of the Geological Society—but he is certainly wrong in dealing so briefly with the Glacial episode as a whole. A geographer could not, we should have thought, consider the parts of Britain north of the Thames and Bristol Channel without recognising how profoundly the whole face of Nature has been modified by the power of ice. The map of the solid geology gives but a poor idea of the actual surface of the land, the contours of which are due over large areas to boulder clay alone; and the courses of many rivers have suffered revolutions in the Ice-age which must entirely mask the consequences, the subsequences, nay even the obsequences of the secular advance of the "geographical cycle." We feel sure that even though Mr. Mackinder's geomorphology may be criticised and possibly confuted in parts, the latter and more purely geographical part of his work will stand unshaken.

This latter part includes a chapter on racial geography and another on historical geography which are models of clear and brilliant exposition. They will not, perhaps, give pleasure to the devotees of Celticism, who may be inclined to demand proofs for a classification including "the catholic Irishman essentially a pre-Celt . . . , the Highlander pre-Celtic and mercurial . . . , the Welshman with a strong pre-Celtic infusion." The different regions of the country are considered under the heads of Metropolitan England, Industrial England, Scotland and Ireland, showing how the dominant facts of relief, structure and climate control the life of the people, the routes along which they travel and the sites in which they settle. Here there is nothing of the gazetteer or the guide-book; no attempt is made to enumerate all important towns, and throughout the references to scenery are surprisingly scanty; but the reader feels that he is being initiated into some of the secret springs of history. Two chapters follow impressing these views still more strongly; they treat of strategic and economic geography, and the latter in particular shows much care and completeness. It is curious, however, to notice that while the power of the tides, which are still unharnessed, is spoken of in almost poetical terms as a possible substitute for coal, the water power of the land, better understood and more utilised as it already is, has hardly any attention directed to it. Yet even now we find water power successfully competing with coal in the supply of electrical energy for extensive manufactures, and its vast potentialities are not unknown to practical men. A short chapter on Imperial Britain illustrates some of the lessons which the geographer may teach, or at least offer to teach, the politician; and a summary and conclusion recapitulate the argument.

There is, in our opinion, too much hypothesis in the book, and the grounds for many of the conclusions are inadequately stated. Rival interpretations are not set one against the other, and the reader coming fresh to the subject is apt to form an exaggerated opinion of the certainty of some historical processes, both geological and human. But, on the other hand, we have here an attempt to show how the worlds of Nature and Man may very justly be conceived as knit together, and it is extremely probable that such a book, written with more boldness than most scientific men could display, will bring home some aspects of scientific thought to minds shut against ordinary and clumsier exposition. The book is eminently deserving of study, and it is sure to suggest many new and valuable ideas both to novices and experts.

The numerous illustrations are restricted to maps and diagrams, and we have never seen sketch-maps used to better purpose, although a few betray in their weak outlines a draughtsman not yet fully alive to the precautions required in drawing for photographic reduction.

THE BOOK OF THE DEAD.

The Book of the Dead: an English Translation of the Chapters, Hymns, &c., of the Theban Recension, with Introduction, Notes, &c., and with Four Hundred and Twenty Vignettes. By E. A. Wallis Budge, M.A. Litt.D., D.Lit. In three volumes. Pp. xcvi + viii + iii + 702. Vols. vi.–viii. of the series "Books on Egypt and Chaldæa." (London: Kegan Paul and Co., Ltd., 1901.)

READERS of NATURE will remember that nearly three years ago we noticed the appearance of a work, published by the trustees of the British Museum, in which facsimiles were given of the Egyptian papyri of Hunefer, Ànhai, Kerāsher and Netchemet, together with the text of the papyrus of Nu, the whole work being edited and annotated or translated by Dr. Wallis Budge, the keeper of our national collection of Oriental antiquities. As we pointed out at the time, this monumental work completed the series of facsimiles of papyri of the "Book of the Dead," which the trustees of the Museum have published at intervals during the last eighteen years, and by its appearance furnished scholars with a remarkable series of papyri of all periods for the study of the funereal literature of the ancient Egyptians. The great amount of new material published in this series of volumes rendered still more apparent the want of a complete edition of the text of the "Book of the Dead," which has been increasingly felt since the appearance in 1886 of M. Naville's "Das Todtenbuch der Ægypter," in which were given the various chapters from the different papyri then available.

The want was supplied by Dr. Budge, who, under the title "Chapters of Coming Forth by Day," published a complete edition of the text, based upon all known papyri, together with a translation and a full vocabulary to the hieroglyphic texts. This bulky work in three volumes appealed in the main to scholars, while its price placed it beyond the reach of many whose interest in the "Book of the Dead" stopped short of the acquisition of its complete hieroglyphic text. It was in answer to numerous requests from this latter class of readers, as we learn from the preface to the volumes before us, that the publishers decided to include Dr. Budge's English translation in their series of little "Books on Egypt and Chaldæa." The books under review, however, contain no mere reprint of a portion of the former work. Careful revision, based on a comparison of the original documents, constitutes the translation a new edition of the English rendering; and while from the introduction the general reader may gain a knowledge of the history, object and contents of the "Book of the Dead," he need not be puzzled by obscure references or phrases in the translation if he consults the many explanatory notes which have been added to this edition. We shall in the main confine ourselves to the new material thus presented, and shall refer in some detail to the remarkable series of vignettes here published for the first time; before doing so, however, it will be necessary to sketch briefly the nature of the religious texts which are here translated.

The title "Book of the Dead" is now almost a household word, and it is never likely to be changed either for the Egyptian title "Chapters of Coming Forth by Day," or for any conventional description of its contents. That it is unsatisfactory Dr. Budge admits, for the "Book of the Dead" is not a book in the strict sense, that is to say, it is not a fixed composition the different copies of which vary but slightly. But the title is short, it is sanctioned by the authority of Champollion and Lepsius, and the texts so described certainly concern the dead; moreover, it is far preferable to the titles "Ritual of the Dead" and "Funeral Ritual," which have been suggested as substitutes. The great body of Egyptian religious texts which bear this title have a long and varied history; with their origin buried in the remote past, they grew by accretion throughout the whole life of the Egyptian nation, and their contents reflect the beliefs and opinions of many different and conflicting schools of thought. But, as Dr. Budge points out, every chapter or section that has yet been recovered has a link which connects it with the rest; however barbarous or however exalted may be the character of the beliefs a chapter embodies, it shares a common object with the others—that of benefiting in some way the deceased. And it is this common object which constitutes the claim of the "Book of the Dead" to be the great national religious composition of ancient Egypt. In what way its chapters were to benefit the deceased may best be described in Dr. Budge's own summary:—

"They were intended to give him the power to have and to enjoy life everlasting, to give him everything he required in the life beyond the grave, to ensure his victory over his foes, to procure for him the power of going whithersoever he pleased and when and how he pleased, to preserve the mummy intact, and finally to enable his soul to enter into the bark of Rā or into whatever abode of the blessed had been conceived of by him."

The recently discovered graves of some of the indigenous inhabitants of Egypt show that two distinct methods of burial were practised at that early period, and probably by two distinct peoples. By the one the dead were partially burnt, and afterwards the skull and bones were placed in a shallow pit; by the other the body was buried either whole or after it had been dismembered. Both peoples oriented the dead in the same direction and both made offerings to the dead. It is clear, therefore, that both peoples had a clear perception of a future life, while the traces of bitumen discovered by Dr. Fouquet upon some of the buried bodies suggest that these early inhabitants of Egypt, like their later descendants, believed that the welfare of the deceased depended upon the preservation of their earthly remains. Although no inscriptions have been found in these early graves, there is much that lends colour to Dr. Budge's suggestion that the origin of the "Book of the Dead" may be traced to the prayers and formulæ recited during burial at this early period in order to preserve the dead body from the attacks of wild animals and from decay. The earliest written version of the "Book of the Dead" occurs upon the walls of the chambers and passages in the pyramids of the kings of the fifth and sixth dynasties at Saḳḳâra, and it does not, therefore, date from an earlier period than B.C. 3500; but the mistakes and misunderstandings of the scribes who engraved these texts prove that many of the formulæ were even then unintelligible

by reason of their antiquity; moreover, the beasts and creatures, which the prayers and spells were intended to frighten away from the dead man, belong to the period when forests clothed the banks of the Nile in Egypt and river monsters of all kinds abounded which are now only to be found on the upper reaches of the Blue Nile and near the Great Lakes.

In his introduction, Dr. Budge has brought together some exceedingly interesting evidence that parts of the "Book of the Dead" were in general use even before the period of the kings of the first dynasty; but what concerns us here is, not the early history of the book, but the traces which its early history has left upon it, and which have been retained even in its most perfect and complete form, the so-called "Theban version," which is found written upon papyri in tombs of the eighteenth, nineteenth and twentieth dynasties. The Egyptian was conservative to the back-bone, and to this conservatism the anthropologist and the scientific student of religion are much indebted; for as he advanced in his religious beliefs and conceptions, he did not discard all traces of his earlier and more primitive state, but along with the profession of his more spiritual faith he jealously clung to and retained the earlier spells and formulæ which had long ceased to apply to his own condition of life. It is thus possible in the "Book of the Dead" to trace the semi-barbarous North-African element contending with more moral and spiritual beliefs, the rise of which Dr. Budge traces to the presence of some Proto-Asiatic element in the composition of the Egyptian race. The space at our disposal does not admit of our treating this fascinating subject at greater length, and for a more detailed discussion we must refer the reader to Dr. Budge's introduction.

We have already made a brief reference to one of the most striking characteristics of this latest edition of the "Book of the Dead"—the beautiful series of outline blocks with which the chapters are illustrated. The ancient Egyptian scribes and artists used to add to the separate chapters or sections of the work vignettes, or pictures, intended to illustrate their general contents and also to have in themselves a magical effect upon the destinies of the deceased; and these pictures are often of considerable assistance in the interpretation of the texts to which they refer. Dr. Budge has selected the vignettes from the best papyri, and where the designs vary in different papyri he has given more than one version; as interesting examples of varying treatment we may refer to the three vignettes illustrating the "Weighing of the Heart" (p. 31 *f.*), the numerous illustrations to chapter xvii. and the curious variant to the vignettes of chapter xxxvi. This last chapter ensures the driving away of the insect called *Ápshait*, which Dr. Budge identifies with

"the beetle which is often found crushed between the bandages of poorly made mummies or even inside the body itself, where it has forced its way in search of food."

Thus, in most vignettes to this chapter the deceased is represented spearing a beetle, as in those illustrated on p. 161; but in the vignette on p. 162 the deceased is portrayed spearing a pig and not a beetle, which the translator ingeniously explains as due to the scribe having confused the proper name *Ápshait* with *shaà*, the word for "pig." The vignettes throughout the volume have been faithfully drawn from the originals in bold, clear outline, and, apart from the light they throw upon the text, they form in themselves a beautiful series of examples of Egyptian design and draughtsmanship.

In conclusion, we may say that we heartily endorse the remarks which are made in the preface with regard to the fashion that has grown up among certain writers on Egyptology during the last few years, who decry the "Book of the Dead" and announce as a great discovery that parts of its text are corrupt. But, as Dr. Budge remarks, this fact has been well known to Egyptologists for the last fifty years, and is, moreover, a characteristic shared by every great national religious composition which is handed down first by oral tradition and secondly by copies which are multiplied by professional scribes.

"The more the 'Book of the Dead' is read and examined," he adds, "the better chance there is of its difficult allusions being explained and its dark passages made clear, and this much-to-be-desired result can only be brought about by the study, and not by the condemnation, of its texts."

To this end no other scholar has contributed so much as Dr. Budge himself, and his latest efforts, embodied in the volumes before us, will place a rich store of material within the reach of the humblest worker in the great field of the comparative study of religions.

FOSSIL FISHES IN THE BRITISH MUSEUM.

Catalogue of Fossil Fishes in the British Museum (*Natural History*). Part iv. By Arthur Smith Woodward, LL.D., F.R.S., F.G.S. Pp. xxxviii + 636, 22 figures, 16 plates. (London: Printed by order of the Trustees, 1901.)

THE fourth volume of this great work, which has just appeared after an interval of six years since the publication of the third volume, completes the account of the unrivalled collection of fossil fishes preserved in the national museum, to which the author has devoted so much attention during the twenty years which have preceded his appointment to the post of keeper of the geological department, on the retirement of Dr. Henry Woodward. The issue of this volume, dealing entirely with the Teleosts, was eagerly awaited, not only by palæontologists, but also by all students of fishes, as great hopes were entertained that a revised arrangement of the bony fishes, the preponderating element in the recent fauna, would result in very considerable progress in our understanding of the inter-relations of the components of this difficult group.

If the feeling of joy be mixed with some disappointment at so many problems of classification remaining unsolved, the fault rests entirely with the nature of the material with which Dr. Woodward has had to deal. Those who merely glance over the beautiful series of fish-remains exhibited in the gallery at South Kensington are apt to carry away too sanguine an impression of the osteological information which is to be obtained from their study. It is a fact that, on some very essential points, fossil remains, however numerous and well preserved they may appear, still fail to afford the information which is most wanted. As an example we would allude

to the regrettable fact that the author has been obliged to abandon the use of a very important character in the definition of the higher groups, viz. the presence or absence of the mesocoracoid or "precoracoid" arch, the presence of which in the Isospondyli as understood by Cope had been duly emphasised in the diagnosis of this suborder at the end of the preceding volume. The Isospondyli are now made to include the Haplomi, an innovation with which the reviewer is unable to agree for the reason that the study of recent fishes proves their separation to be absolutely necessary. Even where the character of the "precoracoid process" is appealed to for the definition of families, error has crept in, at least in the case of the Gonorhynchidæ, which are stated to be devoid of it, and hence are unjustifiably regarded as "only slightly modified Scopelids." Other points in the identification of the elements of the pectoral arch seem in need of revision, as in the Thrissopater figured on plate vii., where the bone named "postclavicle" either represents the supraclavicle or overlies the latter and the clavicle, in which latter case it does not, as I believe, answer to the definition of the Elopidæ, and in the restoration of *Eurypholis boissieri*, p. 206, where the basalia of the pectoral fin are represented as attached to a bone termed "postclavicle." In the definition of the Apodes, "pectoral fin with more than five basalia" is true of Anguilla, but does not apply to Conger and other genera.

It is clearly often impossible to assign extinct fish-remains to their systematic position with that rigid precision which may be attempted in the case of living forms. Dr. Woodward, as he tells us in the introduction, has therefore deemed it advisable to adopt a broad conception of families and genera more in accordance with that of Dr. Günther than with that of later writers. But his classification, on the whole, is greatly ahead of that followed in Zittel's manual and in the text-books published in this country. He has amply availed himself of the reforms introduced by Cope and by Sagemehl. The arrangement of the great group of Acanthopterygians is still the most unsatisfactory, the definition of its subdivisions being of a very provisional nature and lacking in precision; groups like the Beryciformes, Chætodontiformes and Blenniiformes are certainly quite artificial, and the new sense in which these terms are used must be regarded as a retrograde step. Some explanation might have been given by the author of the reasons that have induced him to place the Blochiidæ among the Blenniiformes rather than among the Scombriformes.

The fossil forms dealt with under the Isospondyli offer a highly interesting and suggestive gradation from the later Ganoids to the earlier Acanthopterygians, such as the Berycidæ, so abundant in Cretaceous formations, but we are unfortunately still without a clue to the derivation of the eels proper, or Apodes, degenerate fishes which are traced back to the Chalk. Among these, Urenchelys, from the Chalk of Mount Lebanon, is shown to differ from existing genera of the same family in having a small caudal fin supported by expanded hypurals, thus showing the "diphycercal" condition which prevails at the present time to have been derived from a "homocercal." The Percesocine genus Cobitopsis settles once for all the vexed question of the systematic position of our sand-launce, Ammodytes, as it has retained the abdominal pelvic fins which have entirely disappeared in the existing genus; Ammodytes must hence be removed from the Ophidiid Anacanthines and placed near the Scombresocids or gar-pike and allies.

The publication of the "British Museum Catalogue of Fossil Fishes" marks a great advance in ichthyology, and we heartily congratulate Dr. Smith Woodward on its completion. It is announced in the preface that the author proposes to prepare, in the course of the present year, a supplement giving a list of additional important genera discovered and published since the earlier volumes were issued, the first dating as far back as 1889; also a stratigraphical table showing the appearance in time of families and genera of fossil fishes, together with a general index to the four volumes.

A last word as to the illustrations. The plates, as well as the outline figures in the text, are excellent, both from the point of view of artistic finish and scientific accuracy, and do the greatest credit to the artist, Miss G. M. Woodward. The intercalation of a collotype plate (xvii.) is, however, to be regretted, as not in keeping with the style of the other illustrations and quite superfluous, the figures having already appeared elsewhere, although no allusion to this is made in the accompanying explanation.

G. A. B.

OUR BOOK SHELF.

Tales of a Dying Race. By Alfred A. Grace. Pp. x+250. (London: Chatto and Windus, 1901.)

