THURSDAY, NOVEMBER 15, 1888.

FOSSILS OF THE BRITISH ISLANDS.

Fossils of the British Islands, stratigraphically and zoologically arranged. Vol. I. Palæozoic. By Robert Etheridge, F.R.SS.L. and E. (Oxford: Clarendon Press, 1888.)

GEOLOGISTS and palæontologists will hail with satisfaction the publication of the first volume of Mr. Etheridge's "Fossils of the British Islands," which has just issued from the Clarendon Press. Most of us who have been occupied in this department of science have long been expecting the appearance of this work, for those who have laboured much among fossils know full well the value of such a help to study.

When the late Prof. John Morris, in 1854, brought out the second edition of his "Catalogue of British Fossils," only about 4000 species were known, and yet so great was the need of some such aid, that the publication of that catalogue has been referred to as marking an epoch in British palæontological studies. During the thirty-four years which have since elapsed, palæontology has made most rapid strides, and Mr. Etheridge now estimates the number of British fossils at nearly 18,000 species. So vast an increase is of itself sufficient to show the necessity for some enlarged work of reference, which should bring the accumulated material within the grasp of the working palæontologist; and such is the scope of this catalogue of the "Fossils of the British Islands." Indeed, Mr. Etheridge tells us, in his preface, that it was to facilitate his work as Palæontologist to the Geological Survey of Great Britain that he, in the year 1865, commenced the manuscript of this tabular arrangement of fossils.

Those of us who have had the advantage of working for a number of years beside the author, and have been able to use these manuscripts, which were ever placed freely at our disposal, have learned to know their value, and to look forward with no little desire to the time of their publication.

The works of reference for fossil species, which have hitherto been available, are D'Orbigny's "Prodrome de Paléontologie" (1850), Bronn's "Index Palæontologicus" (1848), and Morris's "Catalogue of British Fossils" (1854). The first of these is divided into stratigraphical sections, with an index of species at the end. Bronn's "Index" is arranged alphabetically throughout, and the horizon of each species is indicated by letters referring to a table. The alphabetical arrangement is convenient for obtaining references to authors and descriptions, but the second reference for the horizon is troublesome. Morris's "Catalogue" is divided into zoological sections, similar to those adopted by Mr. Etheridge, and in each section the genera and species are placed alphabetically, with references to authors and descriptions, the chief horizon of each species being given on the right of each page.

In neither of these catalogues have either references or horizons been given in such detail as in the work now before us, which is not only a catalogue of all known British species, but also a table giving their full distribution in time, with voluminous references to the most important descriptions and figures; and the synonymy has been, as far as possible, brought up to date. The tabular form adopted by Mr. Etheridge has necessitated the division of the book into several stratigraphical groups; and consequently this first volume, which includes all the species recorded from Palæozoic formations, is divided into four sections: (1) Cambrian and Silurian; (2) Devonian or Old Red Sandstone; (3) Carboniferous; (4) Permian or Dyas.

In an appendix, three of these sections are repeated, so as to bring the work down to the year 1886.

At the head of each section the divisions of the formations which have been adopted are explained, and the important localities are noted at which the beds occur. Each page is arranged with vertical columns, one for every stratigraphical division, and on the left are the names of the genera and species, stars being placed opposite the latter, in the appropriate column, to mark their distribution. One column indicates those forms which pass up into the next higher section, while on the right the references are given.

The strata included in Section 1 are thus divided:—Cambrian, including (1) Harlech and St. David's beds, with Longmynd, Llanberris, and Bray Head; (2) Menævian; (3) Lingula Flags; (4) Tremadoc. Lower Silurian, including (1) Arenig; (2) Llandeilo; (3) Caradoc or Bala; (4) Lower Llandovery. Upper Silurian, including (1) Upper Llandovery; (2) Woolhope Limestone; (3) Wenlock Shale; (4) Wenlock Limestone; (5) Lower Ludlow; (6) Aymestry; (7) Upper Ludlow; (8) Tilestones or Passage Beds and Downton Sandstones.

The second section, Devonian or Old Red Sandstone, is divided into lower, middle, and upper beds, and the third or Carboniferous section is divided into (1) Calciferous Series; (2) Lower Limestone Shales; (3) Carboniferous Limestone; (4) Upper Limestone Shales (Yoredale); (5) Millstone Grit; (6) Lower Coal Measures; (7) Middle Coal Measures; (8) Upper Coal Measures.

The fourth section, Permian, is divided into (1) Passage Beds; (2) Rothliegende; (3) Marl Slate; (4) Lower Limestone; (5) Middle Limestone; (6) Upper Limestone.

Under each of the four sections the plants are first dealt with, the genera being in one alphabetical series; and then follow the animals, which are divided into the following groups, the genera in each being arranged alphabetically—namely, Rhizopoda (divided into Spongida and Foraminifera), Hydrozoa, Actinozoa, Echinodermata, Annelida, Crustacea, Arachnida, Myriapoda, Insecta, Polyzoa, Brachiopoda, Conchifera, Gasteropoda, Pteropoda, Cephalopoda, Pisces, Amphibia. In the appendix the Placophora and Heteropoda are separated from the Gasteropoda.

There can be no question but that in works of reference the alphabetical order is the simplest, and therefore the best, where it can be adopted; but in the present instance it was obviously necessary to make geological divisions; and the zoological groups which Mr. Etheridge has used are nearly the same as those of Prof. Morris's "Catalogue," which in practice has been found very easy for reference. This arrangement has the advantage also of bringing together the members of each of the groups, and the index of species supplies what further help is needed.

The zoological divisions being merely for convenience, little need be said about them; but, at the same time, there are one or two points which may be noticed in passing. The Sponges are retained as a sub-group of the Rhizopoda in the sub-kingdom Protozoa. Possibly the first pages of this work were in type before the separation of the Spongida from the Protozoa, which is now generally accepted, was so strongly insisted on by biologists. It is well, however, for students to be reminded that the Sponges are regarded by most naturalists as presenting a higher type of organization than is found in the Protozoa.

In the first part of this volume the name Conchifera is used for the bivalve Mollusca. This is to be regretted, inasmuch as the term is incorrect, unless it can be used to include all the shell-bearing Mollusks. In the latter part of the appendix, Pelecypoda is used instead of Conchifera. It may be that the latter name has priority, but surely it is not so appropriate nor so correct as that of Lamellibranchiata, which has for so long been in general use; and it seems questionable whether this reversion to old names, for groups of animals, is justifiable.