THE title of this little book is somewhat misleading. Out of eight-and-twenty tales, only four are, properly speaking, Maori tales. The rest are stories of the contact between the Maories and the white settlers, traders and missionaries. Even the four Maori tales are retold in *pakeha* fashion, until there is little of the Maori left in them beyond the skeleton. The majority have already appeared in antipodean periodicals. They are all charmingly told, and, illustrating as they do many sides of the Maori character and the romance of earlier days of the colony, they form a worthy tribute to the noblest of savages, and cannot fail to rouse vivid feelings of regret that the race is doomed to extinction. Mr. Grace writes of the people and their surroundings with keen sympathy, the full secret of which is not disclosed until the last story, in which he relates an adventure of his early life as a missionary's son, when his mother and her children were rescued from an impending and horrible death by the unflinching courage and fidelity of a native chief. He has done well to preserve the narrative, as well as the other contents of this entertaining book, in a permanent form; but he himself would hardly claim scientific value for the collection.

Lehrbuch der Differentialgleichungen. Von Dr. H. Liebmann. Pp. vi + 226. (Leipzig: Veit and Co., 1901.)

THIS interesting and well-written book shows that the ideas of Sophus Lie are at last bearing fruit, even in elementary text-books. There are three chapters dealing respectively with ordinary differential equations of the first order, with similar equations of higher order and systems of such equations, and with partial differential equations of the first order with two independent variables. Besides this, there is an introductory chapter dealing mainly with existence-theorems, and a concluding one on partial differential equations of the second order.

The examples are numerous, and admit of geometrical interpretation; many of them illustrate the theory of tangential transformations, which, happily, receives a good deal of attention. The articles on existence-theorems appear to be sound, so far as they go, and are unusually readable. Altogether, Dr. Liebmann's book may be recommended as a useful introduction to the modern treatment of the vast subject with which he deals. M.

The Theory of Equations: with an Introduction to the Theory of Binary Algebraic Forms. By W. S. Burnside, M.A., D.Sc., and A. W. Panton, M.A., D.Sc. Fourth edition. 2 vols. Pp. xiv + 286 and xii + 292. (Dublin: Hodges, Figgis and Co., Ltd.; London: Longmans, Green and Co., 1899, 1901.)

IN this new edition of a well-known and popular treatise the principal change is the addition of a chapter on the theory of substitutions and groups. Following the methods of Serret, Jordan and Netto, the authors give just so much of the elementary theory of substitution-groups as to enable them to prove the fundamental property of the Galoisian resolvent of an equation, and to demonstrate that the general equation of any degree higher than the fourth cannot be solved by an algebraic formula. It is strange that no reference is given to the work of Kronecker and others on equations which do admit of algebraic solution.

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.*]

Note on Electric Charging and Discharging at a Distance.

A NUMBER of experiments, which I began in 1888, continued in 1894 and again in 1896, have been waiting for publication until the completion of certain others that I have been hoping to find time to carry out. As, however, the results are somewhat akin to those on the discharge of insulated bodies that are of great interest at the present time, it may be worth while not longer to delay publishing a preliminary note on a few of them.

The interest of the experiments lies partly in the fact that I was not merely able to *discharge* an electroscope by means of various bodies, hot and cold, placed within distances from it varying between 1 cm. and 300 cm., but that I was also able to *charge* the electroscope by the same means. The special interest, however, arises from *cold* bodies, viz. cotton wool dipped in ether, methylated spirit, or dilute sulphuric acid, being different, so far as I am aware, from any that have hitherto been employed for discharging or charging an electroscope at a distance.

A gold-leaf electroscope was employed, its outer case properly screened with strips of tinfoil, and the knob replaced with a metal pot to increase its capacity. A charge sufficient to make the leaves diverge by rather more than a right angle was generally given, so as to render the collapse easy to see. In every case the sign of the charge was tested before it was noted.

I.—*Discharging an Electroscope at Short Distances by means of a Candle Flame.*—With an insulated candle flame at 15 cm. distance, the leaves collapsed in forty seconds, whether they were charged positively or negatively. At 40 cm. between the two, the positive charge leaked away more slowly than the negative. With 42 cm. distance, the leakage was very slow for both, and at 48 cm. there was none.

When the candle was earthed, by having a wire sticking into the wick, the discharge was quicker than when it was insulated, but not if the wire dipped into the melted wax. The flame of a match had no less power, and an electric arc no more power, than an uninsulated candle flame placed at the same distance.

II.—*Discharging an Electroscope at Long Distances by means of an Insulated Candle.*—The candle and the electroscope were next placed 150 cm. apart and a *negative* charge given to the electroscope. Result—no leakage. A glass rod was then rubbed, brought up to the candle on the side *remote* from the electroscope, and then withdrawn. When this had been done several times, the leaves began to collapse, and collapsed in jerks, each time the rod was excited, brought near the candle and withdrawn. The collapse appeared to take place at the withdrawal of the rod. The same experiment was performed with distances varying up to 200 cm. between the candle and electroscope, and the numbers of withdrawals and re-excitations of the glass rod that were needed before the leaves began to collapse were noted. It varied from 1, with a distance of 125 cm. between candle and electroscope, to 14, with a distance of 203 cm. Thus the number of excitations increased very rapidly with the distance. The same results were obtained by charging the electroscope positively and bringing rubbed sealing-wax up to the candle. The further the distance of the two apart, the longer was it before the leaves began to collapse and the slower was the collapse when it began.

III.—*Charging an Electroscope at Long Distances by means of an Insulated Candle.*—All the experiments in II. were repeated, but the electroscope and the candle were now charged with the *same* sign. The number of withdrawals before the leaves began to move was much the same as before, but now the leaves diverged more widely, whether both electroscope and candle were charged positively or negatively. The electroscope was then left uncharged, and the charge rod was brought up to the candle as before. The leaves then diverged, and were found to have a charge of the same sign as that of the rod. Thus a charged electroscope placed at a distance up to 200 cm. from an insulated candle can be discharged by repeatedly bringing a charge of the *opposite* sign near the candle, on the side remote from the electroscope, and, similarly, an uncharged electroscope can be charged with a candle and rod placed at distances up to 200 cm. from the electroscope.

IV.—*The same Experiments with an Earthed Candle Flame.*—None of the results in III. are obtained if the candle is earthed.

V.—*Discharging an Electroscope by means of a Red Hot Platinum Wire.*—I., II., III. and IV. were repeated with the candle replaced by a platinum wire kept red hot by a current from two Grove's cells, which were placed on a cake of sealing-wax standing on four cubes of paraffin wax when the cells were required to be insulated. The results were practically the same as with the candle flame, except that the platinum wire, when earthed, discharged a negatively charged electroscope, but not one positively charged. Also when it was insulated, it discharged the electroscope at as great a distance, in one case, as 300 cm. from it.

Since writing the preceding, I find that some experiments on discharging, and discharging by means of *hot* bodies placed at *short* distances from the electroscope, were deseribed by Prof. Worthington at the meeting of the British Association in 1889.

VI.—*To Restore to Platinum Wire the Power to Discharge when it has lost it by being kept White Hot for many hours.*—Prof. Schuster first observed, I believe, that glowing platinum wire ceased to discharge electrified bodies near it after it had been kept white hot for some time. He attributed its discharging power to occluded gases and the loss to these having all been expelled. To see if the power could be restored to the wire by placing any substance on it, I first put a drop of oil on some wire that had lost its power, but with no effect. A grain of sugar was equally ineffectual, &c., but either salt or common washing soda was, I found, instantly efficacious. It seems possible, therefore, that it is some trace of a salt of sodium or other metal on an ordinary platinum wire that either enables, or assists, the hot wire to discharge, and that the white heat chemically cleans this off. I intend, however, to make further experiments on this point.

VII.—*Charging and Discharging an Electroscope by means of Cotton Wool dipped in Ether, Methylated Spirit, or Dilute Sulphuric Acid—the whole Insulated.*—II., III. and IV. were next tried, when the candle flame was replaced with an insulated saucer of cotton wool, saturated in turns with ether, methylated spirit and dilute sulphuric acid placed at a distance from the electroscope. Each was found to act just as well as the candle flame and in the same way. None would act when earthed, and carbon dust—dry—was quite ineffectual in both cases.

Many other experiments were tried, but the preceding are sufficient to show the nature of the phenomena observed.

HERTHA AYRTON.

The Origin of the Scale of Fahrenheit's Thermometer.

YOUR issue of February 13 contains, on p. 348, a note on the above subject, in which it is stated that Fahrenheit based his scale upon a scale previously adopted by Newton, Newton's scale having its zero at freezing point and the temperature of the human body marked as 12 degrees. Fahrenheit (says Sir Samuel Wilks) found Newton's divisions too large. He therefore divided them by two. Next he altered his zero to the temperature produced by a mixture of ice and salt. Later on he again divided each degree into four parts, giving the scale which is now in use. This explanation is substantially that which is given in the "Encyclopædia Britannica."

It is evident that the origin of the Fahrenheit scale is a matter of some speculation. A recent work, the "Evolution of the Thermometer," by Mr. H. C. Bolton (reviewed in NATURE of May 9, 1901), states that Fahrenheit's selection of a scale was unfortunate, and did not appear to have been based on anything.

It seems very unlikely that Fahrenheit, who was an accomplished man of science and experimenter, and whose thermometers were acknowledged to be a great advance on others existing at the time, should have based his scale on nothing at all.

An examination of the main features of Fahrenheit's work upon thermometers gives, I think, the key to the origin of the scale, and shows that he based it upon a very sound and scientific foundation. In discussing this question, one must have a regard for the state of the knowledge of kindred matters at the beginning of the eighteenth century, and consider how the problem would be likely to present itself to Fahrenheit.

Reference is made in the note to a paper in the *Philosophical Transactions* for 1701, supposed to have been written by Newton. In this paper, which is written in Latin, is described a scale of degrees of temperature (Scala graduum Caloris) from the freezing point of water to the melting point of gold, but it does not appear that this scale was intended to be actually applied to a thermometer. It seems only to be intended as a convenient scale of reference for comparing temperatures covering a very wide range. The zero or starting point is the freezing point of water. The external temperature of the human body is taken as the second point from which the scale is derived. The range of temperature between these two points is divided into twelve parts. The freezing point is, therefore, called 0, and the body temperature 12. The scale is continued upwards, and it was found that the temperature of water boiling violently corresponded to 34 degrees. Many other degrees are noted as indicating the melting points of metals, &c.

The paper continues with a description of a thermometer, the liquid element of which is linseed oil. The actual scale of the thermometer, however, was not that described above, but was determined as follows:—

The thermometer was placed in melting snow. The space filled by the oil in the bulb and the stem together was taken as occupying 10,000 parts. The same oil, when expanded by the heat of the human body, occupied a space of 10,256 parts, and by the heat of boiling water 10,725 parts. Thus, on this thermometer, if the freezing point was marked 0, body temperature was 256 and boiling water 725. It was by means of this thermometer that the temperatures were obtained from which the "Scala graduum Caloris" was computed.

Fahrenheit is credited with having been the first to use mercury in the thermometer. He also discovered how to produce a temperature much below the freezing point of water by mixing "ice, water and sal-ammoniac or salt."

In a paper (also in Latin) which he contributed to the *Philosophical Transactions* of 1724, on the subject of "Experiments concerning the Freezing of Water," he described his thermometer, but did not explain his reasons for adopting the particular scale. It may be safely assumed that he was acquainted with the paper published in 1701 referred to above.

Having then decided upon the use of mercury in his thermometer in place of the oil previously used, the problem upon what basis his scale should be constructed would next arise. What could be more natural than to base it upon the expansion of mercury itself? The idea of making his degree or unit that difference of temperature by which the liquid expands by one *ten-thousandth part of its volume* would naturally occur to him, for it had already been done in the case of the oil thermometer. That this is the basis of the Fahrenheit scale I think is proved by the fact that for each degree of the Fahrenheit scale mercury *does* expand by one ten-thousandth part of its volume.

Having, therefore, determined upon the size of his divisions or degrees, the next thing was to fix on a zero or starting point. What, again, could be more natural than to start with the greatest degree of cold which he knew how to produce, namely, the temperature of the ice and salt mixture? Having settled upon this, everything else follows, and we have the Fahrenheit scale as we know it to-day. The thermometer registers for freezing point 32°, blood heat 98½°, and boiling point 212°. In his own description of his thermometer, he states that the temperature of the body is 96°, but this slight error was probably due to the thermometer not being properly heated by that part of the body to which it was applied, and in any case does not affect this explanation, which, I think, suggests that the Fahrenheit scale is based upon scientific principles, and is not, as is often supposed, a scale without rhyme or reason.

GILBERT S. RAM.

The Inheritance of Mental Characters.

I QUITE agree with Prof. Cockerell that further discussion of this subject had better be postponed, if, indeed, it be not wholly unprofitable. But I may, perhaps, be permitted to make three remarks:—

(1) The coefficient of correlation is a measure of the degree of resemblance between brothers. We are told it may be due to "soul," heredity or environment. "Soul," I take it, can only contribute to likeness between brothers, if they have like "souls." If so, I suppose the likeness of "soul" is due to inheritance of "soul," and I do not see how this is going to be distinguished from other forms of heredity. I am not unaware of Dr. Wallace's views on spirit hierarchies. I considered them in my "Grammar of Science," and still hold them thoroughly illogical and unscientific.

(2) What I asked Prof. Cockerell to do was to explain why the intensity in inheritance of mental and physical qualities came out the *same*. He may have views why they ought to be different, but it remains for him to explain why soul + heredity + environment in one case = heredity + environment in the other.

(3) I believe the mental characters in man are far more persistent than Prof. Cockerell credits them with being. The relations between head-measurements and intelligence are almost identical whether we deduce them from young children or undergraduates, and there is no apparent change of correlation when we compare brothers at close and at more distant ages. It is perfectly possible to determine from our data the proportions of children at each age with given mental characters. Prof. Cockerell belongs to those critics who live in the region of "may-be." If he will collect observations on some 5000 to 6000 children as we have done, he may still come down from the region of "may-be" and be able to place fact against fact.

University College, London. KARL PEARSON.

The Colours of Wings in Butterflies.

YOUR correspondent in India, W. G. B. (NATURE, February 13, p. 344), has been examining a butterfly in some ways like the *Morpho Cypris* of South America, the difference being that the latter has the upper side brilliant and the lower side brown.

The Morpho can be placed so that the two wings on one side of the body are metallic blue, while the other two are black; with a slight turn the two sides reverse colours. This seems to be like the case of the Purple Emperor, in which all edges of the scales facing one way are blue, and other edges are brown. A ploughed field with furrows running east and west might after snow and sunshine appear white from the north and black from the south. In London it is easy to see the Morpho; instead of the furrows it is possible to take for illustration a common form of advertisement.

The Morpho, like the Indian specimen, presents shades of ultramarine, peacock-blue, and sea-green; also in transmitted light the scales are golden. In most cases of coloured surfaces we are not yet able to point out the action on the light waves. Prof. Tyndall showed how small particles in air or water might reflect blue waves and allow the larger red waves to curl round them and go forward; but this does not apply to a surface which reflects the larger waves. It can only be said that coloured surfaces are such as have the power at a minute depth of selecting some waves for reflection; in the case of gold leaf or some butterflies' wings, the remainder of the light may be seen, transmitted almost without any loss by absorption, as the thickness traversed is so

minute. It is familiar knowledge that the intensity and the polarisation of reflected and transmitted lights vary with the incidence; and it seems likely that in the Morpho the changing tints of blue may arise through a varying partition of the reflected and transmitted colours. While, then, diffraction does not usually affect the appearance of the wings, it is, however, interesting to a student in optics to use the scales for experiment. Let a few wings, light-coloured for preference, have the scales scraped off on to a piece of glass, and let these be covered with glass as in a lantern slide; when they are placed in strong sunlight, there is the appearance of so many minute sparkling diamonds.

Since I wrote before, I have felt that in humming-birds also the colour is seldom due to diffraction. In one which I have before me, the head is red or black, the breast is golden or olive-green; the details of the feathers have two colours, one on each edge. They are strong mixed colours, not like spectrum colours of any order. In the Gould collection at South Kensington I was, however, able to find two birds—*Rhodopis vesper* and *Calypte annae*—in which the pigment colours were so subdued that diffraction lights were able to have some influence in the mixed effect. W. B. CROFT.

Winchester College, February 17.

Birds attacking Butterflies and Moths.

IN connection with the controversy on the above subject, I am permitted to add the testimony of an old friend of mine, Mr. H. S. Wise, of Ford, Drewsteignton, South Devon, an extremely keen and accurate observer, with wide experience both of British and Indian fauna. In letters to me dated February 9 and 12, 1902, he says:—"I have seen birds attack butterflies both in England and in India," and gives the following notes:—"On summer evenings, magpies hunt a grass field and catch immense numbers of moths, beetles and, I believe, butterflies. . . Last summer I shot a magpie, one of a family that was carefully working a large grass field; his beak was full of recently-caught Swift Moths (*Hepialus lupulinus*)." Later he says, "I have seen the common spotted flycatcher pursue a butterfly and miss it, giving up the pursuit; this was of course on the wing." Further, "titmice eat quantities of small moths, which they catch when at rest." Speaking of the large Yellow Underwing (*Tryphoena pronuba*), Mr. Wise tells me, "several small birds eat this moth, sparrows among the number; it is a strong moth, and the bird generally beats it on the ground to kill it before eating it. This insect is fond of lying on the ground among leaves, &c., and birds will hunt it out and catch it." Among other enemies of British Lepidoptera, Mr. Wise notes that "bats feed largely on the night-flying moths; *Tryphoena ianthina* is one I have seen them catch." My friend also refers to a note by G. C. Dudgeon, in the Journal of the Bombay Natural History Society for March 20, 1895, on the King Crow (*Dicrurus longicaudatus*) catching a butterfly (*Teinopalpus imperialis*, ♂), and adds, "In the case of a jungle-fire in an Indian forest, birds at once come and catch the numerous insects which fly up for safety, the above-mentioned King Crow being always to the fore." In India also lizards are formidable enemies to Lepidoptera. Mr. Wise says, "in Bombay there is hardly a lamp-post which has not got a gecko on it; these feed on the moths which are attracted to the light."