Perhaps the most difficult part of the work which Mr. Etheridge has undertaken is the correction of specific synonymy, and specialists in certain groups may possibly be inclined to differ from him; but those who have done most in the endeavour to rectify the synonyms of fossil species will best appreciate the difficulty of the task, and be most ready to make allowance for any difference of opinion in these matters.

There are few palæontologists who have such a grasp of the entire range of British fossils as Mr. Etheridge, and probably none better qualified for the work, the first part of which is here so successfully accomplished. The author is to be congratulated on the completion of so much of his task, and on the admirable manner in which it has been printed and published.

That the book has been printed by the Clarendon Press is sufficient guarantee of its excellence. The careful typing and arrangement, as well as the clear printing and good paper, are all that could be wished for, and add greatly to its value.

It is much to be desired that the Secondary and Tertiary portions of this catalogue should speedily be in the hands of geologists; but one reads with regret, in a note at the end of the preface, that the pressure of official duties will prevent the author preparing these parts for publication, although the manuscript is practically complete. It is sincerely to be hoped that the delay may be of short duration, and that Mr. Etheridge will shortly see his way to the completion of this valuable work, which every geologist and palæontologist ought to possess, as it must of necessity be for many years the standard work of reference for British fossils. E. T. N.

YORKSHIRE LEGENDS AND TRADITIONS.

Yorkshire Legends and Traditions, as told by her Ancient Chroniclers, her Poets, and Journalists. By the Rev. Thos. Parkinson, F.R.Hist.S., &c. (London: Elliot Stock, 1888.)

LEGENDARY LORE has its interest if not its value to the anthropologist as well as to the philologist. It sometimes happens that a word has given rise to a legend, and that the existence of a legend or tradition indicates identity of race, or a common origin of two widely separated peoples. The science of philology in particular welcomes the data in legends and traditions faithfully given in the vernacular, and undoubtedly affords in its turn a scientific explanation of the origin or meaning of some of them.

The limitation in the title of the present work does no small injustice to the subject, and to the qualifications of the author for treating it, as it excludes many of the most interesting, most local, and most characteristic of Yorkshire legends and traditions, which must be well known to so true a Yorkshireman as the Rev. Thos. Parkinson. This, however, is only a first instalment or "wainload of the marvellous from this county of broad acres," and as such is acceptable. It would be well if the author were to give references to all the principal sources of these legends, as some of them are found in more than one shape, and different versions of the same story sometimes present details which identify the legend with a third legend found perhaps in a distant locality, or with more than one such, thereby proving a still more remote common origin. We will presently exemplify this in the Handale legend. Our author has grouped his materials under nine heads: legends and traditions connected with the early history of Yorkshire; those of abbeys and monastic life; of Satanic agency; Barguest and ghost legends; Mother Shipton; dragons and serpents; battle-fields; legends of wells, lakes, &c.; and miscellaneous legends. The name of *Eboracum*, or York, has proved a fertile source of legends, several of which are collected in the opening chapter; its true origin, not being scientifically demonstrable, is, as our author justly observes, "buried in obscurity." Of the legends connected with the coming of the Danes, that of "Buern the Busecarle" (pp. 10-14), taken from the translation in the "Church Historians of England" (by the Rev. Jos. Stephenson) of the Anglo-Norman "Metrical Chronicle" of Geoffrey Gaimar, written in Stephen's reign, is of historic interest, and receives further elucidation and support from the self-evident fact that "Buern Busecarle" is a Scandinavian or Old Norse and not an English name and title. Björn Bús-Karl = "Björn the farmer of the King's estates," or the "Karl" (A.S. ceorl) of the Konungs-bú or royal demesnes, as he is, in fact, described in the legend. It was because he was a Northman that he called in the aid of the Danes, including Northmen, when his wife was dishonoured by King Osbert, as related by Gaimar. Passing by numerous legends, among which that of the death of King Ella, and the probable site of Ellsworth and Ellecroft or Ellecross is interesting, we note (p. 96) that the horn of Ulphus, or Ulfr, a Norseman who, about the time of King Canute, governed in the western part of Deira, is "a portion of the tusk of an elephant, about 3 feet long." The author excites the reader's curiosity by adding that "round the thick end are engraved a number of emblematic figures, in some respects not unlike those found on Egyptian and Assyrian monuments." Surely there must be extant some expert opinion as to the species of elephant, as to the date and nationality of the workmanship, and whether the tusk was brought from the East, already engraved, by the far-roving Northmen—but here our author fails us. The "Filey

Haddock Legend" (p. 121) appeared in Hone's "Table Book," 1838, ii. p. 638, signed "T. C."

We are compelled to pass over much interesting matter, such as the legend of the submerged town in Semerwater (for which see also Barker, "Wensleydale," 1856, p. 239), which is also told of Gormire Lake, of Lough Neagh, and is one of the legends of the Rhine. Gormire Lake is formed on the back of a landslip. The original version of the pretty ballad on the legend of the Troller's Gill (p. 127) and of Billy B.'s adventure (p. 130) is given in Hone's "Table Book," 1838. The article is signed "T. Q. M.," the *nom de plume* of the late Dr. J. H. Dixon in the "Table Book." Also our author's "Wise Woman of Littondale" (p. 134), from the "Table Book," ii. p. 775, signed "T. Q. M.," is one of Dr. Dixon's productions. With regard to the probable site of "Stoknmore" (p. 162) a local tradition identifies the erect column of stone, 11 feet high, known as the "Long Stoop," on Yeadon Moor, as the subject of Mother Shipton's prophecy "then will ravens sit on the cross, and drink as much blood of the nobles as of the commons."

With reference to the Handale legend (p. 168), the version there given is taken from the *Leisure Hour* for May 1878, but that, in its turn, is almost word for word taken from Ord's "History of Cleveland," 1846, p. 283, as related by Mr. Marr, then tenant of Handale farm. Another original version obtained by the present writer from Mr. Robert D. Watson, of Loftus-in-Cleveland, describes the hero as "a *shoemaker* of the name of Scaw" [O.N. Skór, a *shoe*] who "had a suit of clothes made into which he had by some means stitched all over it razor-blades edge outwards," an item which is identical with that given by our author (p. 171) of the slayer of "the dragon of Loschy Wood." Though our author does not include Beowulf among his legends of Yorkshire, we are of opinion that the able demonstration of Mr. Haigh, in his "Anglo-Saxon Sagas," 1861 (which can now be supported by additional facts, overlooked by him, such as the two coins of "Hæreth," found in Northumbria and engraved in Hickes's "Thesaurus," 1705, iii. p. 168), that Cleveland was the scene of the principal event recorded in Beowulf, remains unshaken by the numerous foreign and English commentaries that have since appeared on the subject. We cannot doubt that the "Grendel" destroyed by Beowulf was a religious house at "Grendale, afterwards Handale," as appears by a charter, anno 1133 (Charlton, p. 90), but space forbids doing more than noting the omission. There are some grievous misprints, *e.g.* "bretwalder" for "Bretwalda" (p. 11), "Worsaal" for "Worsaae" (p. 221), "Upsalier" for "Upsalir" (p. 222).

Among the miscellaneous legends is one called "Swine Harrie" (p. 219) apparently belonging to deer-stealing days, and found in various forms. It appeared in Hone's "Table Book," 1838, ii. p. 722. The thief in carrying his burden home slips in crossing a rock or wall, and is hung by the cord. It should, however, be observed that "Hanging" is a common epithet in the Pennine Hills, *e.g.* "Hanging Stones." *Apropos* of this legend "there is a crag on Embsay Moor called 'Deer Gallows,' and it is said a deer was once hanged there. There is a deep crevasse in the rock becoming narrower toward the bottom, and—the story goes—a deer once fell down and caught with its horns across, and so was hanged" (J. J. Wilkinson). "Gallas", or "gallowses" in the dialect means "braces." The name "hanging" as applied to rocks alludes to some physical feature, but may have localized the legend.

Among the excluded legends we may mention the pretty legend of the "Walling in the Cuckoo," by "t' Hoastik Carles" (the Austwick Carles) and "the funny one of Wengby," "Meal Ark Spring," "Hobthrush Hall," "Simon Amangus," and many others. The legend of "Wallin' in t' Cuckoo" has a wide range, and is told of various villages in the Northern counties. We have heard it in Borrowdale. It is told of Austwick, near Settle, that, seeing a cuckoo in a tree, the carles began to build a wall round it to keep it, and its consequent, the summer, always there, and they were very much astonished when it flew away.

There is another legend of Austwick:—

> "T' Austwick Carles cried 'Whittle ta t' tree,'
> Lifted t' bull ower t' yet, an t' pig inta t' stee."

"There was only one 'whittle' or butcher's knife in Austwick, and when anyone wanted it he went to the tree in the middle of the village in which it was kept stuck. If it were not there, he cried 'Whittle ta t' tree!' three times, and whoever had it was bound to bring it." In the glossary to "Studies in Nidderdale," 1882, p. 291, occurs the article "Wittaled. 'Ah've gittan fas'en'd ta t'sod, if ah aint gittan *wittaled* ta t'tree.'—*Nid. Al.*, 1880. *Wel.* Gwydaw, *to grow woody*; gwyden, a *tree*; gwyddawl, rudimental; so 'wittaled' means rooted to the tree so as to form part of its wood, grafted." Here, the legend evidently takes its origin in the similarity of sound of the two words "whittle," a *butcher's knife*, a familiar word, and "wittaled," *grafted*, a forgotten word preserved in the phrase "wittaled ta t'tree." As to lifting the bull over the gate, they were too simple to know that the gate was meant to open (J. J. Wilkinson). These are samples of the excluded but most interesting legends, which will, we hope, find a place in our author's promised second series.

JOSEPH LUCAS.

FOREIGN BIOLOGICAL MEMOIRS.

Translations of Foreign Biological Memoirs. Vol. I. *Memoirs on the Physiology of Nerve, of Muscle, and of the Electrical Organ.* Edited by J. Burdon-Sanderson, M.D., F.R.SS.L. and E. (Oxford: Clarendon Press, 1887.)

THIS volume is the firstfruits of a scheme which was started some years ago. The original intention was to translate and put before English readers as soon as possible after their publication the most important foreign papers on various biological subjects. Owing to various difficulties, the original scheme had to be altered, with the result that the first volume of the proposed series has taken the form of the present book.

Prof. Burdon-Sanderson has in this volume confined himself to that subject in which he himself is especially interested—viz. the physiology of nerve, muscle, and the electrical organ—and has collected and edited the translations of the most important papers which have appeared in the German language during the last five years on this very difficult and abstruse subject. The book is divided into three parts: viz. Part I. Researches relating to the Law of Contraction, which contains the well-known papers of Tigerstedt, Grützner, and Hering on this subject; Part II. Researches relating to Secondary Electromotive Phenomena, containing papers by Du Bois-Reymond, Hering, Hermann, and Biedermann; Part III. Researches on the Electrical Phenomena of Certain Electrical Fishes, by Du Bois-Reymond. In addition, a short summary of two or three of the most recently published papers on the subjects treated of in this volume is given in the form of an appendix.

The memoirs selected for translation in Parts I. and II. form a group of papers which are most interesting to all those who are anxious to obtain more than a text-book acquaintance with the difficult questions treated of in them. The translations have been made with great care and accuracy, and with a careful attention to style, though naturally the original German construction is more palpable in some than in others; it would, however, be invidious to select any individual memoirs in this respect. The editor is also to be congratulated upon the manner in which the especially difficult German phraseology inherent to the nature of the subject has been rendered into English. Uniformity of translation among the different translators has been fairly well attained. Perhaps the most noticeable discrepancies are in the translation of the words "*Lücke*" and "*Schwelle.*" The phenomenon of the "*Lücke*" is called by one translator the phenomenon of the "gap," and by another the phenomenon of the "hiatus"; of the two, "gap" is perhaps preferable. The almost untranslatable word "*Schwelle*" is sometimes rendered as "limen," at other times as "threshold"; of these two, "limen" sounds best. It is also a pity that the editor has not settled whether the opposite pole to the anode ought to be spelt with a "c" or a "k": cathode and kathode are pretty equally distributed throughout this volume. As to the arrangement of the different memoirs, they all follow each other in natural sequence, with the exception of the second and third papers of Tigerstedt, which ought to have been transposed, as the author assumes in No. 2 that No. 3 has already been read.

Not the least prominent part of the work is the preface, in which the editor briefly links together the various memoirs. As it will seem to many that this should be the most important part of the whole book, it is to be regretted that it is not fuller and also more critical; for undoubtedly any collection of translations of foreign memoirs upon a special biological subject would be very much more valued by English readers if the recognized English authority on that subject prefaced the translations with a critical commentary embodying his own views.