Mr. H. S. Wise, I am glad to say, promises to devote especial attention this summer to the question of birds attacking Lepidoptera, and to note, whenever possible, the name of the bird and the victim. If naturalists would more generally devote time to such work, we should soon accumulate sufficient direct evidence of the severity of the struggle for existence to place the matter beyond the possibility of dispute.

I regret to find that in my previous letter (p. 299) I unintentionally added a word to Mr. Latter's phrase, which should read "relinquished its hold in consequence of a luckily-aimed stick"—not "*only* relinquished," &c. The difference is not, however, essential, as the stick is stated to have been a cause of the bird's action. LILIAN J. VELEY.

20 Bradmore Road, Oxford, February 15.

ONE morning in 1901 (actual date not recorded) I found a Humming-bird Hawk (*Macroglossa stellatarum*) on a window in my house. I opened the window and tossed it out, thinking it would fly away, but it fell to the ground, where it remained quivering its wings within six feet of me.

A House Sparrow flew down from a deodar, and with four dexterous pecks separated the wings from the thorax; it then pecked the middle of the thorax, splitting it, and one or two more pecks separated the abdomen from the thorax. Taking the abdomen in its beak, the sparrow flew back to the tree from which it had come and, I presume, made a hearty breakfast.

The sparrow attacked the hawk in such a business-like way that it was obviously no new proceeding on its part.

There is always a martin's nest in my porch, and it is not uncommon to find wings and thorax of Agrotis, &c. on the seats or floor. JOHN HARTLEY DURRANT.

Merton Hall, Thetford.

The Severn Bore.

SINCE writing to you on February 12, I have had the opportunity of observing the bore of this morning, a tide which corresponds with that of February 12, 1899, which was remarkable. But to-day's "head" was a very poor one indeed, for no reason that I can find out; no wind and no fresh water in the river of any consequence. The only measure that I could make was of the wave at the shore, which at one point, and one point only, rose to 2¼ feet, whilst in midstream there was but little visible.

A distance of 520 yards having been measured out, and the time of passage having been taken by watches, I found that the speed was a fraction under 15 miles per hour.

The period occupied by the passage of the "head" from Newnham ferry was one hour; the mileage taken from the Ordnance map is a little over ten miles; average speed is, therefore, ten miles per hour.

This average cannot be far from correct, for I measured at Newnham, where the river is broad, and with wide sand-banks, which spread out on either side, up to Framilode, a distance of 5·2 river-miles, and here the banks begin to approach one another, and at five miles further up the stream is only 250 feet wide. E. W. PREVOST.

Newnham, February 24.

Beautiful Birds.

IN reviewing my child's book, "Beautiful Birds," F. E. B., writing in your columns, says, "Why should he select the 'beautiful birds' only, and, by implication, condone the massacre of birds that have not that advantage?" The question is a misstatement of fact, which I hope you will allow me to show, though I can only do so by quoting myself. On the last page—which I daresay F. E. B. did not get to—there is this: "'Mother, promise not to wear *any* feathers except the beautiful ostrich feathers that you look so *lovely* in?' As soon as she has promised, then all the beautiful birds in the world (and that means all the birds, for all birds are beautiful) will be saved," &c. (The italics are mine). This is the final promise and the goal to which I have been leading. May I ask F. E. B. whether, if he wished to arouse a child's interest and sympathies in any subject, he would choose the more or the less salient material to do it with?

19 Clarence Square, Cheltenham, Feb. 9. EDMUND SELOUS.

I ADMIT that I did not observe the phrase which Mr. Selous quotes from his book. But supposing that he can quote half-a-dozen such, I cannot allow that my observations to which he takes exception contain any injustice to him or real misstatement of fact. I would commend to Mr. Selous Dr. Samuel Johnson's sound remark concerning a quite analogous statement. An orchard, observed the Doctor, would be properly described as barren of fruit, even if subsequent research discovered a dozen apples and pears upon two or three trees. Now Mr. Selous' book is called "Beautiful Birds." It is not called "Birds." It is clear, too, what Mr. Selous means by "beautiful." His plates and the greater part of his descriptions deal with the Paradiseidæ, Humming Birds, and other birds which everyone calls beautiful. I do not find chapter after chapter relating to partridges, quails, sparrows, and other "plain" birds.

F. E. B.

King Og's Bed.

A HEBRAIST once told me that he thought that Og's iron bed, mentioned in Deuteronomy iii., 11, was a sarcophagus of basalt. The Hebrew word is "barzel," which is evidently the same as the Ethiopic "basal," iron, which Stormonth's dictionary gives as the derivation of "basalt." O. FISHER.

Harlton, Cambridge, February 20.

THE ROYAL SOCIETY AND THE PROPOSED ACADEMY.

A COPY of the following petition referring to the proposed British Academy has been sent to us for publication :—

To the KING'S MOST EXCELLENT MAJESTY IN COUNCIL

The Humble Petition of

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G. F. BRISTOL
ROWLAND BLENNERHASSETT, Bart., LL.D., President of the Queen's College, Cork; Senator of the Royal University of Ireland
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FRANCIS ELGAR, F.R.S., Past Director of H.M. Dockyards
N. BODINGTON, Litt.D., Principal, Yorkshire College
FRANK E. BEDDARD, F.R.S., Vice-Secretary Zoological Society

Sheweth

That Whereas His Majesty King Charles II., in order to prove that His Majesty did "look with favour upon all forms of Learning" and particularly "Philosophical Studies," and in order that such Learning and Studies should "shine conspicuously" among his People, did by Charters granted in the 14th, 15th and 21st years of His Reign found the Royal Society for the promotion of such Learning and Studies

And Whereas the progress of Learning and Philosophical Studies has been great, and scientific methods of inquiry have been applied to many new fields of knowledge since the time of His Majesty King Charles II.

And Whereas Your Petitioners are of opinion that it is desirable that all the Intellectual forces of the Realm should be so organised as to promote the greatest advancement of Scientific Studies within the Empire

And Whereas a large and influential group of representatives of Studies connected with History, Philosophy and Philology have lately presented a petition to Your Majesty praying to be embodied under Royal Charter as an Academy or like institution

And Whereas Your Petitioners are of opinion that such incorporation can be most efficiently provided for in some relationship to the Royal Society

We Your Petitioners humbly pray that Your Majesty may be graciously pleased to cause an Inquiry to be made with a view of instituting a general and formal organisation of all the Studies depending upon Scientific Method now carried on similar to that inaugurated for the Philosophical Studies of the 17th century by the Charters of His Majesty King Charles II.

And Your Petitioners will ever pray,

POSITION AND PROMISE OF WIRELESS TELEGRAPHY.

THE meeting of Marconi's Wireless Telegraphy Company held last week was of more interest than such meetings usually are, as Mr. Marconi made use of the opportunity by replying in a long speech to the many adverse criticisms which had been passed on his work. No new development has ever been brought about without having to encounter a certain amount of opposition; wireless telegraphy is no exception to the general rule, and the criticism which it has had to meet has been accentuated on account of the magnitude of the interests vested in cable enterprise. But wireless telegraphy has also enjoyed more than its share of popular enthusiasm, and it is perhaps partly on account of the unreasoning nature of this enthusiasm that technical writers have thought it desirable to sound a warning note. It is doubtless unnecessary to sell out cable shares immediately because the signal "S" has been successfully transmitted across the Atlantic, but it is equally unnecessary to assume that the result is not genuine before the details of the experiments have been published. With reference to these recent experiments, and the suggestion put forward by some of the technical papers that Mr. Marconi was deceived by atmospheric disturbances, he appeals, we think with justice, to his long experience in the matter as sufficient guarantee of the genuineness of the result, and points out that in his first successful experiment over 200 miles it was the same signal that was received.

The question has often been asked, Why is it that, if a distance of 2000 miles can be bridged, the system is not in actual commercial operation over shorter distances?

To this Mr. Marconi replies that the Post Office monopoly prevents its adoption round the coasts of this island, but that it is in continuous and perfectly satisfactory work in connection with more than seventy ships and twenty-five land stations, as readers of NATURE are aware from paragraphs which have appeared from time to time in our Notes columns.

The greatest interest, however, centres around the questions of the speed and the secrecy of signalling. Mr. Marconi states that with his latest apparatus a speed of twenty-two words a minute is obtainable. For short distances much higher cable speeds are possible, but in Transatlantic work the speed of signalling under the best conditions is only about forty words per minute, so that in this respect wireless telegraphy can certainly become a serious competitor. Distance, it is stated, has no effect on the rapidity of signalling by ætheric waves, a result which was, of course, to be anticipated on theoretical grounds.

As to secrecy, Mr. Marconi asserts that the development of his syntonic system has been carried so far that no interference troubles need be feared, and quotes an interesting example in support of this contention. The permanent station at the Lizard is at present able to work with ships without suffering any interference from the working of the big-power station at Poldhu, only seven miles distant, from which the signals were transmitted to Newfoundland. The solution of the problem of tuning has always been seen to be of fundamental importance to wireless telegraphy, and if Mr. Marconi has successfully achieved this result, it is a development greater and more far-reaching than even the Transatlantic signalling. That he is himself confident of having done so may be inferred from the challenge which he issued to Sir W. Preece and Prof. Lodge to intercept and read any of his messages, for which purpose he offers to put any of his adjacent stations at their disposal.

At the present day, when the general public takes

so much interest in scientific progress, any new development becomes so soon the centre of numberless contradictory and inaccurate reports that it is often difficult to get at the truth of the matter. Mr. Marconi's authoritative statement last Thursday is therefore very welcome. Even those most sceptical of the ultimate value of the discovery cannot but admire the energy and perseverance which Mr. Marconi has shown throughout. Whilst others have been pointing out its impracticability, he has been steadily making it practicable, and, considering the splendid results which he has already achieved, one cannot help sharing his confidence in his ultimately attaining complete success. M. S.

PROF. I. V. MUSHKETOFF.

WE regret to see the announcement of the death of Prof. Ivan Vasilievich Mushketoff, the president of the physical geography section of the Russian Geographical Society, at the age of only fifty-two.

Prof. Mushketoff was from the Don region, where he was born in 1850, and received his early education at the Novocherkask lyceum. In 1867 he entered the St. Petersburg University, joining the philological faculty, but soon went over to the Mining Institute.

Already while a student he published his first original research on the Volhynite, and in 1872 he began his continuous, almost uninterrupted explorations of Russia, first in the Urals, where he discovered a gold-bearing formation of arsenicated minerals—pharmacosiderite, arseniosiderite, &c.—and then on the Don. Next year, 1873, he was in Turkestan, where he remained for six years, making extensive journeys. He embodied the results of his explorations in a great number of geological and geographical papers, as also in a remarkable work, "Turkestan," vol. i. (1886), which was described in these pages, and, with Prof. Romanovsky, in a geological map of Turkestan.

In 1881, Mushketoff began the exploration of the Caucasus, and especially of the Astrakhan, the Kalmyk and the Kirghiz steppes, and later on of the Transcaspian region, of which he published an excellent geological description, with a map, in 1892.

A second journey to Turkestan, in order to explore the earthquake at Vyernyi, brought Mushketoff to the study of earthquakes in Russia, for which purpose numerous regular observations and a catalogue of earthquakes (by Orloff) were published by him in the periodicals of the Geographical Society. Later on he became interested in glaciers, and organised for the International Commission on Glaciers the first regular observations in Russia upon the oscillations of the glaciers of the Caucasus. All these researches enabled him to publish the first volume of an excellent course of physical geography (1891) and a short course of petrography (1895). In 1882 he was nominated head geologist of the Geological Committee, and took, in this capacity, a lively part in the geological survey of Russia. From 1885 he was president of the physical geography section of the Russian Geographical Society, and in this capacity he took, with P. P. Semenoff, the liveliest part in the organisation of all the expeditions of the Society, as well as in its publications, of which the "Annuary" is perhaps the most remarkable for the fulness of information about all geographical, geological, geo-botanical, geo-zoological and anthropological work done in Russia.

In Mushketoff, both Russia and science have lost one of their best physical geographers. He was at the same time an excellent man, and the obituary notices published in the Russian papers represent him as a most sympathetic friend of the Russian youth. P. K.

NOTES.

M. C. ANDRÉ has been elected a correspondant of the Paris Academy of Sciences, in the Section of Astronomy.

THE council of the Zoological Society has resolved to bestow the gold medal of the Society upon Sir Harry Johnston, in consideration of his very great services to zoological science, and in commemoration of his discovery of the Okapi, and the silver medal of the Society upon Mr. E. W. Harper, of Calcutta, in acknowledgment of his numerous contributions of rare Indian birds to the Society's collection. These medals will be presented at the general meeting of the Society on June 19.

IN accordance with the usual custom, the French Physical Society announces that two meetings for the exhibition of experiments described before the Society during the year will be arranged for on Friday and Saturday, April 4 and 5. On the first evening members only will be admitted; the second will be open to visitors. The rooms of the Society (44 Rue de Rennes, Paris) will be open during the whole of the Saturday for those desirous of studying the experiments more at their leisure than is possible in a crowded meeting.

THE Belgian Royal Academy makes the following announcements as to awards of prizes on scientific subjects for 1901:—For the first question, as to the part played physiologically by albuminoid substances in the nutrition of animals or vegetables, no award has been made. For the second question, relating to the organisation and development of a Phoronis, one essay has been submitted which has been adjudged worthy of honourable mention. On the subject of the effect of external influences on karyokinesis and cell-division in plants, an essay has been submitted by Mdlle. Maria Maltaux, of Laeken, to whom a silver medal has been awarded. The Charles Lemaire prize has been awarded to M. Paul Christophe, engineer of the Belgian "Ponts et Chaussées."

MR. CARNEGIE'S gift of ten million dollars, in 5 per cent. bonds of the United States Steel Corporation, for the promotion of scientific research, has already been announced in these columns, and an outline has been given of the Carnegie Institution to be founded for this purpose (pp. 278, 302). A meeting of the trustees of the institution was held at the end of January, when Mr. Carnegie described briefly the object he had in view in making the gift, and gave emphasis to his repeated desire that the income of the fund should be largely devoted to extending human knowledge by original investigation and research. The methods by which knowledge is to be advanced are left to the free action of the trustees, who will await the carefully matured suggestions of the executive committee. "Nothing," says *Science*, "has been done in founding the new institution to further or to hinder the establishment of a national university which has been so many times proposed to Congress. Nothing is projected which will in any way interfere with the purpose of the George Washington Memorial Association to secure the funds requisite for the erection of a memorial building. Nor has there been any step taken which will prevent the Washington Memorial Institution, initiated early in the last summer, from developing plans for the introduction of students to the various scientific bureaus of Washington. The Carnegie Institution is simply a new force for the promotion of science, ready to cooperate with other institutions which are now or may be established in Washington or elsewhere."

THE Russian Geographical Society has awarded this year its Constantine medal to the geologist, K. I. Bogdanovitch, who has spent several years in the exploration of Central Asia and

has contributed one large volume to the beautiful series of quarto volumes edited by the Society and devoted to this part of Asia. The Semenoff medal has been awarded to Prof. Eduard Suess for his new classical work, "Das Antlitz der Erde," and the Prjevalsky medal to the zoologist, Prof. Zarudnyi, the author of several most valuable works on the birds and also the geography of the Transcaspian region, and the author of a work, "Journey to East Persia," just published by the Society. The great gold medal of the Section of Statistics has been awarded to N. V. Slyunin, for his researches into the economical conditions of the inhabitants of the Okhotsk and Kamchatka coasts. Three small gold medals have been awarded to Messrs. N. P. Petrovsky, D. K. Zelenin and M. N. Kositch for ethnographical works published in the excellent ethnographical periodical of the Society, *Zhivaya Starina* (*Living Antiquities*). Prof. Gordyaghin, of Kazan, has been awarded the Prjevalsky silver medal for his botanical work in East Russia, and the Semenoff silver medal has been awarded to A. K. Bulatovich for his journey to Lake Rudolph. A number of small silver medals have also been awarded, chiefly for meteorological work in connection with the Society's meteorological committee, or for expeditions.

THE Elizabeth Thompson Science Fund, "for the advancement and prosecution of scientific research in its broadest sense," now amounts to 5200*l.*, and grants will be made in November from the income derived from this sum. This endowment is not for the benefit of any one department of science, but preference will be given to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from this fund, in order to receive consideration, must be accompanied by full information, especially in regard to the precise amount required; exact nature of the investigation proposed; conditions under which the research is to be prosecuted; and manner in which the grant asked for is to be expended. All applications should reach the secretary of the Board of Trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A., before April 1. During the past twelve months, the following grants have been made:—30*l.* to Prof. E. W. Scripture, New Haven, Conn., for work in experimental phonetics; 60*l.* to Prof. W. Valentiner, Heidelberg, for observations on variable stars; 10*l.* to Mr. A. M. Reese, Baltimore, Md., for investigation of the embryology of the alligator; 25*l.* to Dr. F. T. Lewis, Cambridge, Mass., for investigation of the development of the vena cava inferior.

ON March 5, the Hon. Alan de Tatton Egerton, M.P., will read a paper to the Cold Storage and Ice Association, of which he is president, at the Institution of Mechanical Engineers, on the cold stores and ice factory at Knutsford.