Also, as the object of the book is presumably to enable students and physiologists who do not read German easily to understand the present position of the physiology of nerve and muscle without having to refer to the original papers in the German journals, it would have been better to afford more indication as to the nature of the contents of previous papers which are referred to by the authors but have not been included among the translations. This might have been done by the more copious use of footnotes, or by the translation of one or two more papers. Thus in Biedermann's paper the whole argument is so bound up with his previous papers on the heart of the snail and the muscle of the anodon, that it would have been better to translate the three papers rather than only one. If this had been done, the book would have been large enough without Part III. and there would have been no harm in that, for in the first place the physiology and histology of the electrical organ might well be treated of in a separate volume of memoirs, and in the second place, the papers included in Part III. are all by the same author, and can hardly be considered so important as those in Parts I. and II. Thus Du Bois-Reymond's statement as to "irreciprocal conduction" is based upon an error of observation, according to the recent paper of Gotch in the Proceedings of the Royal Society, and is therefore hardly worthy of a place in these memoirs.

The book is essentially of the nature of an experiment, and it is to be hoped that the demand for it will be sufficient to repay the editor for the time and trouble which he has spent in carrying out his task, and to encourage him to bring out a series of similar volumes dealing with a number of the most important of those biological questions which are the subject of controversy at the present time.

OUR BOOK SHELF.

Examples in the Use of Logarithms. By Joseph Wolstenholme, Sc.D. (London: Macmillan and Co., 1888.)

Practical Logarithms and Trigonometry. By J. H. Palmer. (London: Macmillan and Co., 1888.)

THESE are two books for the use of mathematical students from the hands of practical teachers, who may be assumed to be well acquainted with the difficulties met with by students.

The first one consists entirely of rules and their application to examples. The earliest examples are on the extraction of logarithms from tables. Then follow the reductions of $\sqrt{a^2 + b^2}$ and $\sqrt{b^2 + c^2 - 2bc \cos A}$, after which come the various solutions of triangles, finally concluding with a lengthy series of examples on the calculation of the parts of tetrahedra when the sides are given. The author's experience has indicated that examples of the latter class are especially useful in teaching the habitual accuracy which it is desirable to attain, and another reason for their introduction is that they afford preliminary practice in the solution of spherical triangles. Such, then, is the first book, and no one will contradict us when we remark that a student who carefully works out the examples given cannot fail to become perfectly familiar with logarithms and their applications.

The range of the other book is a little wider. Beginning with involution and evolution treated arithmetically, and following with geometrical and trigonometrical definitions, the author leads to logarithms and their simpler applications. The aim of the book is to give a thorough practical knowledge of the use of logarithms and the solution of plane triangles and problems in trigonometry. The general plan adopted is first to state a rule, give worked examples, and then to give a number of exercises on each rule, which may be tested by the answers given.

The omission of the proofs of the rules and formulæ renders the book liable to be looked upon as a cram book, but it is apparently intended mainly for the use of those who simply wish to know how to use logarithms and trigonometry, and to whom proof is of secondary importance.

The exercises given will make both books specially valuable to teachers, for the working of numerous examples is indispensable in the teaching of mathematical subjects.

Elementary Statics. By the Rev. J. B. Lock, M.A. (London: Macmillan and Co., 1888.)

WE gladly welcome another addition to Mr. Lock's excellent series of text-books. To the new terms already introduced by him, another is now added. This is the term "resolute" as a substitution for "resolved part," the argument for the change being that "the idea is so important in the subject that a definite *name* will be found useful." Those who have already become familiar with the older expressions may not be willing to accept the changes, but there can be no doubt that the new expressions are appropriate, and will be of great service to beginners.

The treatment adopted is based upon Newton's laws of motion, the author's opinion being—and we quite agree with him—that this greatly simplifies the subject. The parallelogram of forces is assumed, the student being recommended to postpone the proof until he commences his study of dynamics. The working of examples, as every teacher knows, is the only way to obtain a thorough knowledge of any subject which requires mathematical treatment, and Mr. Lock has fully recognized the importance of this. Typical examples, excellently selected, are worked out at full length, and numerous others are given as exercises. There is also a selection of papers from some of the Oxford and Cambridge examinations. A new departure is the introduction of a short chapter on graphic statics, which we highly approve of. The teaching of this subject has made rapid strides during the last few years, and the methods are so simple, and applicable in cases which would involve laborious calculations, that the introduction of the subject into text-books is very desirable.

The whole subject is made interesting from beginning to end, and the proofs of the various propositions are very simple and clear. We have no doubt that the book will be appreciated by all who have an opportunity of judging of its merits.

Catalogue of the Fossil Reptilia and Amphibia in the British Museum (Natural History). Part I., containing the Orders Ornithosauria, Crocodilia, Dinosauria, Squamata, Rhynchocephalia, and Proterosauria. By Richard Lydekker, B.A., F.G.S., &c. (London: Printed by order of the Trustees, 1888.)

THIS work forms a very valuable addition to the series of British Museum Catalogues, and will be welcomed by all palæontologists as giving a full and complete account of the specimens of fossil reptiles in the National Collection, many of which have an especial interest as being the "type-specimens" on which so many classical monographs have been based.

Mr. Lydekker adopts, with some alterations, the classification proposed in 1885 by Cope, with the modifications recently suggested by Baur. The reasons for the changes he has introduced are fully discussed in the introduction.

Full descriptions of the orders, families, genera, and species, are given in most cases, and the book is illustrated by sixty-nine woodcuts, many of which are taken from the works of Marsh, Dollo, and others. The introduction of the names of many of the larger groups which are not represented in the British Museum collection renders the work more complete, and the addition of so much descriptive matter, and of copious references to the bibliography of the subject, also increases its value far beyond that of an ordinary Catalogue.

The History of Australian Exploration. By Ernest Favenc. (Sydney: Turner and Henderson, 1888.)

THE author of this volume does not profess to give a complete history of the exploration of Australia. Much of the work of exploration has been done by private travellers and adventurers; and it is of course impossible that their labours can ever be adequately recorded. For the fulfilment of such a task the co-operation of hundreds of old colonists would be necessary; and the work, when completed, would not only fill many volumes, but, as Mr. Favenc says, would prove most monotonous reading. He has therefore confined his attention to public expeditions, dividing his subject into two distinct parts—land exploration and maritime exploration. His narrative covers a period of one hundred years—from 1788 to 1888. The book is issued under the auspices of the Governments of the Australian Colonies, and it is in every way worthy of this distinction. Mr. Favenc has invariably gone to the best sources for information, and has produced a record which is not only trustworthy, but full of interest. The value of the book is considerably increased by several maps and facsimiles.

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.*]

The Protest in *The Nineteenth Century*.

THE present age is eminently a sensational one. Everybody deals in superlatives and universals. Morning and evening the newspaper bills vie with each other in appealing to that particular form of curiosity which feeds upon alarms. Our civilization is declared to be altogether wrong. Dr. Pangloss's doctrine is reversed—nothing that is is right. We are incessantly invited to take stock of our arrangements political and social, and treated to denouncements of almost every detail of them. We are too serious, too frivolous, a prey to panics, stolidly blind to dangers, distrustful, credulous. To crown all, what was fondly supposed to be one of the greatest of modern improvements is roundly declared to be a sham; to be worse—a lure to destruction, mental and physical. Loud were the pæans sung some forty years ago over the then new system of competitive examinations which so vexed the soul of the author of "Gryll Grange." Now we are assured that the whole examinational system is utterly stupid, and, in effect, that it were better at once ended than in any way mended.

But literary rhetoric, however brilliant, in these days produces but a momentary impression. We have so much of it that we have come to regard it with the contempt bred of over-familiarity. After the first shock of delight or astonishment has passed off, we begin to look for the facts and criticize the logic. Sweeping phrases, sounding invective, the vigorous style in general, cease to convince. There is too much of the scientific spirit abroad for the roar of the old lions or of the young lions to cause more than a passing alarm. Denunciation is always easy, though not, of course, of the forcible and brilliant kind with which Prof. Freeman and Prof. Harrison have made us familiar, perhaps a thought too familiar. I shall look forward with interest, and with the certainty of some instruction, to the statement which will, no doubt, be forthcoming of the facts the *Nineteenth Century's* protest is based upon, but as a competitive examinationist I look forward to it without anxiety.

Meanwhile, I venture to offer one or two remarks upon a single sentence in the protest. "Again and again," it is said (p. 620), "brilliant young men once full of early promise go down from the Universities as the great prize-winners, and do little or nothing in the after years." The reason, it is added, is that "they have lost their mental life before they are five-and-twenty"; in other words, that the examinational system, *quâ* examinational, has killed in them the love of knowledge by that age—a sad fact enough, if true.

But is it true? Brilliance of parts is not always, I am almost inclined to assert not commonly, accompanied by a disinterested love of knowledge, though often enough by ambition, which is a very different thing; nor, unfortunately, is a love of knowledge always associated with the capacity to gratify it. To many men, again, opportunities fail, or health, or energy of character, or perseverance, or the means enabling them to wait for success in the career chosen, or, lastly, circumstances may have compelled them to adopt an unsuitable career, and so their intellectual lives are wrecked. It is only in respect of the residue remaining after elimination of these cases that the reproaches addressed to the examinational system are capable of being justified. What proportion that residue may bear to the totality of brilliant failures it may be difficult to determine. My impression is that it is a very small one. At any rate, it is so in the University to which I belong—the University of London. So large a proportion of the men who have taken high degrees at that University have in after life fully maintained, to say the least, the distinction of their University record, that the failure of the residue—if such failure there be—may be justly ascribed to causes of the nature above indicated rather than to any ill effect of the examinational system. The assertion may easily be verified by reference to the Honours Lists, more especially in the Faculties of Science and Medicine. I mention these Faculties because it is much easier to trace the after life of graduates in them than in the other Faculties. But on looking over the list of M.A. medallists, I do not find a single name which suggests any lack of after-life response to earlier promise.

Finally, on turning to the University record of many, probably of most, of the eminent men of the day, the very reverse of the alleged disparity between promise and performance upon which the protest is based will be found to exist.

I am, for my part, fully convinced after several years' daily familiarity with the working of a purely examinational system, that in examinations we have the best means yet devised of testing the general ability and attainments of young men and women. And I have shown above that competition does not produce any of the evil results complained of in the protest. On the contrary, I believe it to be in most cases—but certainly not in all—a most useful discipline.

But I have no faith whatever either in piecemeal examinations, or in examinations in technical or special subjects, or in mere manipulative matters. I admit, too, that nothing like sufficient attention is paid to the progressive improvement of examinations in accordance with the advance and increasing volume of knowledge. In particular, the range of optional subjects at higher examinations should be greatly extended, that the test applied to each candidate may better correspond with his opportunities and with his mental structure. Above all, the tendency which unfortunately exists to increase beyond measure the difficulty of examinations requires to be carefully guarded against. Too highly pitched syllabuses necessarily involve a low standard of performance, with the result that the successful candidate and the public are equally deceived. F. VICTOR DICKINS.

Burlington Gardens, November 6.

Gresham College.

THE communication of Mr. R. D. Roberts states that the article of Prof. Ray Lankester "is based entirely upon a misapprehension as to the purpose and function of the London Society for the Extension of University Teaching and its position with regard to Gresham College."

I beg to be allowed to state that I can indorse Prof. Ray Lankester's statements with regard to the London Colleges. It is nine years since my connection with King's College ceased, but for nine years I was a lecturer in the Evening Class Department of the College. I know that the College staff, often at great personal sacrifice on the part of some of its members, threw such energy into the teaching of evening classes that their efforts can best be described as thoroughly educational in the highest sense. The number of lectures in the winter courses were twenty-five to thirty, in the summer ten. They were, as a rule, as complete and advanced as similar courses in the Universities, some of them more complete than such courses elsewhere.

At the time when the Society for the Extension of University Teaching was first established, it appeared to me to be a superfluous and mischievous institution. The leading idea which it communicated to the public by very extensive advertisements and reports of meetings was, that there was no such form of education in London, and that the teachers subsidized by the Society were bringing enlightenment from the Universities of Oxford and Cambridge. For several years there were courses consisting of only three or four lectures, delivered in districts widely separated, as, for instance, in Mile End, Kensington, and Dulwich, while a long course consisted of only ten lectures. There was no curriculum in any one centre in either arts or science. The courses of lectures were not even grouped into Departments or Faculties, such as modern languages and literature, Latin and Greek, ancient history and archæology, pure and applied mathematics, experimental science, or biological science. Desultory instruction, not education, appeared to be the object of the Society. The lecturers were, as a rule, qualified for the duties they undertook; some were eminent men, even of the highest eminence; but I do know that others from the Universities should certainly not have been intrusted with the duty of public lecturers until they had undergone an additional term of instruction and training of at least three to five years as assistants to Professors. The Society provided employment for a number of unemployed graduates from Oxford and Cambridge; and at the time, no doubt, it was considered politic and conciliatory to make an assumption of carrying culture to the masses. The young men were willing to take up such duties, for they gained opportunities for practice in the art of teaching which led to possibilities in the way of promotion. There is little doubt that the Society has improved latterly, and it may or may not deserve to be supported by public subscriptions; but it would be a monstrous injustice to King's and University Colleges to place the funds of Gresham College in the hands of this Society. The injustice would be the greater in the case of King's College, because, as I understand, University College has discontinued its Evening Class Department; but for at least twenty years before this London Society for the Extension of University Teaching was in existence or thought of, the staff of King's College, without endowment, were teaching by night as well as by day, and with inadequate remuneration doing more than fulfilling the intentions of Sir Thomas Gresham. The City clerks, engineers, and manufacturers left their places of business to attend these lectures, and obtained sound theoretical and practical instruction in art and science, ancient and modern literature and languages. I have in mind many who have risen to distinction; and there are, no doubt, thousands who are ready to acknowledge the benefit they derived from the evening classes of King's College.