IT is reported that Prof. Virchow continues to make satisfactory progress towards recovery. He is now permitted to make some attempts to walk, and it is hoped that he will in time regain the full use of the injured limb.

WANT of knowledge of the principles and results of vaccination and of antitoxin treatment is responsible for many incorrect opinions and for opposition to medical research. The Vaccination League has been formed with the object of extending the knowledge of the subject of vaccination, and thus, to some extent, counteract the erroneous impressions received from pamphlets prepared by anti-vaccinationists. Among the influential names recently added to the long list of vice-presidents of the League are those of the Bishop of London, Archdeacon Sinclair and Lord Newton. It will be remembered that Lord Newton recently introduced a Bill into the House of Lords on the question of vaccination. Those who are desirous of obtaining free literature dealing with the advantages of vaccination, or of organising popular illustrated lectures on the subject in their respective districts, should apply to the secretary of the Vaccination League, 110 Strand, W.C.

THE anniversary meeting of the Geological Society was held at Burlington House on Friday last (February 21). The officers were appointed as follows:—President, Prof. C. Lapworth, F.R.S.; vice-presidents, Sir Archibald Geikie, F.R.S., Mr. J. E. Marr, F.R.S., Prof. H. A. Miers, F.R.S., and Prof. H. G. Seeley, F.R.S.; secretaries, Mr. R. S. Herries and Prof. W. W. Watts; foreign secretary, Sir John Evans, K.C.B., F.R.S.; and treasurer, Dr. W. T. Blanford, F.R.S. The following awards of medals and funds were made. The Wollaston medal to M. F. Schmidt, of St. Petersburg; the Murchison medal to Mr. F. W. Harmer; the Lyell medals to Prof. Anton Fritsch and Mr. R. Lydekker, F.R.S.; the Wollaston fund to Mr. L. J. Spencer; the Murchison fund to Mr. T. H. Holland; the Lyell geological fund to Dr. Wheelton Hind; and the Barlow-Jameson fund to Mr. W. Hutchings. The president delivered his anniversary address, which dealt chiefly with the evolution of ideas during the nineteenth century as to the genesis and classification of sedimentary and metamorphic rocks.

THE annual meeting of the Institution of Mechanical Engineers was held on Friday last. The report of the council records that the work of preparing the sixth report of the Alloys Research Committee—dealing mainly with the effect of annealing and tempering on the properties of steel—was continued in the laboratories of Sir W. C. Roberts-Austen at the Royal Mint and at the Royal College of Science until October 31; and a full report, which is now partly written, is expected to be ready during the present year. The second report of the Gas-Engine Research Committee was read and discussed at the October meeting, and the Institution has agreed to provide during the present year instruments for trials with a large experimental gas-engine which Prof. Burstall is designing to form part of the power and lighting plant in connection with the new Birmingham University Buildings. The experiments at University College, London, on the value of the steam jacket were continued during the early part of last year with the old apparatus, but were interrupted by the appointment of Prof. T. Hudson Beare to a chair in the University of Edinburgh. The apparatus has been removed from London to Edinburgh, and Prof. Beare is now designing several improvements in the valves for the admission and exhaust of the steam into the hot pots of the apparatus. As soon as these new valves are made, the experiments will be resumed, and it is hoped more satisfactory results will be obtained with this new apparatus. The series of experiments at King's College on the compound steam-jacketed engine has been completed, and Prof. David S. Capper has promised his report early this year. A second series of tests with unjacketed cylinders has been commenced, and is being carried through at the same speeds and steam pressures as the first jacketed series. Direct comparisons can then be made both with and without steam jackets. The council has joined with the councils of the Institution of Civil Engineers, the Iron and Steel Institute and the Institution of Naval Architects in forming a committee, to be called "The Engineering Standards Committee," for the purpose of recommending standard sizes for rolled sections, and other matters. The question of standardising pipe flanges, being of great importance at the present time, will be dealt with in a paper to be read before the Institution at an early meeting.

THE death is announced, at Vienna, of Dr. Emil Holub, the famous African explorer. From an obituary notice in the *Times*, we learn that Dr. Holub, who was a native of

Bohemia, was of Czech descent. He was born in the small town of Holics on October 7, 1847. After practising for a time as an apothecary, his scientific leanings and his adventurous spirit led him, at the age of twenty-five, to emigrate to South Africa. His principal inducement to explore the land beyond the Zambesi was his love of natural history, and more particularly his interest in ornithology. Indeed, the first period of seven years spent by him in South Africa was mainly devoted to ornithology and to zoology in general. On his return to Europe he took up his residence at Prague, and afterwards in Vienna, where he prepared his "Beiträge zur Ornithologie Südafricas" ("Contributions to the Ornithology of South Africa"). A little later he published "Seven Years in South Africa" and "The Colonisation of Africa." At this time he devoted himself seriously to the study of astronomy and geography, having during his first journey been greatly hampered, as he was always the first to confess and deplore, by his lack of physical and mathematical knowledge. His explorations, therefore, had been rather those of a zoologist than of a geographical explorer. Having resolved to overcome this difficulty, he set to work, and when, in 1883, he landed on African soil for the second time he was probably as well equipped as any of his predecessors in African exploration. After a little delay, Dr. Holub proceeded to the country of the Mashukulumbe, into which he penetrated further than any European had done before him. There, accompanied by his wife, he spent four years, returning to Europe in 1887. His book, entitled "From Cape Town to the Country of Mashukulumbe," which contains a record of his labours, has become a standard work. Like his former publications, it has been translated into many languages.

THE German Physical Society's publication, *Die Fortschritte der Physik*, has, under the editorship of Profs. Scheel (for pure physics) and Assmann (for cosmic physics), fairly succeeded in attaining the maximum efficiency in keeping up to date with the most recent papers, consistently with its appearance as a yearly volume. In order to accelerate further the issue of a summary of current literature, Messrs. Fried. Vieweg and Son, of Brunswick, now announce the publication, in connection with the *Fortschritte*, of a *Halbmonatliches Litteraturverzeichniss*, which will furnish the physicist at fortnightly intervals with a list of papers and books classified under the various branches of physics. The first and second numbers contain forty and twenty pages respectively. The titles only of the papers are given, so each page contains the names of some five-and-twenty different papers. The subscription price of the *Litteraturverzeichniss* is only 4 marks per annum, so it should soon find its way into the library of every physicist.

THE *Bulletin* of the French Physical Society, No. 174, describes briefly some important experiments by M. Marey on the motion of fluids studied by photography. In the case of liquids, M. Marey was successful, as long ago as 1893, in studying the motions by means of beads of the same specific gravity as the liquid. He has recently succeeded in studying the movement of air-currents past a fixed obstacle by means of smoke filaments, obtained by filtering the air-current through silk gauze with even meshes, the smoke being photographed by means of magnesium light. Where no obstacle exists, the filaments of smoke are rectilinear and parallel, while if an inclined plane be placed in the current, they will be seen to indicate the form of the stream lines, some bending round the upper and others round the lower edge. To obtain the velocity of the current at different points, a lateral oscillatory motion of ten periods per second is given to the screen, when the smoke filaments assume a sinusoidal form which is preserved throughout their path and the distance between the inflexions at any point determines the velocity. When the experiments were repeated under identical conditions, the two images were found to agree to such an extent as to be capable of superposition.

IN connection with the wreck of *Santos Dumont* No. 6, Dr. J. Y. Buchanan, F.R.S., has written a letter to the *Times* which may serve to correct any false impressions that may have been formed as to the value or general conclusions of the experiments. It is pointed out that "to M. Dumont himself every fresh ascent, whether the public term it a success or a failure, is full of lessons on a quantity of matters of detail of which the uninitiated can have no perception. Indeed, the more complete the apparent failure, the greater is the value of the experience to the air pilot, provided he escape so as to be able to utilise the experience himself." Since Dr. Buchanan arrived at Monaco, M. Dumont has taken his balloon out three times. The first time (on February 10) the balloon completely outstripped the Prince of Monaco's launch, and was even estimated to achieve 15 knots relative to the ground, going against a breeze. But "the most striking and at the same time unfavourable feature was the heavy pitching of the balloon, which at times attained an amplitude of not far from 45° on each side the vertical." On the 11th, M. Dumont performed his most successful journey in the direction of Cap Martin and back, the balloon pitching much less than previously. The accident which occurred on the 14th appears to have been mainly due to this pitching. "Arrived abreast the pigeon-shooting ground, the pitching became more violent, and the balloon rose, taking the guide-rope, which usually trails on the surface of the water, entirely out of the water and to a height of fifty yards or more above it. The situation was now becoming critical. In pitching, the balloon came to be standing very nearly vertically, first on one end and then on the other." M. Dumont appears then to have let out gas, which had the effect of causing the rear and lower end to collapse, and the rudder was thereby rendered useless. From this time until M. Dumont was rescued, wet and bedraggled, from the wreck, frequent photographs were taken showing the form assumed by the balloon during its gradual deflation. Two conclusions are drawn from the experiments; firstly, that the pitching must be prevented by the application of aeroplanes or side pieces performing the functions of bilge keels, or by other means, and, secondly, the great difficulty attaching to the ellipsoidal balloon as compared with the typical one of spherical or more strictly pear-shaped form, in that the former tends to revert to the spherical shape as soon as it is somewhat deflated, while the latter better preserves its natural form in shrinking.

A WRITER in the *Dumfries and Galloway Standard and Advertiser* (February 12) directs attention to a curious anticipation of a magnetic means of communication contained in the following paragraph from the *Spectator* of December 6, 1797:—"Strada, in one of his prolusions, gives an account of a chimerical correspondence between two friends by the help of a certain loadstone, which had such virtue in it that if it touched two several needles, when one of the needles so touched began to move, the other, though at never so great a distance, moved at the same time, and in the same manner. He tells us that the two friends, being each of them possessed of one of these needles, made a kind of a dial plate, inscribing it with the four and twenty letters, in the same manner as the hours of the day are marked upon the ordinary dial plate. They then fixed one of the needles on each side of these plates in such a manner that it could move round without impediment so as to touch any of the four and twenty letters. Upon their separating from one another into different countries, they agreed to withdraw themselves punctually into their closets at a certain hour of the day, and to converse with one another by means of this their invention. Accordingly, when they were some hundreds of mile

asunder, each of them shut himself up in his closet at the time appointed and immediately cast his eyes upon his dial plate. If he had a mind to write anything to his friend, he directed his needle to every letter that formed the words which he had occasion for, making a little pause at the end of every word or sentence to avoid confusion. The friend, in the meanwhile, saw his own sympathetic needle moving of itself to every letter which that of his correspondent pointed at. By this means they talked together across a whole continent, and conveyed their thoughts to one another in an instant over cities or mountains, seas or deserts."

PROF. A. AGASSIZ and his party have returned to Colombo, after spending a few weeks in the exploration of the Maldives. From the *Ceylon Observer* we learn that about three hundred photographs were taken, principally of coral-reef subjects. The principal work done was the sounding of the channels between the lagoons and the development of the plateau on which the atolls of the Maldives have been formed. The principal atolls are separated by comparatively shallow water in the central part of the group, while towards the south, between Hadumati and Suvadiva and Addu, the depths are very much greater—nearer a thousand fathoms. A line was run to the westward of Ari Atoll into fifteen hundred fathoms, and one to the southward of South Male into twelve hundred fathoms, showing that the plateau of the Maldives is much steeper on the west than on the east face. Soundings were also taken between the northern Maldives and Colombo, and they show that the Maldives are separated from the Indian continental slope by a deep bank of the ocean of more than fifteen hundred fathoms in depth. The atolls of the Maldives are said to exhibit the most simple and primitive conditions for the formation of atolls which are found anywhere except in some parts of the Yucatan plateau in the West Indies. Atolls can be found in all stages of growth, from a mere bank rising to a few feet above the plateau to banks within five or six fathoms from the surface or to banks which have just reached the surface and on which sandbanks or islets are beginning to forms. Prof. Agassiz says that one reason for the success of his expedition is that the charts published more than seventy years ago are as accurate to-day as they were then. The only changes noticed were changes such as the washing away of banks or the formation of banks since the charts were published; but these are changes without any special importance.

WE have received the Report of the Meteorological Commission of the Cape of Good Hope for the year 1900. The Commission has had to contend with considerable difficulty owing to the irruption of hostile bands into Cape Colony and the wanton destruction of many instruments. Nevertheless, it is able to report that the interest shown in the subject both by observers and the general public continues to grow, and that observations have been restarted at Johannesburg and Kimberley. Compared with the previous year, there has been a considerable increase in the number of observers, especially at rain-gauge stations, which now number 447. An investigation is being made into the connection between the weather and the plague in Cape Town. The result goes to show that each marked rise in temperature was followed in a period of from ten to fourteen days by an increase in the number of plague cases. The Commission has also taken up the investigation of ocean currents with the cooperation of the Union-Castle Steam-ship Company, whose captains are instructed to throw bottles overboard at fourteen different points along the coast. Among various papers which have recently been read before the South African Philosophical Society may be mentioned one of especial interest on some periodical changes in the rainfall at the Royal Observatory, since 1841, by Prof. J. T. Morrison, in which evidence is shown of two prevailing periodicities running simultaneously through the monthly amounts, and completing themselves in ten years and in slightly over nine years respectively. The author also finds a well-marked periodicity of about sixty years, but its exact period has not yet been determined.

THE Meteorological Office pilot chart of the North Atlantic and Mediterranean for the month of March states that, although there is a general diminution in the strength of the winds at this season, gales are still of frequent occurrence, especially on the western half of the ocean, where, over a considerable area, the frequency is from 25 to 36 per cent. This locality is indicated on the inset chart of mean barometric pressure by a closing up of the isobars. The prevalent north-easterly winds in the neighbourhood of the British Isles are associated with the dipping of the isobars south-eastwards towards Spain. On the Gulf of Mexico the "northers" are becoming less frequent, but they undergo certain important modifications. They are shorter in duration and are accompanied by finer weather, but they blow with greater violence during the first twenty-four hours of their continuance and draw less to the north-east. Fog on the Banks having reached its minimum in February is now spreading east and west, and mariners are cautioned against hugging the coasts of the United States during the prevalence of east winds, and particularly gales, as the low shores are then hidden in fog. Two inset charts are given to illustrate the north-easterly type of weather over western Europe, one being the blizzard of March, 1891, when many of our southern counties were buried deep under snow. One result of the presence of these spring north-east winds is seen in their marked influence on the currents. Not only is there a south-westerly set traceable from the Channel soundings, but even northward of the 50th parallel there is a westerly flow to about 22° W., where it curves to southward and south-eastward and merges in the south-westerly set near the 40th parallel. The Gulf Stream water is thus kept away from our south-western shores at this season, but out on the ocean its flow can be traced north-eastward to the neighbourhood of Rockall. No ice appears to have been reported since the early part of December.

THE issue of the pilot chart referred to in the foregoing note completes the series for a whole year, and investigators have now at their service a most valuable summary of the salient features of the various elements month by month. The circulation of the ocean waters will attract most attention, because the currents of the Atlantic have never before been published for each of the twelve months, and as the results here given are based on observations extending over the very long period of sixty-five years, they are as complete as can be hoped for. Commander Hepworth has been singularly successful in his selections of weather types and other matter for the several months, many of them being justified in the course of the period covered, such, for instance, as the northerlies in May, the summer thunderstorms, the September hurricane near the Cape Verde Islands, the recent exceptionally high barometer (31·11 in.), and the dust storm off north-west Africa in January, &c. Reports from different parts of western Europe indicate very clearly that the sand precipitated in South Wales and the south-west of England on January 22 and 23 had travelled northward from the sandstorm experienced about the Canaries and Madeira on the 17th and 18th, when an easterly gale was blowing from the African mainland.

SO comparatively easy has it now become to obtain good photographs by means of flashlight that pictures of places situated under the level of the earth's surface are not uncommon. So interesting are some of these underground passages, caves and grottoes, and so great is the chance that as time goes on they will undoubtedly be

deprived of their natural charms, it seems only right that their features should be at once rendered permanent by means of photography and kept as records for future generations. As pointed out in the current number of the *British Journal of Photography* (February 14), we have not necessarily to leave our own country in search of such subterranean cavities, for we have in Yorkshire, Derbyshire, Thanet and other parts of the country grottoes which are well worth seeing and photographing. Why, then, should not these British caves be treated in the same way as has recently been done for the famous grotto of Han? This subterranean paradise, as it has been called, has lately been photographed with great success and the pictures published in a booklet entitled "The Wonders of the Grotto of Han." In some cases, magnesium light was used as an illuminant, while in others the electric light which adorns the principal galleries of the cavern was sufficient. Even if it were impossible to get sufficient light for such dark interiors by flash, the above-mentioned journal suggests that there is no reason why a time exposure should not be made, making use of a pyrotechnic composition with magnesium or aluminium as its base.

MESSRS. W. M. MORDEY and B. M. Jenkin, in their paper on electrical traction on railways, which was read before the Institution of Civil Engineers last week, dealt with the relative merits of direct-current, alternate-current and composite systems. The present time is opportune for such a paper, as the electrification of some of the larger railways is being more or less seriously discussed. In this country, as the recent Inner Circle arbitration showed, direct-current driving is favoured, the system being generally a composite one, with generation of alternating current at high voltage and conversion to direct-current at 500 volts at substations. On the Continent, as the authors pointed out, there is a tendency to work out the more difficult problems in traction work by the use of three-phase alternating current for both transmission and driving. After summing up the requirements that should be met by any general system of electrical railway working, the authors concluded that the distribution of power is best effected by single-phase alternating current. The Ward Leonard system of utilising such current was then discussed in detail; by this the current is supplied to a single-phase motor on the train which drives a dynamo, which in turn drives the direct-current train motor. This method, though it appears complex, is, they consider, the one best satisfying all the conditions for a general electric traction system.