I doubt whether these facts were placed before Mr. Goschen on the occasion when he made his speech on the subject of this Society and Gresham College. It seems to me that the matter should be put before him and all others concerned in a true and proper light, and without partiality.

In conclusion, I will state it as my carefully-considered and deliberate opinion that the Lecture Society called the London Society for the Extension of University Teaching has done no educational work which for extent or solidity is worth consideration in comparison with that of King's and University Colleges.

W. N. HARTLEY.

Royal College of Science, Dublin, November 9.

Divergent Evolution.

SOME of your readers may possibly remember a paper of mine on "The Variation of Species as related to their Geographical Distribution," which appeared in NATURE, vol. vi. p. 222. About the same time I prepared a paper on "Diversity of Evolution under One Set of External Conditions," which was published in the Linnean Society's Journal—Zoology, vol. xi. pp. 496–505. I refer to these papers simply to say that the problems there discussed have occupied my attention more or less ever since.

Part of my paper relates to the subject discussed by Mr. Romanes in his paper on "Physiological Selection"; but as it has been independently worked out, I believe it will be of interest to all who have followed the discussion on the "Origin of Species." The abstract of Mr. Romanes's paper given in NATURE, vol. xxxiv. pp. 314, 336, 362, did not come into my hands till the following January, when my theory of "Divergent Evolution through Cumulative Segregation" was, for the most part, written out in its present form. Since then, and with reference to the discussion on "Physiological Selection," I have worked out the algebraic formulæ given in the fifth chapter, and have introduced explanations of the same.

My "segregate fecundity" and Mr. Romanes's "physiological selection" are the same principle; and our theories still further correspond in that we both insist on the prevention of intercrossing as a necessary condition for divergent evolution. This conclusion was reached by me through investigations made many years ago, and was maintained in my paper on "Diversity of Evolution under One Set of External Conditions," and in still stronger language in articles in the *Chrysanthemum* (Yokohama), January 1883, and in the *Chinese Recorder* (Shanghai), July 1885. In the first of these papers I used the word "separation" to indicate the phase of the principle that results from migration; but for a fuller discussion of the subject I found it necessary to introduce "segregation" as the more significant term; and in the second paper I maintain that "While external conditions have power to winnow out whatever forms are least fitted to survive, there will usually remain a number of varieties equally fitted to survive; and that, through the law of segregation constantly operating, ... these varieties continue to diverge till separate species are fully established, though the conditions are the same throughout the whole area occupied by the diverging forms;" and in the third paper I said, "I am prepared to show that there is a law of segregation rising out of the very nature of organic activities, bringing together those similarly endowed," and causing "the division of the survivors of one stock, occupying one country, into forms differing more and more widely from each other." Since then, my nomenclature of the subject has been worked out with that word as the central symbol of my theory. It is therefore a pleasure to find that Mr. Romanes uses the same word to express the same general idea, giving to his theory the alternate name of "segregation of the fit" (Linnean Society's Journ.—Zool., vol. xix. pp. 354, 395), and in one place at least describing it as "physiological segregation" (see letter on "Physiological Selection," NATURE, vol. xxxiv. p. 408).

As I have explained in chapter iv., I at first thought of using "physiological segregation" in place of "industrial segregation," but finally concluded that it was a term of such wide significance that it could not be well used as the name of any one kind of segregation, while at the same time it was not broad enough to serve as a general term for all kinds. I therefore greatly prefer the term "segregation of the fit." I would, however, so define it as to cover all forms of segregation.

Though our use of this fundamental word is undoubtedly due to our having the same general truth to express, several divergences appear in the development of our respective theories, tending, we may hope, to a fuller elucidation of the subject.

76 Concession, Osaka, Japan. JOHN T. GULICK.

Alpine Haze.

THE peculiar haze mentioned by Prof. Tyndall is no doubt identical with what is commonly met with in some parts of the Mediterranean. During the hottest and driest weather of the summer, and when no wind is blowing, perfectly horizontal strata of haze can be seen occupying the Gulf of Naples. The peaks of the Sorrentine Mountains, with Solara of Capri, Ischia, Vesuvius, Camaldoli, &c., stand out above this haze. The height of the strata rarely reaches 2000 feet, and is more often about 1500 feet. The same facts that led Prof. Tyndall to consider it other than water vapour, and of micro-organic nature, had produced in my mind similar conclusions. This haze, when looked at near the sea, has often a beautiful pink tint, due, no doubt, to a complementary effect from the sea-water colour, as the colour is more marked on the limestone rocks, where the white sea-bottom makes the water look much greener When, however, the observer is cut off from a view of the green sea for some time, the haze has then a light buff colour. The opacity of this haze is so great as sometimes to resemble a slight London fog.

Anyone who would count the number and study the characters of the organisms and other solid contents of the air here at different times would soon settle the question what this phenomenon is due to, and whether there is any truth in the old *blight*. H. J. JOHNSTON-LAVIS.

Naples, November 4.

The Astronomical Observatory of Pekin.

IN your number of November 8 (p. 46), you gave an account of a lecture by Mr. S. M. Russell, of Pekin, on the instruments in the old Observatory there. May I mention that the late Alex. Wylie, about nine or ten years ago, published a full account of them (with illustrations) in the "Travaux de la 3me Session du Congrès International des Orientalistes," vol. ii. Having had my attention drawn to them by some photographs kindly sent me by Mr. Russell, I pointed out the scientific interest of Ko Show-King's instruments (which anticipated the ideas of Tycho Brahe by three hundred years), in a paper published in the Proceedings of the Royal Irish Academy, vol. iii., 1881, and in *Copernicus*, vol. i. J. L. E. DREYER.

Armagh Observatory, November 12.

AN HISTORICAL AND DESCRIPTIVE LIST OF SOME DOUBLE STARS SUSPECTED TO VARY IN LIGHT.

THE light-changes of double stars are, for the most part, of an intermittent character. Unmistakable at one epoch, they may completely evade detection at another. Hence observations of them which, by the nature of the case, cannot be repeated are apt to incur discredit for lack of confirmation. They should, on the contrary, if properly authenticated, be carefully borne in mind, as testifying to an incident in the history of the stars they refer to which, however apparently isolated, must be extremely liable to recur. We have therefore thought that it would be useful to put together, as concisely as possible, a few facts bearing on the supposed variability of some stars which we may reasonably consider to be physically double, referring those of our readers who desire fuller information on the subject to the original authorities we shall cite for their convenience.

γ Virginis = Σ 1670.—The first observation is by Bradley in 1718. The components, normally of the third magnitude, were regarded as equal by all observers until W. Struve, May 3, 1818, noticed the preceding star as slightly the fainter. It continued so for several years; the difference was obliterated from 1825–31, and reversed, doubtfully 1832–33, certainly in 1834 ("Mensuræ Micrometricæ," pp. lxxii. 4). O. Struve's observations, 1840–74, showed decided variability in a double period, oscillations of half a magnitude in a few days being superposed upon a fluctuation extending over many years. An investigation of the law of change, begun in 1851, led to no result, owing to the low altitude of these stars at Pulkowa ("Obs. de Poulkova," ix. 122). Dawes found them equal, 1840–47; but each alternately about a quarter of a magnitude brighter than the other, 1847–54 (Memoirs R. Astr. Soc., xxxv. 217–19). Similar swayings of lustre were constantly apparent to Dembowski (*Astr. Nach.*, Nos. 1111, 1185, 1979). Each star is given as of 3·5 magnitude (combined 2·8) in the "Harvard Photometry" (see also "Harvard Annals," xiv. 454). Gould assigns to them the combined magnitude of 3·1, Pritchard of 2·67; Gore thought them nearer to the second than to the third magnitude, April 5, 1883 ("Cat. of Suspected Variables," p. 362). (The combined magnitude of two third magnitude stars is 2·25.) Owing to their uncertainty of shining, the angle has often been reversed in measuring these stars. They are of a pale yellow colour, and show a spectrum of the Sirian type. They revolve in a highly eccentric orbit in a period of 180 years, and emit fully sixteen times as much light proportionately to their mass, as the sun.

44 (*i*) Boötis = Σ 1909.—On June 16, 1819, Struve noted a difference of two magnitudes between the components; of one invariably 1822–33, but of only half a magnitude 1833–38. Argelander found them exactly equal, June 6, 1830 ("Mens. Microm.," p. lxxii.). To Dawes, in April 1841, the attendant star seemed a shade brighter than its primary, which was rated as of fifth magnitude (Mems. R. A. Soc., xxxv. 232). Dunér's observations at Lund, 1868–75, confirm their relative variability, causing the disparity between them to range from 0·4 to 1·3 magnitude; and he points out that they appeared to Herschel consider-

ably unequal in 1781, but perfectly matched in 1787. Both stars were yellow in 1875, but the tint of the smaller was at times less deep than at others ("Mésures Microm.," 1876, p. 74). Admiral Smyth marked it as "lucid gray" in 1842; Webb and Secchi respectively found it blue in 1850 and 1859; Webb and Engelmann reddish in 1856 and 1865. The principal star has often been considered as pure white. The spectrum belongs to Class I. The photographic magnitudes of the pair, as determined at Paris in 1886, are 5·3 and 6. Engelmann concluded the smaller component to vary from magnitude 5 to 7, the larger from 5 to 6 (*Astr. Nach.*, No. 1676). They revolve in a period of 261 years, the plane of their orbit passing nearly through the sun. The periastron passage was in 1783. They possess at least four times the solar luminous intensity.

δ Cygni = Σ 2579.—The chief star remains steadily of the third magnitude; its companion varies probably from the seventh to about the ninth. Discovered by Herschel in 1783, it was invisible to him in 1802 and 1804, as well as to his son in 1823, and to South and Gambart, under exceptionally favourable conditions, in 1825 (Phil. Trans., cxiv. 339, cxvi. 376). Struve re-detected it in 1826, since when it has been continuously observed. The fact of its variability has even been doubted (Dunér, "Mésures Microm.," 1876, p. 118; Sadler, *Observatory*, ix. 307). Its changes of colour are, however, unquestionable. Struve marked it as ashen gray, 1826–33, but as remarkably red in 1836 ("Mens. Microm.," p. 297). Dawes found it blue, 1839–41; Secchi, red, 1856·62, blue, 1856·98, violet, 1857·53 (Engelmann, *Astr. Nach.*, No. 1676). Dunér saw it always red, except on one occasion, when it seemed olive. The primary is of a greenish white, and exhibits a Sirian spectrum. The period of 415 years attributed to the pair by Behrmann is probably too long; Hind's, of 179 years, is certainly too short. With Behrmann's elements, the light-power relative to mass comes out *one hundred times* that of the sun.

The three couples just described are the only variable double stars of which the orbits have been computed. We shall now mention a few which have so far described arcs too small to serve as the bases for investigations of the complete ellipses.

ζ Boötis = Σ 1865.—The following component was found the brighter by Herschel in 1796, and by Struve, in general, until 1833, when the order was reversed. They were pretty equal 1821–24 (Pickering, "Harvard Annals," xiv. 458). Their alternating fluctuations were confirmed by O. Struve's observations, 1840–63, since when, until 1878, the preceding star had always the advantage ("Obs. de Poulkova," ix. 143). F. Struve estimated their magnitudes at 3·5, 3·9, adding the remark, "Splendor in altera stella est variabilis" ("Mens. Microm.," p. 21). Their photometric magnitudes were determined at Harvard as 4·4, 4·8, the following star being the brighter. Dawes considered them as equal at 4 or 4·5 magnitude in 1847–48, but each star in turn took a slight lead (Mems. R. A. Soc., xxxv. 229). Dunér noted them sometimes as both of fourth, sometimes as of third magnitude, the changes occurring, as a rule, simultaneously ("Mésures Microm.," p. 68). The colour of these stars is white, or yellowish, and their spectrum well marked of the first type. The period of their revolution must be enormously long, and their mass proportionately small.