MR. W. L. SCLATER'S illustrated notice of that remarkable bird, the ground-hornbill (*Bucorax cafer*) of South Africa, which appears in the February issue of the *Zoologist*, will be read with interest by ornithologists. These birds, which are generally seen in the open, live entirely on the ground, and wander about in parties of five or six. It is believed that several females lay in the same nest, which is situated in a hole high up in the stem of a tree.

TO the *Revue générale des Sciences* for September 15, Prof. A. Forel contributes a long article on the psychic faculties of insects. According to the author, these creatures are certainly endowed with four senses, namely sight, smell, taste and touch, the possession of hearing being doubtful. Some writers attribute to them a "photodermatic" sense, but this is merely a modification of touch. After describing the location of each of these senses, the author proceeds to discuss the powers of perception, volition and "sentiment" possessed by insects, concluding with a comparison between their intellect and that of man.

THE February number of the *Zoologist* contains Mr. T. Southwell's account of sealing and whaling for the past year. For the first time for an unknown period, no British whaler visited the sea between Greenland and Spitzbergen. Davis Strait, on the other hand, was visited by several vessels, and whales were by no means scarce, although, owing to bad weather, captures were not numerous and two whales were lost after being killed. One whale with whalebone close on twelve feet long was secured. The price of whalebone during the season was 1450*l.* per ton, but it is now said that 2000*l.* is being asked. The Newfoundland sealing was fairly successful, and was remarkable for the early date at which the vessels completed their cargoes. The Gulf sealing, on the contrary, was a practical failure.

AN influential committee has been appointed to promote a "nature-study" exhibition to be held in London about the end of July. It is suggested that the exhibition should be open to urban and rural elementary day schools, continuation schools, higher-grade schools (boys and girls), Home Office schools, secondary schools (boys and girls), and other institutions and colleges, and that prizes or certificates should be offered in each class for (1) The best collection of common dried plants, injurious insects, &c., apparatus for class lessons, drawings made in class of natural objects, home-made maps with a school as centre, showing features of interest within a radius of two or three miles of the school, note-books, natural history calendars, plans of gardens, photographs, models in clay or plasticine of natural objects, plants grown in boxes and pots, and rustic carpentry. Schools would not be restricted to these exhibits, nor would they be required to send all of them. Teachers would use their own discretion in sending what they believe will most fully illustrate their courses in "nature-study." Specimens of rare plants would not be asked for, and the uprooting of any plant would be especially forbidden. (2) The best individual exhibit of one pupil's work. (3) The best scheme of instruction and descriptive account of work, methods, &c. There should be no difficulty in obtaining the necessary funds for such an excellent object.

THE discourse on "The Discovery of the Future," delivered at the Royal Institution on January 24 by Mr. H. G. Wells, and printed in our issue of February 6, has been published in book form by Mr. T. Fisher Unwin.

MR. W. A. SHENSTONE'S little book on "The Methods of Glass Blowing" (Longmans, Green and Co.) is favourably known to all who have cultivated the art for the purposes of constructing physical and chemical apparatus and accessories. The practical hints on glass-blowing contained in the book are the result of long practice at the blow-pipe, and experience of the requirements of laboratories. The fourth edition of the book, which has just been published, contains a new chapter in which Mr. Shenstone describes the methods of working silica in the oxy-gas flame, a subject to which he has given particular attention.

THE presidential address delivered at the Philadelphia meeting of the Chemical Society by Prof. F. W. Clarke appears in a recent number of *Science*. The address deals with the development of chemistry, and is an interesting discussion of the progress and prospects of chemical science. Prof. Clarke considers that the chief need of chemistry at the present time is the better organisation of research. Whilst fully appreciating the great work that is done by individuals working independently in the field of science, he thinks that collaboration and systematisation are urgently required. He maintains that either by public expense or by private enterprise, laboratories for research should be established in all civilised countries. By conference between them, the work should be so adjusted as to avoid repetition, each one reinforcing the others. Their primary function should be to perform the drudgery of science, to undertake the tedious, laborious, elaborate investigation

from which the solitary worker shrinks, but which are, nevertheless, essential to the development of chemistry. Brilliant discoveries might be made in them, but incidentally, and not as their main purpose.

THE table of atomic weights issued annually by the international committee appears in the January number of the *Berichte*, and the table, based upon oxygen = 16, is unaccompanied by the didactic table with hydrogen = 1. The withdrawal of the didactic table is in accordance with a widely expressed wish. It is generally felt that if oxygen is to be taken as 16 for any purpose it should be taken as 16 for all purposes. Discussing this subject in a paper recently contributed to the American Society of Sciences and Arts, Prof. Richards made a strong appeal to chemists to conform to the decision of the international committee. He pointed out that oxygen has actually served as the experimental standard of reference in a great majority of cases, that the great bulk of valuable work has already been published on the basis oxygen = 16·000, and that the use of this standard involves no important didactic difficulties. He contends that the decision of the representatives of the international committee is in itself an important reason for adopting this standard, and that uniformity of usage is more important than any of the special advantages claimed by either side in the discussion. The only alterations of atomic weights in this year's table are of calcium from 40 to 40·1, iron from 56 to 55·9, and tellurium from 127 to 127·6.

THE additions to the Zoological Society's Gardens during the past week include two Guinea Baboons (*Cynocephalus sphinx*), a Red-footed Ground Squirrel (*Xerus erythropus*) from West Africa, presented by Captain R. H. Wilford; a Snow Leopard (*Felis uncia*) from Northern India, presented by Captain H. Nicholl; two Half-collared Turtle Doves (*Turtur semitorquatus*) from West Africa, presented by Captain Thorne; a Ring-necked Pheasant (*Phasianus torquatus*) from China, presented by Mr. B. Tufnell; seven Black-headed Gulls (*Larus ridibundus*), a Common Gull (*Larus canus*), European, presented by Mr. E. J. W. Eldred; a Green Monkey (*Cercopithecus callitrichus*), an Erxleben's Monkey (*Cercopithecus erxlebeni*), eight West African Love-Birds (*Agapornis pullaria*) from West Africa, a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, a Levaillant's Amazon (*Chrysotis levaillanti*) from Mexico, ten Common Toads (*Bufo vulgaris*), European, a Loggerhead Turtle (*Thalassochelys caretta*) from Tropical Seas.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MARCH.

Mar. 3. 22h. Vesta in conjunction with the moon. Vesta 0° 35′ S.
5. 15h. Saturn in conjunction with the moon. Saturn 5° 1′ S.
6. 14h. Jupiter in conjunction with the moon. Jupiter 5° 41′ S.
7. 7h. Venus in conjunction with the moon. Venus 2° 11′ N.
12. 10h. 12m. Minimum of Algol (β Persei).
15. 7h. 1m. Minimum of Algol (β Persei).
15. Venus. Illuminated portion of disc = 0·198, Mars = 1·000.
17. 2h. 0m. Mercury at greatest elongation (27° 41′ W.).
17. 9h. 19m. to 10h. 16m. Moon occults 26 Geminorum (mag. 5·1).
18. 5h. 48m. to 6h. 14m. Moon occults 68 Geminorum (mag. 5·0).
18. 15h. 19m. to 18h. 58m. Transit of Jupiter's Sat. III.
20. 8h. 27m. to 9h. 43m. Moon occults ω Leonis (mag. 5·6).
20. 19h. 0m. Venus at maximum brilliancy.
Mar. 21. 1h. 0m. Sun enters Aries. Spring commences.
21. Saturn. Outer minor axis of outer ring = 13″·75.
22. 11h. 19m. to 12h. 24m. Moon occults p^5 Leonis (mag. 5·5).
28. 13h. 41m. to 15h. 0m. Moon occults ν Scorpii (mag. 4·5).
29. 13h. Mars in conjunction with sun.

OBSERVATIONS OF 900 DOUBLE AND MULTIPLE STARS.—The first of the astronomical series of publications from the University of Pennsylvania consists of the measures of 900 double and multiple stars made by Prof. Doolittle with the 18-inch refractor of the Flower Observatory. These observations were made during the period 1897 January 1 and 1900 October 15. In all cases a power of 592 diameters was employed. Twenty-two of the stars are now catalogued for the first time, having been discovered during the observation of neighbouring doubles.

The 18-inch objective is the largest lens made by Brashear up to the present time, and has given every satisfaction, both as to resolving and light-grasping power. The mounting, by Warner and Swasey, is of similar construction to the Lick and Yerkes instruments (*Publications of the University of Pennsylvania, Astronomical Series*, vol. i. part iii.)

OBSERVATIONS OF 194 DOUBLE STARS.—*Bulletin* No. 11 from the Lick Observatory contains a list of observations made by Mr. R. G. Aitken during 1900 and 1901 with the 36-inch and 12-inch refractors. Many of the stars are difficult pairs, and in most cases the 36-inch telescope was employed, with powers ranging from 1000–2400.

RADIO-ACTIVITY AND THE ELECTRON THEORY.[1]

ELECTRONS emanating from radio-active bodies behave like material particles, and are impeded by the molecules of the surrounding medium, in contrast with ether waves, which are not thus affected except by absorption. It is not difficult to put these indications to test. A pair of shallow cells, A B (Fig. 1), 1·5 mm. deep and 25 mm. square, were made by cementing slips of glass to a thick glass plate. The cells were filled to the same depth with a radio-active substance chiefly containing actinium.[2] Over cell A was placed a piece of thick lead pipe, 28 mm. high and 25 mm. internal diameter, to ensure that any emanations from the active substance in A would be confined to the inside of the hollow cylinder. The radio-active substance in B was freely exposed to the air, save for a pillar of lead at C, to support the sensitive film. A sensitive film was laid horizontally over the cylinder and support C. On the film was a plate of glass, and cylinder and film were pressed together by heavy weights. The whole was covered in a light-tight box and put in a dark cupboard.

At the end of forty-eight hours the film was removed and developed. There was a strong action shown over cell A (the one covered by the lead cylinder), but over B, the cell exposed to the air, there was no visible impression. Measured in Mr. Chapman Jones's "Opacity Meter"[3] the results were:—

Image over cylinder—Opacity log.[4] = ·79; Opacity[5] = 6·17.

The experiment was repeated, using the same apparatus, but a different preparation of actinium. In this case the exposure was for seventy-two hours. As before, there was a strong impression over cell A and none over cell B. The figures were:—

Opacity log. = ·89; Opacity = 7·71.

These experiments indicate that the electrons from the radio-active agent, chiefly actinium, partake of the properties of a fog or mist of material particles, capable of diffusing away in the free air like odoriferous particles, when not kept in by a thick metal screen.

A further experiment was now tried with the same apparatus, the agent a strongly active radium and barium bromide. This material being self-luminous, a sheet of black paper was placed

[1] By Sir William Crookes, F.R.S. A Paper read before the Royal Society on February 6.

[2] The body I called Uranium X in my Royal Society paper, May 10, 1900, has since proved to be M. Debierne's Actinium.

[3] *The Photographic Journal*, vol. xx. p. 86, December 21, 1895.

[4] The opacity logarithm represents the density of the image, absolute density being represented by 2·00.

[5] The "opacity" is the whole number corresponding to the "opacity log." The "opacity" is directly proportional to the photographic energy acting on the sensitive surface.

immediately over it, so that nothing but emanations capable of passing through the opaque paper would be subject to experiment. After four hours' exposure in total darkness, the film was developed. A good circular patch was obtained over cell A, and a faint diffused darkening showed over the rest of the film, darker at the spot immediately over cell B, fading away at the sides as the distance became greater. That this action was due to the material in the open cell B, and not to general fog over the plate, was seen by the clearness of the film where covered by the lead, and where shadows were thrown by the lead cylinder and pillar.

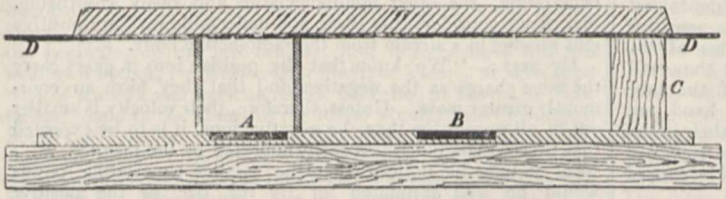

Fig. 1—Elevation.

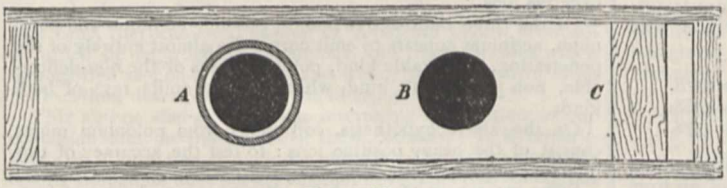

Fig. 1.—Plan.

Circles of the same diameter were drawn round the dark impression over A, and round the darkest part of the impression over cell B. Measurements were taken of different parts of the spaces enclosed in these circles, and the mean of all these came out—

Circle over cell A—Opacity log. = ·53; Opacity = 3·39.
Circle over cell B—Opacity log. = ·32; Opacity = 2·09.
Ratio B/A = ·62.

The experiment was repeated, with the addition of a sheet of aluminium, 0·2 mm. thick, under the black paper, the electrons now having to pass through both paper and metal before reaching the film.

The exposure was for six hours, and the appearance on development was very similar to the last: a dark disc over the protected cell A, and a diffused action over the other part of the film, except in the shadow of the lead supports. Measurements as on the previous occasion gave the following results:—

Circle over cell A—Opacity log. = ·78;
Opacity = 6·03.
Circle over cell B—Opacity log. = ·48;
Opacity = 3·02.
Ratio B/A = ·5.

Finally, I tried polonium subnitrate, which gives off emanations hardly capable of passing through any screen, and greatly obstructed by a few centimetres of air.

The apparatus was substantially the same as the one just described, with the modification that the lead cylinder was 12 mm. high, and at the other end a rod of glass 12 mm. high was used to support the film. The reduced height was chosen, experience showing that polonium emanations have great difficulty in penetrating many millimetres through air. The exposure was seven days, at the end of which time the film was developed. Over cell A a dark disc sharply defined the inside of the cylinder, while over cell B was a hazy diffused patch which to the eye looked much the fainter of the two. But measurements of patch A, and of a disc over cell B of the same size as A, showed that the opacities in each case were practically identical, as shown by the following figures:—

Circle over cell A—Opacity log. = ·74; Opacity = 5·49.
Circle over cell B—Opacity log. = ·76; Opacity = 5·75.
Ratio B/A = 1·05.

A repetition of the experiment, taking the mean of five concordant results, gave the same opacities as before.

Without proving that the emanations from polonium are less material than those from actinium and radium, this experiment shows that their behaviour is entirely different as regards diffusibility through air. Whether this is due to the larger mass of the individual particles, or to the less distance they have to travel (12 mm. as against 28 mm. in the case of actinium and radium), or to some other cause, further experiments must decide.

Dr. Rutherford shows that air which has remained for some time in the neighbourhood of thoria and then is carried in a current to a distance retains its property of communicating radio-activity to other bodies. He explains these phenomena by supposing that thoria gives off a special kind of emanation capable of being conveyed by the air, and that this is the cause of the induced radio-activity.

To ascertain if the electrons or corpuscles from radium also possess the property of being carried along in a current of air I fitted up an apparatus shown in Fig. 2. A, B, and C are three brass tubes closed at the lower end and cemented with paraffin to a wooden block. The upper ends were accurately ground to a level surface and then coated with a thin layer of paraffin wax. Holes were drilled in B and C, to admit glass tubes, cemented air-tight into the cylinders, as shown in the figure. The upper end of the tube in B was closed with a plug of cotton-wool, and the outer end in C was connected to a water-pump, so that when the cylinders were closed at the top a current of air was drawn through B and C. As the radium compound was self-luminous, discs of thin aluminium foil were placed over cylinders A and B to cut off the luminous rays. A sensitive film was laid on the three cylinders over the aluminium, and it was tightly pressed down by a heavy weight, the contact between the film and the tops of the cylinders being sufficient to make the whole air tight. At the bottom of A and B a radium compound was placed, equal weights and equal surface in each. The whole

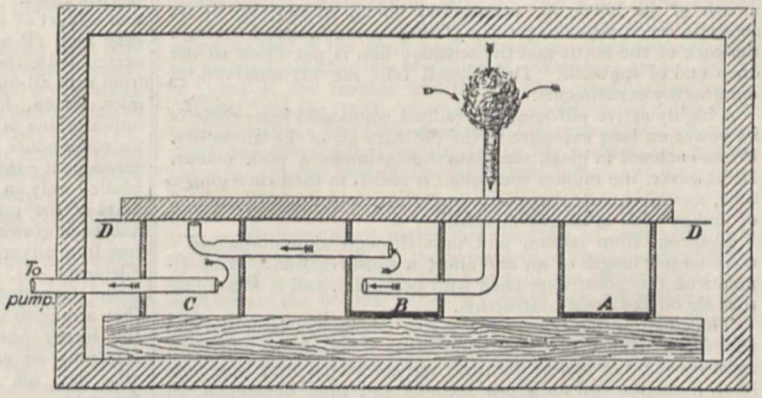

FIG. 2.—Elevation.

was put into a light-tight box, and air drawn through. The cylinder A was used only as a standard. The air passing into B was expected to carry along with it some of the corpuscles emitted from the active material at the bottom; and the inlet tube in C was turned up at the end, so that the stream of corpuscles-laden air should impinge on the surface of the centre of the film on C, and if it carried with it any radio-active properties the result should be seen on development, by the production of a dark patch. If, however, the air carried no corpuscles, there would be no image on the sensitive film over C.

The experiment was continued for eleven hours, 120 litres of air having passed through in the time.

On development and measuring the resulting images, the following figures were obtained :—

Circle over cell A—Opacity log. = ·342 ; Opacity = 2·20.
Circle over cell B—Opacity log. = ·178 ; Opacity = 1·51.
Circle over cell C—Opacity log. = ·025 ; Opacity = ·11.
Ratio B/A = ·68.

It thus appears that a current of air passed over the surface of a radium compound carries with it a certain proportion of the corpuscles. This is proved by the diminished photographic action in the second cell, slightly confirmed by the evidence that some few of the corpuscles so carried away get to the sensitive film on cell C. Judging from our slender knowledge of the properties of free electrons, it is highly probable that they will not easily turn a corner, but cling to the sides of the tube through which they are being led. On the other hand, the constant collisions with the atoms of air may reduce their initial mobility almost to a vanishing point before they have travelled along the tube between B and C, and then they would be carried along with the air.

The experiment was repeated, using a preparation of actinium (Uranium X). It was kept going for seventy-two hours, during which time 750 litres of air were drawn through the apparatus. On development and measurement, the following results were obtained :—

Circle over cell A—Opacity log. = ·99 ; Opacity = 9·78.
Circle over cell B—Opacity log. = ·67 ; Opacity = 4·68.
Circle over cell C—Opacity log. = ·25 ; Opacity = 1·78.

Here then the results agree with those tried with radium compounds ; that corpuscles are carried by a current of air from cell B, through the connecting tube to cell C. They also confirm those of Dr. Rutherford—who finds that thorium emanations travel in a current of air while retaining their activity—and of P. Curie and A. Debierne, who show that induced radio-activity can be transmitted through capillary tubes, of an internal diameter of ·1 mm. and 75 cm. in length, bent once at right angles.

I have not obtained, however, a similar result with the emanations from hydrogen peroxide. As shown by Dr. Russell, this substance has a strong action on a sensitive photographic plate. The emanation from a bottle half full of hydrogen peroxide acts strongly on a sensitive film laid over the open mouth of the bottle for twenty-four hours, while there is no action in seventy-two hours if a U-shaped tube passed through the cork of the bottle and the sensitive film is put close to the open end of the tube. Dr. Russell tells me his observations confirm my experiments.

A highly active self-luminous radium compound loses some of its power on long exposure to the ordinary air of the laboratory. When enclosed in glass, the glass soon assumes a pink colour. If, however, the radium compound is sealed in vacuo in a *quartz* tube, no coloration takes place, and I can detect no diminution of energy even in twelve months.

Electrons from radium will pass through aluminium and a considerable length of air and affect a sensitive film.[1] Experiments on this point were tried with polonium, and it was found that air offered great obstruction.

The electron theory explains a fact which has long puzzled experimentalists. It is well known that if a coin is laid on a sensitive plate in perfect darkness and connected with one pole of an induction coil for a few seconds and then developed, an image can be obtained of the raised parts of the coin. This has generally been explained by saying that the electrified stream of air, or the "brush discharge," affects the film like light.

But Mr. F. Sanford (NATURE, vol. lv. p. 485) shows that coins embedded in the centre of a block of paraffin 2 cm. thick, where they could not send off streams of electrified air, can still be photographed by means of the induction coil. In these circumstances it is probable that electrons are the agents, as electrons will easily pass through paraffin wax from the coin to the sensitive plate, when the coin is connected with the negative pole of an induction coil, the other pole being connected with a metal plate placed below the wax block.

[1] Using an active compound of radium, I have obtained an impression on a sensitive film, through a penny-piece.

Hitherto we have been dealing with negative electrons—a free positive electron at present is unknown. In a paper communicated to the Royal Society, December, 1890 (*Phil. Trans.*, 1901, A, vol. cxcvi. p. 525), the Hon. R. J. Strutt offers a suggestion as to positive ions which in a satisfactory manner appears to explain much that hitherto has been left doubtful, not to say contradictory.

He adopts the generally recognised theory that the deflectable Becquerel rays consist of a stream of negative corpuscles with enormous velocities proceeding from the radio-active body. But there are two kinds of Becquerel rays, one deflectable and penetrating, the other non-deflectable and easily absorbable. Mr. Strutt considers that these non-deflectable rays are positive ions moving in a stream from the radio-active body.

He says :—"We know that the positive ions in gases carry the same charge as the negative, and that they have an enormously greater mass. Unless, therefore, their velocity is smaller out of all proportion than the negative ions, it is to be expected that they will be much less easily deflected by the magnet. . . . Next it may be noticed that the smaller penetrating power would be well accounted for by the size of the positive ions, which would, of course, make more collisions with the molecules of the surrounding gas than the much smaller negative ions."

Of the three radio-active bodies, radium, actinium and polonium, actinium appears to emit corpuscles almost entirely of the penetrating, deflectable kind, polonium rays of the non-deflectable, non-penetrating kind, whilst radium emits rays of both kinds.

On the above hypothesis, corpuscles from polonium might consist of the heavy positive ions : to test the accuracy of this inference experiments are now in progress.

Some curious and far-reaching inferences may be drawn from Mr. Strutt's view, supposing it to be correct, that positive as well as negative corpuscles will fly off from a radio-active body. In a paper "On Electrical Evaporation" (*Roy. Soc. Proc.*, vol. l. p. 88, June, 1891) I showed that many bodies, such as silver, gold, platinum, &c., usually considered non-volatile at ordinary temperatures, easily volatilise in a vacuum if connected with the negative pole of an induction coil, remaining fixed when connected with the positive pole. This phenomenon was first observed by Dr. Wright, of Yale College, and was applied by him for the production of mirrors for physical apparatus. It is shown by experiments that the action in the vacuum tube is of two kinds. A silver pole was used, and near it, in front, was a sheet of mica with a hole in its centre. The vacuum was very high (P = 0·00068 mm.), and when the poles were connected with the coil, the silver being negative, electrons shot from it in all directions, and passing through the hole in the mica screen, formed a bright phosphorescent patch on the opposite side of the bulb. The action of the coil was continued for some hours, to volatilise a certain portion of the silver. On subsequent examination it was found that silver had been deposited only on the mica screen and in the immediate neighbourhood of the pole, the far end of the bulb, at the spot which had been glowing for hours from the impact of electrons, being free from silver deposit. Here then are two simultaneous actions. Electrons, or, as I once called them, "radiant matter," shot from the negative pole and caused the glass against which they struck to glow with phosphorescent light. Simultaneously the heavy positive ions of silver, freed from their negative electrons, or under the influence of the electrical stress, likewise flew off, and were deposited in the metallic state near the pole.

During the course of my experiments a curious circumstance was observed, which deserves record as it may elucidate some of these obscure phenomena. While the volatilisation of the silver pole is rapidly proceeding, the metal glows as if red-hot. This "red heat" is superficial only. The metal instantly assumes, or loses, the appearance of red-heat the moment the current is turned on or off, showing that the high temperature does not penetrate below the surface. The volatilisation of the positive ions is confined to the surface and the surface glow is connected with that action. If instead of silver, a good conductor of heat, I take diamond, a bad conductor, the surface layers are changed sufficiently to convert them into a form of graphite, which from its great resistance to oxidising agents cannot have been formed at a lower temperature than 3600° C.

THE MILROY LECTURES ON TYPHOID FEVER.

PROF. CORFIELD gave the first of his course of Milroy Lectures on typhoid fever at the Royal College of Physicians on Thursday last.

After an introduction, in which he defended the name typhoid fever as that used by Louis and Jenner, and as being the least objectionable name to give to the disease, and pointing out that the name of enteric fever is a bad one, not only because it gives the name to a general disease from a particular lesion, but because it suggests the false idea that the disease is due to that lesion, he proceeded to give a short history of the subject from the beginning of the last century, first introducing a hitherto unknown author, Dr. Christopher Mayr, of Vienna, an unopened copy of whose Latin work on fevers, published in Vienna in 1806, he had found in the library of the Royal Medical and Chirurgical Society of London. He stated that there is no other copy of this book known in London, whether in the British Museum or anywhere else, and that the leaves had not been separated when he found it. This author gives an admirable classification of fevers into genera and species, the different varieties of typhus forming his second genus, and including typhus fever and the oriental plague, which were confused together until long after that time, the occidental plague or American yellow fever, all of which he regarded as contagious, and three varieties which he regarded as non-contagious and which were evidently, from his excellent description, varieties of typhoid fever.

This author also gave a most interesting disquisition on the contagion and on the causes of these diseases. It is remarkable also to note that he includes phthisis pulmonalis among the fevers, though he does not say whether he regards it as contagious or not.

Dr. Corfield then gave an account of the work and views of MM. Louis, Chomel, Gaultier de Clanbry, Montault, Rochoux, and other French physicians, some of whom considered typhus and typhoid as the same disease and others as different diseases.

After alluding to the work of a number of other investigators, especially Dr. Lombard, of Geneva, and Dr. Shuttuck, of Boston, he gave an account of an important paper, read by Dr H. C. Barlow before the Parisian Medical Society on February 6, 1840, on the distinction between typhus and typhoid fevers. In this paper Dr. Barlow described the differences between the two diseases, and decided positively that they were quite distinct from one another.

Two months after this, Dr. Alexander P. Stewart also read a paper on the same subject before the Parisian Medical Society, but, contrary to the opinion generally held, he did not advance the knowledge of the subject in any way by his paper, and, in fact, did not lead us as far as Dr. Barlow had already done.

The work of Prof. Forget, of Paris, on follicular enteritis (even a worse name for the disease than enteric fever) was next alluded to, it being quite clear that Prof. Forget thoroughly understood what typhoid fever was and that it was a different disease from typhus.

Such was the position when Dr. William Jenner (afterwards Sir William Jenner, Bart., G.C.B., president of the Royal College of Physicians) undertook the investigation of the question. As he had been resident medical officer of the London Fever Hospital, he had had an excellent opportunity, of which he made the best use, of observing cases, both of typhus and typhoid fevers, and in 1849 he published his admirable paper on the identity or non-identity of those diseases. He proved to a demonstration that they were different diseases, and in a subsequent paper also proved that without a doubt their causes were different.

It was reserved, however, for Dr. Charles Murchison, in his able paper read before the Royal Medical and Chirurgical Society of London in 1858, to demonstrate that typhoid fever is caused in some way or other by water, air and soil contaminated with foul organic matters. In his great treatise on the continued fevers of Great Britain, he maintained that the poisons of those diseases were generated *de novo*; that of typhoid fever from decomposing excrement.

In 1873, Dr. William Budd produced his masterly work on the disease, proving that "typhoid fever is in its essence a contagious or self-propagating fever."

Dr. Corfield finally quoted from his own paper, "On the alleged Spontaneous Production of the Poison of Enteric Fever," read before the Epidemiological Society in March, 1874, when he combated the views of Dr. Murchison and maintained that the disease was infectious and had a special poison, which was not generated *de novo*, but was always derived from a previous case of typhoid fever. The correctness of this view has now been established by the discovery of the organism peculiar to the disease.

VESSELS WITH TURBINE MACHINERY.

THE introduction of the Parsons marine steam turbine into practice has extended ever since the time the *Turbinia* showed her marvellous qualities for speed, and was followed by the two torpedo boat destroyers, H.M.S. *Viper* and H.M.S. *Cobra*, which broke all previous records with a speed above 35 knots. The next steamer thus equipped was the *King Edward*, an excursion steamer plying on the Fairlie-Campbeltown route, and being the pioneer vessel belonging to the mercantile marine fitted with turbines, created a considerable interest at the time. The *King Edward* has now undergone a season's running, and (says *Engineering*, January 24) in order thoroughly to test her turbine machinery and coal consumption, data have been tabulated from her and also from the Clyde passenger paddle steamer of the same size named *The Duchess of Hamilton*, thus giving a comparative statement of the two vessels for the "running" throughout the season. The table is as follows:—

Comparative Statement of Speed, Mileage and Coal Consumption of the Paddle Steamer "Duchess of Hamilton" and the S.S. "King Edward."

	Duchess of Hamilton.	*King Edward.*
Total coal	1758 tons 13 cwt.	1429 tons 16 cwt.
Miles run	15,604	12,116
,, per ton	8·87	8·47
Number of days running ...	111	79
Daily average consumption..	15 tons 17 cwt.	18 tons 2 cwt.
Average speed	about 16½ knots	about 18½ knots

On referring to the above table, it will be seen that the figures of coal consumption per mile are satisfactory, and also the data prove a decided victory for the steam turbine over the reciprocating engines, insomuch as although the *King Edward* is by far the faster boat, her consumption of coal per mile is almost as low as that of the *Duchess of Hamilton*. In a previous issue we pointed out that one of the chief advantages gained by the adoption of the turbine was the possible modification in the "model" of the boat, as finer lines could be introduced for speed purposes. The *King Edward* in this respect also, we understand, has given entire satisfaction to her owners, and not unnaturally another boat of the same type, but 21 feet longer and with a speed of 21 knots, is being built, the Parsons Marine Steam Turbine Co. being at present engaged on the machinery.

It is also worthy of notice that the class of craft being built with turbine machinery at the present time comprise three high-speed yachts of large size, one being of the torpedo-boat type with water-tube boilers, so, as is pointed out, the turbines will have every opportunity of appearing at their best. The Parsons Company have also a torpedo-boat destroyer with a similar speed to the *Viper* (not being built to the order of the Admiralty) which we are informed will have a less consumption both in cruising and full speed than any other 30-knot boat in the Navy.

This vessel, which is named the *Velox*, was launched by her builders (hull and boilers), Messrs. R. W. Hawthorn, Leslie and Co., on the Tyne on February 11, and measures 210 ft. long, 21 ft. beam, with a moulded depth of 12 ft. 6 in., and to guard against "buckling" she has been specially "stayed" longitudinally. The *Velox*, to ensure economy at cruising speeds, has fitted in her a novel arrangement of power wherein engines of the ordinary reciprocating type are designed to work in conjunction with, and are coupled direct on to, the steam turbines, the turbines being kept in reserve for the higher speeds only. In considering coal consumption, it will be seen at once that the engine arrangement introduced by Mr. Parsons forms a very important item, because, as in the case of torpedo-boat destroyers, but a small percentage of their steaming is spent on full speed work; and also, as is well known, as all steam engines (steam

turbines included) do not work so economically when running much below the power for which they are designed. For the long periods on which these boats are simply cruising about, the coal consumed is only that of the two small triple compound reciprocating engines, the steam turbines not being utilised, thus reducing their "cruising" coal consumption to a minimum which, when running at full speed, is only increased by the low consumption derived from the use of the steam turbine.

The marine steam turbine, forming, as it does, "one of the most striking developments in the history of marine engineering," is largely adopted by private enterprise; but, as *Engineering* points out, "it is a little surprising that at present no vessel is in progress fitted with turbine machinery and built for the Royal Navy."

MECHANICAL VENTILATORS FOR MINES.[1]

THIS report is the outcome of a large number of experiments conducted under the directions of a strong committee of eminent mining engineers. Its object was to obtain exact information concerning the relative efficiencies of various ventilating fans. In order to make the comparisons of real value, the experiments were restricted to collieries provided with two fans, each of which could be used in turn; the conditions were therefore identical in each case. Only three kinds of fans were compared, viz., the Guibal, the Schiele and the Waddle, with the result that the Guibal decidedly carried off the palm. But, as pointed out in the report, the conclusions arrived at are not beyond criticism, because the efficiencies were determined in each case by taking the ratio between the so-called "useful effect in air" and the indicated horse-power of the steam-engine used for driving the fan, without knowing how much power was consumed in overcoming the inherent resistance of the engine. Some experiments made in Belgium in 1899 were more satisfactory, because this point was taken into consideration. Here it was found that the Rateau fan had a decidedly higher mechanical efficiency than the Guibal.

The Committee has adhered to Murgue's time-honoured method of comparing the resistance of any given mine to that of an orifice in a thin plate. No doubt the idea of an imaginary "equivalent orifice" has served a useful purpose, but a simpler and plainer way of expressing the amount of resistance is that advocated by Hanarte; he reckons the resistance of a mine by the horse-power required to overcome it, and there is much to be said in favour of his proposal to classify mines according to this system.

Long pages crowded with figures bear testimony to the pains taken by the Committee to fulfil its task, and it is interesting to find that its observations afford a verification of the two fundamental formulæ of centrifugal ventilators. Mr. Walton Brown, the indefatigable secretary of the Institution of Mining Engineers, may be fairly congratulated upon the useful report which he has drawn up.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The 233rd meeting of the Junior Scientific Club was held on February 21. Dr. Hedin, of the Jenner Institute of Preventive Medicine, read a paper, chiefly an account of his recent researches, on "The Proteolytic Enzymes of the Animal Body."

MR. T. P. KENT, scholar of Christ Church, Oxford, and assistant master at Cranleigh School, Surrey, has been appointed professor of mathematics at Rondebosch College, Cape Town.

IN view of the date appointed for the coronation of their Majesties, the day examinations of the Board of Education, South Kensington, arranged to be held during the week ending June 28, will be held during the week ending July 5.

AN article on the use of ordnance survey maps in teaching geography, contributed by Sir Archibald Geikie to the February number of the *Geographical Teacher*, directs attention to the invaluable aid to the study of geography which these maps afford. In spite of the fact that the maps are adapted to instruction in the most elementary or the most advanced stages of geography, and are so cheap, they are but rarely used, and the geographical lesson is usually conducted in the unintelligent way with which we are all familiar. Hung upon the wall of the schoolroom, the maps encourage the study of home geography in the pupils, and give them facility in map-reading. Attention may then be directed to the information the maps contain as to the configuration or topographical features of the land, the system of contouring, and the method of plotting profiles or sections across a piece of ground. The teacher can then pass to the intelligent consideration of the causes of the varying physical features of the land, using for this purpose the maps of the Geological Survey, or can derive lessons on the influence of physical features upon the history and progress of the inhabitants of a country. Many other similar uses can be made of the maps, and by adopting them geography may be made a scientific study instead of a jumble of words, figures and phrases. It is to be hoped that Sir Archibald Geikie's paper will be read by every teacher who desires to make the geography lesson a means of cultivating the intelligence. Another paper in the *Geographical Teacher* which will assist this object is by Mr. A. M. Davies, on the geography of Greater London. Mr. James Bryce's address on the importance of geography in education, delivered at the recent annual meeting of the Geographical Association and already noticed (p. 284), appears in the same number of the magazine.

A REPORT of the discussion on reform in the teaching of mathematics, which took place at the meeting of the Mathematical Association on January 18, is published in the *Mathematical Gazette*. Prof. A. Lodge opened the discussion with a paper in which he advocated the introduction of a course of geometry similar to that taken in French schools. The chief points in the French text-books which he desired to see introduced are:—(1) The more orderly arrangement of propositions; (2) the entire separation of theorems from problems of construction, hypothetical constructions being used in proving a theorem; (3) the closer association of a proposition and its converse when both are true; (4) the adoption of arithmetical notions and algebraic processes; (5) the early introduction of simple loci; (6) insistence on accurate figures drawn by accurate and practical processes; (7) practice in exercises from the very beginning. In the subsequent discussion, Prof. G. M. Minchin, F.R.S., gave instances of the failure of boys to understand Euclid's language and methods, and also described desirable reforms in the teaching and nomenclature of dynamics and hydrostatics. The discussion was, however, mainly concerned with the teaching of geometry, and the general opinion of the speakers was that demonstrative geometry should be preceded by a course of work with ruler, compasses and protractor, in which simple measurements and constructions formed the chief part. This has been done for many years in Scottish schools and also in some elementary schools in England. One speaker expressed his surprise at the amount of work that could be done with a pencil, ruler, a pair of scissors and a piece of paper, and others referred to the value of illustrations of geometrical truths obtained with similar materials. It seems, however, to have been overlooked that this work has long been part of kindergarten teaching.

SCIENTIFIC SERIAL.

American Journal of Science, February.—On geometric sequences of the coronas of cloudy condensation, and on the contrast of axial and coronal colours, by C. Barus.—On a new occurrence of sperrylite, by H. L. Wells and S. L. Penfield. A minute quantity of sperrylite, platinum arsenide, was found in a specimen of platiniferous copper ore from the Rambler Mine, Medicine Bow Mountains. Platinum is found in ores from all parts of the mine in quantities varying from ·06 to 1·4 ounces per ton.—A cosmic cycle, by F. W. Very.—Studies of Eocene mammalia in the Marsh collection, Peabody Museum, by J. L. Wortman. The present instalment deals chiefly with *Patriofelis ferox*, and contains a detailed criticism of the views recently expressed by H. F. Osborn.—On a miniature anemometer for stationary sound waves, by B. Davis. By sufficiently reducing the dimensions of the cups and vanes in the ordinary anemometer, it was found possible to determine the relation between the amplitude of vibration and the rate of rotation in

[1] Report of the Committee of the North of England Institute of Mining and Mechanical Engineers, and the Midland Institute of Mining, Civil and Mechanical Engineers. By Mrs. M. Walton Brown. *Transactions of the Institution of Mining Engineers* (vol. xvii. pp. 96+xvii plates).

a stopped organ pipe giving its first overtone. The cups used varied in size from 7·5 mm. to 4·5 mm., and the lengths of the arms from 20 mm. to 8 mm. The curves found correspond closely to the sine curves near the middle of the loop where the amplitudes of vibration have considerable magnitude.—The occurrence of fossil remains of mammals in the interior of the states of Pernambuco and Alagoas, Brazil, by J. C. Branner.—The estimation of copper as cuprous sulphocyanide in the presence of tin, antimony, arsenic and bismuth, by R. G. van Name. The accurate estimation of copper in the presence of the above-named metals was found to be practicable provided that certain precautions were taken as to the amount of free acid, ammonium bisulphite and sulphocyanide used.—The composition of yttrialite, with a criticism of the formula assigned to thalenite, by W. F. Hillebrand. The empirical formula of Hidden and Mackintosh for yttrialite is confirmed. The formula proposed by Benedicks for thalenite is to be regarded as doubtful.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Astronomical Society, February 14.—Anniversary Meeting.—Dr. J. W. L. Glaisher, F.R.S., president, in the chair.—The secretaries read the annual report of the council, containing obituary notices of deceased fellows and associates, reports of the work of observatories in Great Britain and Ireland and the Colonies, and notes on the progress of astronomy during the past year.—The president announced that the council had awarded the Society's gold medal to Prof. J. C. Kapteyn, of Groningen, Holland, for his work in connection with the Cape Photographic Durchmusterung and his researches on stellar distribution and parallax. The president delivered an address, setting forth the grounds upon which the award had been made. The address dealt chiefly with Prof. Kapteyn's great work in measuring and reducing the stellar photographs taken at the Royal Observatory, Cape of Good Hope, and in preparing the catalogue, which had been completed and published, forming three volumes of the *Annals* of the Cape Observatory. The actual photographing of the plates was begun by Dr. (now Sir David) Gill in 1886 and finished in 1890. Prof. Kapteyn spontaneously undertook the great work of measurement and reduction and the formation of the catalogue—a labour which occupied him more than twelve years. The catalogue contained 454,875 stars down to about the 9·5 magnitude, from −18° to the South Pole.—The president presented the gold medal to Prof. Kapteyn.—He also presented the Jackson-Gwilt bronze medal to the Rev. Thos. D. Anderson, for his discoveries of Nova Aurigæ and Nova Persei.

Entomological Society, February 5.—The Rev. Canon Fowler, president, in the chair.—The president announced the appointment of Mr. F. D. Godman, F.R.S., Prof. E. B. Poulton, F.R.S., and Dr. D. Sharp, F.R.S., as vice-presidents for the session.—Prof. Poulton exhibited with lantern a series of slides belonging to Prof. Meldola, made from actual specimens by the three-colour process, illustrative of mimicry in British and exotic Lepidoptera and Hymenoptera. He also exhibited the several specimens from which the lantern slides had been prepared.—Mr. C. G. Barrett exhibited a series of the perfect insect of *Glottula fusca*, Hpsn., together with ears of maize (locally called mealies), showing the damage done by the well-grown larva of the species, which lives in the first place in the stem, eating the pith from the ground, and afterwards attacking the cobs, and eating from the inside into the bases of the unripe grains, which then change colour and shrivel up. He also exhibited specimens and figures to illustrate the life histories of South African Heterocera, received from Miss Frances Barrett, Buntingville, Transkei, South Africa.—Mr. W. L. Distant exhibited two specimens of Coleoptera which he received alive from the Transvaal—one *Anthia thoracica*, Thunb., now dead, the other *Brachycerus granosus*, Gyll., still living. These insects had been sent him by Mr. Robert Service, of Dumfries, who received them from Sergt. Peter Dunn, of the volunteer company of the Scottish Borderers. The genus Anthia extends to the southern Palæarctic region, and there seems little doubt that these species could be easily acclimatised there. All they require at home is the run of a good palm or orchid house.—Mr. R. Adkin exhibited a series of *Acidalia aversata*. The parent moth (a banded female, the male parent not being known) was taken at Lewisham in June, 1900. Of the resulting larvæ, about one-half fed-up rapidly and produced imagines in the autumn of the same year—a very unusual circumstance; the remainder hibernated and produced imagines in June of the following year, thus occupying the normal time in completing their metamorphoses. The proportion of individuals following the female parent in the two portions of the brood was almost equal.—Mr. G. C. Champion exhibited long series of *Leptura stragulata*, Germ., and *Strangalia pubescens*, Fabr., from the pine-forests of Aragon and Castile, showing the great variation in colour of the two species in these districts, whereas the allied forms occurring in the same places, viz. *L. rubra*, Linn., *L. distigma*, Charp., *L. unipunctata*, Fabr. and *L. sanguinolenta*, Linn., were perfectly constant; also *Dermestes aurichalceus*, Küst., which he and Dr. Chapman had found everywhere in abundance in the old nests of the processionary-moth (*Cnethocampa processionea*, Linn.) on the pines in these forests.—Dr. T. A. Chapman exhibited in illustration of his paper, on a new subfamily of Pyralidæ, living larvæ of *Hypotia corticalis*, Schiff, as well as preserved larvæ, pupa-cases, imagines, and prepared wings to show the neuration of that species.—Mr. Edward Meyrick communicated descriptions of new Australasian Lepidoptera.—Mr. W. F. Kirby communicated a Report on a collection of African Locustidæ, chiefly from the Transvaal, made by Mr. W. L. Distant.

Geological Society, February 5.—Mr. J. J. H. Teall, V.P.R.S., president, in the chair.—The matrix of the Suffolk Chalky Boulder-Clay, by the Rev. Edwin Hill. The author has been examining with the microscope washed residues from Boulder-Clays. He is able to group together the specimens from localities along a belt of country from Lowestoft to Bury St. Edmunds, as containing granules of Secondary clays and limestones. Other specimens contain granules which may be the same kind decomposed, others granules of other kinds; all these lie outside the belt occupied by the group, though some are very near it. The results lead to the conclusion that the materials of the matrix in the Suffolk Chalky Boulder-Clay were not brought from the east or north, but from inland, and not from so far inland as the Coalfields. Their sources therefore lie on a limited belt, bordering the Boulder-Clay area.—On the relation of certain breccias to the physical geography of their age, by Prof. T. G. Bonney, F.R.S. The author has endeavoured in this paper to collect from published accounts and his own observations the evidence which certain well-known and important beds of breccia afford as to the physical conditions prevalent when they were formed. Reasons are given for concluding that the Rothliegende (and probably the Triassic) breccias are indicative of a continental climate, due to a great extension of land or more probably the existence of a mountain-region on the west—winters with severe cold and snow, but rather hot and arid summers. The Caithness breccias are perhaps more analogous to the stone-rivers of the Falkland Islands, but they also indicate a rather low temperature; while the Flysch-breccias land us in the following dilemma, namely, that either similar temperatures existed in Switzerland, and that there was also an important highland district, of which no remnant can be found, within a short distance of the breccia-beds, or they must be the product of a range not inferior to the present Alps, which also has completely disappeared, and would be (for reasons given) very difficult to locate. But, even in the latter case, it must be admitted that a temperature if not lower, at any rate not higher than the present, prevailed in central Europe late in the Eocene period.

Zoological Society, February 4.—Prof. G. B. Howes, F.R.S., vice-president, in the chair.—Dr. Chalmers Mitchell read, on behalf of Mr. E. Degen, a paper entitled "Ecdysis, as Morphological Evidence of the original Tetradactyle Feathering of the Bird's Fore-limb, based specially on the Perennial Moult of *Gymnorhina tibicen*." The material on which the paper was based consisted of a large series of specimens of the Gymnorhina obtained at regular intervals throughout the moulting-period, and the author had thus been able to give a very complete account of the perennial replacement of the feathers, avoiding the errors due to observations on the altered habits as produced by captivity. The author showed that the moulting of the wing-feathers took place in definite groups, and indicated a composite origin of the modern feathering.—A communication from Prof. W. Blaxland Benham contained some notes on the osteology of

the short-nosed sperm-whale (*Cogia breviceps*), based on an examination of a specimen which had been washed ashore on the coast of Otago, New Zealand. The soft parts of the same specimen had formed the subject of a paper presented to the Society by the same author in May of last year.—Two additional papers on the results of the "Skeat Expedition" to the Malay Peninsula were read. The first, by Mr. F. F. Laidlaw, gave an account of the dragon-flies (with the exception of Agrioninæ) collected, and a list of all other species that had previously been known from the Peninsula. One new genus, Climacobasis, and twelve new species were described. The second paper, by Mr. W. E. Collinge, contained an account of the collection of non-operculate land and fresh-water mollusca made by the expedition, and included descriptions of three new genera (Apoparmarion, Paraparmarion and Cryptosemelus) and eight new species, besides contributions to the anatomy of certain species. Descriptions of three species of Prisma in the British Museum collection, one of which, *P. smithi*, was new, were also included in the paper.—A communication from Mr. W. F. Kirby contained a list of twenty-three species of Orthoptera, of which specimens were contained in a collection made by Sir Harry Johnston, K.C.B., in the Uganda Protectorate.

Mathematical Society, February 14.—Dr. E. W. Hobson, F.R.S., president, in the chair.—Prof. Lamb read a paper on Boussinesq's problem. The problem is to determine the strain produced at any point of a semi-infinite elastic solid, with a plane boundary, by the application of pressure to its surface; the solution is obtained in a straightforward manner by the use of Bessel's functions.—Mr. A. Young read a paper on quantitative substitutional analysis. This paper is a continuation of a previous one, published in *Proceedings*, vol. xxxiii., in which the conditions that a function of several variables may be unaltered by particular substitutions, belonging to particular groups, were applied to the development of relations between the concomitants of quantics.—Prof. Love explained a new proof of a well-known theorem concerning zonal harmonics.—The following papers were communicated by the president:—Dr. H. F. Baker, elementary proof of a theorem for functions of several variables. The theorem is that, if an ordinary power series in any number of variables does not vanish for zero values of the variables, the inverse of the series can be expanded in a converging series; it is proved also that the range of convergence of the new series is the same as that of the original series, provided that no zero of the latter is contained in this range.—Mr. T. J. I'A. Bromwich, note on the wave surface of a dynamical medium æolotropic in all respects. The kinetic energy of the medium is taken to be a homogeneous quadratic function of the component velocities, and the potential energy is taken to be a similar function of the components of strain and rotation; the equations of motion are deduced from the Hamiltonian principle, and the form of the general wave surface is obtained without having recourse to the methods of vector-analysis.—Prof. A. C. Dixon, on plane cubics. This note contains some further developments of the theory of corresponding points on a cubic, as given by Salmon, and the closely connected theory of three conics.—Mr. W. H. Young, (1) on the density of linear sets of points, (2) on closed sets of points defined as the limit of a sequence of sets of points. The first paper deals with the distinction between sets of points which are everywhere dense and sets which have the property that every point is a limiting point on both sides; the distinction is of great importance in the application of the theory of sets of points to questions concerning functions of real variables; illustrative examples are given. The second paper deals with the geometrical connection between a set of given rank, in a countably infinite number of closed sets, and the corresponding limiting set; the relation between the content of each set of the countably infinite number and the content of the limiting set is discussed in detail.

Royal Meteorological Society, February 19.—Mr. W. H. Dines, president, in the chair.—Mr. E. Mawley submitted his report on the phenological observations for the year 1901. He showed that as affecting vegetation the weather was chiefly remarkable for the scanty rainfall during the growing period of the year. The deficiency was not confined to any part of the British Isles, but was more keenly felt in the English counties than in either Scotland or Ireland. Wild plants came into flower very late, but not quite as late as in the previous phenological year, which was an exceptionally backward one. The swallow, cuckoo and other spring migrants were, as a rule, rather behind their usual dates in reaching these islands. The crops of wheat, barley and oats were all more or less above average in Scotland and Ireland. On the other hand, in England, although there was a fair yield of wheat, that of barley and oats was very deficient. Hay proved everywhere a small crop, and especially so in the southern districts of England. Beans, peas, turnips, swedes, mangolds and potatoes were all more or less under average in England, but either good or fairly good elsewhere. The yield of hops proved singularly abundant. Apples, pears and plums were below average, especially apples, but the small fruits, as a rule, yielded well. Taking farm and garden crops together, seldom has there been a less bountiful year.

MANCHESTER.

Literary and Philosophical Society, February 4.—Mr. Charles Bailey, president, in the chair.—Mr. J. E. King read the first part of a paper on folklore of the North American Indians, from the Jesuit relations (1611 to 1637). Without attempting to give any complete account of Indian culture, the paper described and illustrated particular practices observed by the Jesuits. The savages believed in two main sources of disease, viz., desires in the mind of the patient, or evil practices of an enemy working by witchcraft. The sorcerers, or medicine men, claimed to cure disease and also to produce it, when desired, by practices which come under the head of sympathetic magic. Great importance was attached by the Indians to dreams, singing, dancing and feasting. Wherever these practices had a magical meaning, they were forbidden by the Jesuits to their converts.—The animistic theory of nature is illustrated by the observances with regard to the bones of animals eaten at feasts, the treatment of fishing nets, and offerings to dangerous rocks and rapids. The life of the human soul after death was a shadow of the life on earth. The ghost of the dead was driven from the abode of the living, and the name of the dead was not to be mentioned.—Mr. W. E. Hoyle exhibited two carved wooden bowls from British Columbia, and referred to the skill shown by the Indians in retaining in their carvings the special characteristics of the various animals represented, illustrating his remarks by a series of lantern slides.—Mr. Francis Nicholson drew attention to a paragraph in Mr. Elijah Helm's "Chapters in the History of the Manchester Chamber of Commerce," wherein it is stated that as early as the first half of the seventeenth century cotton was brought from Cyprus and Smyrna to London and thence to Lancashire, where it was spun by hand on the single spindle frame. Mr. Nicholson pointed out that most of the cotton used in Lancashire at that time probably came from the West Indies, and, as confirming this, he read a letter written from London by his great-grandfather, Robert Nicholson, to his brother, James, in Liverpool in 1749, where he quotes: "Jamaica cotton is sold at 16*d.* per lb., some of the very choicest 16½*d.* per lb., Leeward Islands 14*d.* per lb."

CAMBRIDGE.

Philosophical Society, February 3.—Prof. Macalister, president, in the chair.—Oxidation in presence of iron, by Mr. H. J. H. Fenton. The remarkable influence which is exerted by traces of iron in determining and regulating the oxidation of various organic substances was first observed by the author about twenty years ago, and the observation has since opened up a very wide and fruitful field for investigation. The work is still being extended in several directions, and in the present communication a brief summary is given of the principal researches on the subject already published, and of new results which have recently been obtained. The conditions of this oxidation-method show some very close analogies with certain natural processes, and many experiments are in progress with a view of throwing further light upon the function of the iron.—Decomposition of hydrogen peroxide by light, by Mr. R. F. D'Arcy. The author gave an account of experiments showing:—(*a*) That dilute solutions of hydrogen peroxide are rapidly affected by exposure to sunshine. Experiments were chiefly made with aqueous solutions containing 4 per cent. of "20 vol." H_2O_2. Exposure of such a solution in a flask to the sunshine of five days in June resulted in the decomposition of about three-quarters of the hydrogen peroxide. In open dishes it is more rapidly decomposed, and the effect in this case is not dependent, at any rate to any considerable extent, on the evaporation taking place simultaneously. The effect is not a temperature effect. This property of hydrogen peroxide may possibly be of some importance in some of its reactions. (*b*)

That the surface of a solution of hydrogen peroxide undergoing this decomposition is capable of discharging negative electrification. (*c*) That days on which sunlight decomposes hydrogen peroxide most rapidly are the days on which the discharging action is most pronounced. The author draws from these experiments the conclusion that the decomposition of hydrogen peroxide by light is a possible source of production of positive and negative ions in the atmosphere. A detailed account is to be found in the *Phil. Mag.*, January.—Note on a method for determining the concentration of hydrogen ions in solution, by Mr. H. O. Jones and Mr. O. W. Richardson. The investigation described was suggested by a series of observations by Mr. Fenton and one of the authors. They showed that oxalacetic hydrazone decomposed in presence of water at 100° C. into pyruvic hydrazone and carbon dioxide; but that in the presence of hydrogen ions in sufficient concentration the products were pyrazolone carboxylic acid and water. It was suggested that these reactions might be explained by supposing that the negative ion lost carbon dioxide on heating; whereas the undissociated molecule lost water. Hence the presence of hydrogen ions by diminishing the concentration of the negative ion would diminish the amount of carbon dioxide produced. The experiments here described were undertaken with the view of testing quantitatively the validity of the above hypothesis and the value of the method for determining the concentration of the hydrogen ions in a solution. The authors find that, in the case where the ionisation due to the hydrazone itself is negligible compared with that of the acid used, the experimental results agree with the theoretical conclusions.—The formation of dinitrophenoxazines, by Mr. J. C. Crocker.—When picryl chloride reacts with orthoxyamido-compounds in the presence of alkali, hydrochloric acid and nitrous acid are eliminated, and condensation takes place to a dinitrophenoxazine. Eikonogen, for instance, gave naphthodinitrophenoxazine sodium sulphonate, which consists of minute bronze plates soluble in water.—The interaction of thiocyanates, picryl chloride and alcohols, by Mr. J. C. Crocker. When picryl chloride acts on thiocyanate in absolute alcohol solution, a yellow crystalline body is obtained. It melts at 138°, contains an ethoxy-group, two picryl groups and a sulphur atom. On hydrolysis it gives picramide. Hydrochloric acid is set free in the reaction.—Oxidation of glucosone to trioxybutyric acid, by Mr. R. S. Morrell. Glucosone, prepared from glucose by the action of hydrogen peroxide in the presence of ferrous sulphate, on oxidation with bromine in aqueous solution yielded trioxybutyric acid. The identity of the trioxybutyric acid was established by comparing its calcium and lead salts with those obtained from the trioxybutyric acid which is formed when erythrite is oxidised by nitric acid, also by the reduction of the calcium salt by hydriodic acid and phosphorus to normal butyric acid.—Note on the reduction of a ternary quantic to a symmetrical determinant, by Dr. A. C. Dixon.

EDINBURGH.

Royal Society, January 20.—Lord Kelvin in the chair.—Lord Kelvin, in a paper on the specification of stress and strain in the mathematical theory of elasticity, showed how a perfectly symmetrical system applicable to all kinds of strains and not merely to very small strains could be developed by considering the elongations of the edges of a tetrahedron and the related stresses (see *Phil. Mag.* for January, 1902). The method for bringing this system into relation with the ordinary system for infinitesimal strains was indicated, and the discussion was greatly facilitated by the use of models.—Dr. W. Brodie Brodie read a paper on the condition of the iron in the spleen, and detailed some of the results of an investigation into the histological and chemical position of the iron in this organ. By the use of microchemical methods, the metal was found contained in cells and also in bodies not of a cellular nature. Three varieties of iron-containing elements were described as belonging to the latter class. Three proteid bodies containing iron which had been obtained by means of purely chemical methods were also described.—Lord Kelvin communicated a paper on the molecular dynamics of a crystal, discussing in particular (*a*) stable and unstable homogeneous assemblages, (*b*) deviation from homogeneousness in surface layers, (*c*) tensile strength, (*d*) cleavage. The whole discussion was based upon the Boscovich view that the action between neighbouring atoms is attractive or repulsive according to their distance apart. The forces acting upon a given atom will depend, not only upon the nearest neighbours, but also upon those at greater distances. Taking simple configurations, Lord Kelvin showed how during the condensation of an assemblage of atoms configurations of instability might arise, and how the group originally monatomic might either assume a new stable configuration of different density or break up into a diatomic configuration of greater stability. By a process of successive approximations, the final positions of the end particles of a one-dimensional row of particles acting on one another, according to an assumed Boscovichian law, were calculated. Reckoning from the end, the distances between the successive pairs of contiguous particles were alternately greater and less than the ultimately constant distance to which they converged as we passed further and further from the end. After the first nine or ten particles, the arrangement became uniform.—A communication by Dr. Thomas Muir, on the theory of Jacobians in the historical order of development up to 1841, was also received.

PARIS.

Academy of Sciences, February 17.—M. Bouquet de la Grye in the chair.—A study of the conditions to be realised in the execution of negatives in order to obtain homogeneity and the maximum of exactitude in the determination of the coordinates of stellar images. Formulæ for evaluating the influence of the whole of the causes of error which affect the results, by M. Lœwy. The rectilinear coordinates of photographic stellar images are liable to two distinct classes of errors, the first being due to the unequal sensibility of the gelatine layer and to the irregular deformations which it undergoes during development, and the second having its origin in the subsequent measuring operations. A careful analysis of the relative magnitudes of these two causes of error in the case of stars of different orders of magnitude is given and a formula worked out for the probable error, from which it is hoped that a still higher accuracy may yet be obtained by the photographic method.—An apparatus for measuring differences of longitude with the aid of photography, by M. G. Lippmann. The essential part of the apparatus consists of a transparent mirror inclined at an angle to a mercury bath, and has already been described as a means of measuring photographically small zenithal distances. It is equally applicable to the measurement of small differences of longitude.—Th action of potassium hydride on ethyl iodide and methyl chloride. New methods of preparation of ethane and methane, by M. Henri Moissan. Potassium hydride heated in a sealed tube with ethyl iodide at about 200° forms ethane and potassium hydride. The reaction is not complete, but is perfectly free from bye-products. The ethane is separated from the hydrogen by means of liquid air, and from the ethyl iodide in excess by fractional distillation and subsequent washing with alcohol and water. The gas was proved by analysis to be perfectly pure. The reaction with methyl chloride is analogous, pure methane being produced.—Study of the vineyards of high yield in central France, by M. A. Müntz. It is shown to be more advantageous to moderate production in order to obtain a superior wine than to exaggerate the yield by methods giving enormous quantities of wine of feeble quality.—The estimation of sugars in the blood, by MM. R. Lépine and Boulud. A comparison of the polarimetric and copper reduction methods.—The mechanical action of gelatine on solid substances and particularly on glass, by M. L. Cailletet. Gelatine on drying exercises a very energetic mechanical action on the surfaces to which it adheres. On surfaces of glass, polished marble, Iceland spar and fluorspar, pieces are broken off, and a cylindrical tube of thin glass may be broken by means of the action of a small quantity of drying glue.—M. Charles André was elected a correspondant for the section of astronomy in the place of the late Dr. Gould.—Perturbations of the major axis of small planets, by M. Jean Mascart.—On quasi-entire functions, by M. Edmond Maillet.—On a class of partial differential equations integrable by successive approximations, by M. R. d'Adhémar.—On some transformations of contact, by M. W. de Tannenberg.—On a form of electric thermometer, by M. Georges Meslin. In certain cases the rapidity with which thermocouples follow the temperature changes of the medium in which they are placed is disadvantageous. The author therefore proposes to use the variation of electromotive force of a Latimer Clark cell with temperature as a thermometer, the thermal lag of which is very pronounced compared with a thermocouple.—Researches on ionised gases, by M. P. Langevin. A development of the theory of ionised gases of J. J. Thomson, together with an experimental confirmation of the theoretical deductions.—On the transparency of liquid conductors for the

Hertzian oscillations, by M. Charles Nordmann. The transparencies for the waves vary in the same sense as their resistances, increasing less rapidly than a direct proportion, but more rapidly than in proportion to their square roots.—The conductivity of liquid dielectrics under the influence of the radium and Röntgen rays, by M. P. Curie. Under the action of the radium rays there is a marked increase of electrical conductivity in liquid dielectrics, and on replacing the radium rays with the Röntgen rays, effects of a similar order are observed. The magnitude of the increase of conductivity observed under the action of the rays varies greatly with the liquid used, from 20×10^{-14} mhos per c.c. in the case of carbon bisulphide to $1{\cdot}3 \times 10^{-14}$ mhos per c.c. for liquid air.—Molecular fields of force, by M. S. Leduc.—A second quarter of meteorological observations at Quito, by M. F. Gonnessiat.—On praseodidymium chloride, by M. Camille Matignon. The anhydrous chloride can be obtained from the crystallised $Pr Cl_3, 7H_2O$ by heating in a current of hydrogen chloride at 185° C. Thermochemical data are given for the heats of solution of the various hydrated chlorides.—On the diapedesis of leucocytes charged with lecithin, and on the absorption of the lecithin by the vascular endothelium, by MM. H. Stassano and F. Billon.—Comparison of the egg-laying capacity of fowls fed on meat and on grain, by M. Frédéric Houssay. It was found that on a meat diet there was a marked increase both in the number of eggs produced and also in the average weight of the egg obtained.—On the evolution of stolonial formations in Syllidians, by M. G. Pruvot.—On two caoutchouc-bearing plants of Indo-China, by M. Gustave Quintaret.—On the origin and the differentiation of the vascular meristem of the petiole, by M. Bouygues.—New observations on the *Tanghin du Ménabé* (*Menabea venenata*) and on its toxic and medicinal root, by M. Edouard Heckel.—On the properties of the reflection fringes of silvered plates, by M. Maurice Hsmy.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 27.

ROYAL SOCIETY, at 4.30.—Note on the Discovery of a New Trypanosoma: Lieut.-Colonel David Bruce, R.A.M.C., F.R.S.—The Bakerian Lecture will be delivered by Lord Rayleigh, F.R.S., on the Law of the Pressure of Gases.

SOCIETY OF ARTS at 4.30.—The Industrial Development of India: Nilkanth B. Wagle.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electric Shock and Legislation thereon: Major-General C. E. Webber, C.B., R.E.—Electric Shocks: F. B. Aspinall.—Electric Shocks at 500 volts (illustrated by a Demonstration of 500 volts): A. P. Trotter.

FRIDAY, FEBRUARY 28.

ROYAL INSTITUTION, at 9.—Gold Mining in Klondyke: Prof. H. A Miers, F.R.S.

PHYSICAL SOCIETY, at 5.—(1) On Focal Lines and Anchor-ring Wavefronts: (2) Contributions to the Theory of the Resolving Power of Objectives: Prof. J. D. Everett, F.R.S.—The Absorption, Dispersion, and Surface-colour of Selenium: Prof. R. W. Wood.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Indicating High-Speed Steam-Engines: A. M. Arter.

SATURDAY, MARCH 1.

ROYAL INSTITUTION, at 3.—Some Electrical Developments: Lord Rayleigh, F.R.S.

MONDAY, MARCH 3.

SOCIETY OF ARTS, at 8.—Photography applied to Illustration and Printing: J. D. Geddes.

VICTORIA INSTITUTE, at 4.30.—The Physical History of the New Zealand Fjords: J. Malcolm Maclaren.

TUESDAY, MARCH 4.

ROYAL INSTITUTION, at 3.—The Temperature of the Atmosphere: its Changes and their Causes: W. N. Shaw, F.R.S.

SOCIETY OF ARTS, at 8.—Structural Colour Decoration of the Interior of Public Buildings: G. C. Horsley.

ZOOLOGICAL SOCIETY, at 8.30.—Exhibition of Photographs of Animal-life in the Egyptian Soudan: E. N. Buxton.—On the Origin of Pearls: Dr. H. Lyster Jameson.—On the Organ of Jacobson in the Elephant-Shrew (Macroscelides): Dr. R. Broom.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Paper to be further discussed*: Electrical Traction on Railways: W. M. Mordey and B. M. Jenkin.

WEDNESDAY, MARCH 5.

SOCIETY OF ARTS, at 8.—Sound Signals: E. Price Edwards.

ENTOMOLOGICAL SOCIETY, at 8.—On Mr. Guy A. K. Marshall's Five Years' Experiments and Observations in Mimicry and Warning Colours in South African Insects: Prof. Edward B. Poulton, F.R.S., with an Appendix by W. L. Distant and Colonel C. T. Bingham.—Notes on some Cases of Sexual Dimorphism in Butterflies; with an Account of Experiments made by Mr. Guy A. K. Marshall: Dr. Frederick A. Dixey.—A Monograph of the Genus Acrida, with Notes of some Allied Genera, and Descriptions of New Species: Malcolm Burr.—(*a*) Notes on Hawaian Wasps, with Descriptions of New Species; (*b*) Four New Species and a New Genus of Parasitic Hymenoptera (Ichneumonidæ) from the Hawaian Islands; (*c*) On the Generic Characters of Hawaian Crabronidæ; Four New Genera Characterised: R. C. L. Perkins.

SOCIETY OF PUBLIC ANALYSTS, at 8.

THURSDAY, MARCH 6.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Spark Discharge from Metallic Poles in Water: Sir Norman Lockyer, F.R.S.—Experimental Researches on Drawn Steel. Part I. The Influence of Changes of Temperature on Magnetism. Part II. Resistivity, Elasticity and Density, and the Temperature Coefficients of Resistivity and Elasticity: J. R. Ashworth.—On the Effects of Magnetisation on the Electric Conductivity of Iron and Nickel: G. Barlow.—The Differential Equations of Fresnel's Polarisation-vector, with an Extension to the Case of Active Media: J. Walker.

LINNEAN SOCIETY, at 8.—On some New Species of Lepadidæ in the British Museum (Nat. Hist.): Prof. A. Gruvel.—On the Morphology of the Brain in the Mammalia, with Special Reference to the Lemurs, Recent and Extinct: Dr. G. Elliot Smith.

RÖNTGEN SOCIETY, at 8.30.—Localisation; with Demonstration of a Simple Direct Reading Apparatus: Dr. Barry Blacker.

CHEMICAL SOCIETY, at 8.—The Slow Oxidation of Methane at Low Temperatures: W. A. Bone and R. V. Wheeler.—Isomeric Additive Compounds of Dibenzyl Ketone and Deoxybenzoin with Benzal-*p*-toludine, *m*-Nitrobenzalaniline and Benzal-*m*-nitraniline. Part III.; F. E. Francis.—Mesoxalic Semi-Aldehyde: H. J. H. Fenton and J. H. Ryffel.—*m*-Nitrobenzoylcamphor: M. O. Forster and F. M. G. Micklethwait.—Picrimidothiocarbonic Esters: J. C. Crocker.

FRIDAY, MARCH 7.

ROYAL INSTITUTION, at 9.—Radio-active Bodies: Prof. H. Becquerel.

GEOLOGISTS' ASSOCIATION, at 8.—The Zones of the White Chalk of the English Coast. III. Devonshire: Dr. A. W. Rowe.

SATURDAY, MARCH 8.

ROYAL INSTITUTION, at 3.—Some Electrical Developments: Lord Rayleigh, F.R.S.

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