π Boötis = Σ 1864.—Gilliss's estimates varied from 4 to 5·6 magnitude for one component, from 5 to 6·7 for the other. Schmidt independently suspected fluctuations (Pickering, "Harvard Annals," xiv. 458). As one object, they were ranked by Abdurrahman Sûfi of fifth, by Lalande of sixth, by Harding, Argelander, and Heis of fourth magnitude. Their combined photometric magnitude was determined at Oxford as 4·1, at Harvard as 4·59. Herschel and South marked them in 1822 "nearly equal" (Phil. Trans., cxiv. 199); Admiral Smyth noted a disparity of 2½ magnitudes ("Cycle," p. 411, Chambers's ed.); and Struve found them of 4·9 and 6 ("Mens. Microm.," p. 97), and they were photographed at Paris as of 5 and 6 magnitudes in 1886. They emit white light of the quality of that of Sirius. An arc of about 4° has been described by the companion since 1781.

ε Arietis = Σ 333.—F. Struve had no doubt of the variability of these stars. His estimates of magnitude ranged from 4·5 to 6·5 for one, from 5 to 6·5 for the other component ("Mens. Microm.," pp. lxxii. 1; Pickering, "Harvard Annals," xiv. 434). Struve in 1827, and Dawes in 1845, found them equal; Secchi recorded a difference of one magnitude in 1855 (Engelmann, *Astr. Nach.*, No. 1676). Measured at Harvard as of 5·2 and 5·5 magnitudes, giving combined magnitude 4·6, they together showed to Piazzi and Bode as a fifth, to Harding as a fourth magnitude star. An arc of 10° has been traversed since 1827 (Crossley, "Hand-book of Double Stars," p. 204). The colour of these stars is white.

S (15) Monocerotis = Σ 950 was discovered by Winnecke in 1867 to vary from 4·9 to 5·4 magnitude in a period of 3d. 10h. 38m. (Gore's "Catalogue," No. 41). A ninth magnitude companion at 2″·8 seems to be in very slow orbital revolution. Struve called their colours green and blue ("Mens. Microm.," p. 65). The spectrum is of the first type.

α Piscium = Σ 202.—The magnitudes of these stars were estimated by F. Struve at 2·8 and 3·9 ("Mens. Microm.," p. 43), by O. Struve at 4 and 5 ("Obs. de Poulkova," ix. 17). Harvard determinations brought them out 4·4 and 5·3, but showed relative variability to the extent of half a magnitude. The larger star has been rated from 2·5 to 5·5 magnitude ("Harvard Annals," xiv. 433), and there is scarcely any doubt that the light of both (which is of the Sirian quality) fluctuates to some extent. The colour of the attendant star changes from blue to ashen olive and tawny (Webb, "Celestial Objects," p. 378, 5th ed.; Flammarion, "Cat. des Étoiles Doubles," p. 12). Slow revolution in a plane nearly coincident with the visual line is probable.

OΣ 256 = Lalande 24098, catalogued at Pulkowa in 1853 as 7 and 7·8 magnitudes at 0″·6, but subsequently found to vary respectively from 7 to 7·8, and from 7 to 8 magnitude. Dembowski thrice noted the preceding star as half a magnitude fainter, while four Pulkowa observations, 1842–61, showed it as much brighter than its companion, equality being twice recorded ("Obs. de Poulkova," ix. 327). Their variability was still more plainly evident by the manner of their occultation, as observed by Mr. Tebbutt, August 22, 1887. Three-fourths of their combined light disappeared instantaneously, leaving the semblance of a "blurred ninth magnitude star," representing, nevertheless, the chief component of recent measures, to be extinguished a little later (*Observatory*, x. 391). The stars have described an arc of 17° since 1842 (Crossley, "Hand-book," p. 287). Their spectrum is given by Von Konkoly as doubtfully of the solar type.

38 Geminorum = Σ 982.—Struve observed differences of lustre ranging from 1·5 to 4 magnitudes ("Mens. Microm.," p. lxxiii.). The inference of variability was ratified by Engelmann (*Astr. Nach.*, No. 1676; "Harvard Annals," xiv. 443). The combined magnitude in the "Harvard Photometry" is 4·8. A spectrum of the Sirian type was registered by Vogel in 1883. Colour-fluctuations seem pretty certain in the small star, which has retrograded 18° since 1782. The system has a common proper motion (Crossley, "Hand-book," p. 233).

Σ 1517.—Struve ranked each member of this close pair as of 7·3 magnitude, with slight alternate superiority ("Mens. Microm.," p. 286). Their variability was confirmed by O. Struve, who estimated their magnitudes at 7 and 7·8. A slow retrograde, and a rapid common proper motion, prove their systemic connection ("Obs. de Poulkova," ix. 106).

The remaining stars on our list are relatively fixed.

Σ 2344.—Magnitudes 8·5 and 10 when first measured by Struve; 8·5 and 12 in 1829, distance = 1″·38. The companion was not again seen until 1835 ("Mens. Microm.," pp. 37, 296). The instability of its light was further attested by its invisibility to Secchi in 1859, to Engelmann in 1865 (Engelmann, *Astr. Nach.*, No. 1674).

Σ 2718.—Components intrinsically equal, but by turns slightly superior. Period of change probably short (Struve, "Mens. Microm.," p. 142).

61 Geminorum.—The brighter component varies from 6 to 7·5 magnitude, the fainter from 9 to seeming extinction (Flammarion, "Les Étoiles," p. 320). The larger star, which is of a deep yellow colour, was recorded by Piazzi as of 7·8, by Heis and Argelander as of sixth magnitude (NATURE, xii. 27; "Harvard Annals," xiv. 445). It was photometrically determined at Harvard as of 5·7 magnitude. Its attendant eluded Webb's search in 1855, Knott's in 1861 and 1871, but was recovered in 1875, when of 12·5 magnitude, by H. Sadler, using a 6½-inch Calver's reflector (Smyth, "Cycle," p. 202; Webb, *Popular Science Review*, xiv. 309). Since these stars are 60″ apart, the probability of their physical connection rests chiefly upon their agreement in exhibiting marked fluctuations of light.

ρ (5) Ophiuchi, described by Admiral Smyth as of 5 and 7·5 magnitudes at 4″; yellow and blue colours ("Cycle," p. 457). But Herschel at the Cape, 1834–37, and Jacob at Madras, 1846, found them exactly equal. Herschel and South in 1824, Secchi in 1856–57, give a difference of one magnitude. Main called them 4 and 4·3, and they were measured at Harvard as 5·3 and 6 magnitudes (Sadler, *Astronomical Register*, xvii. 73; Pickering, "Annals," xiv. 461).

β Scorpii is No. 489 of Gore's "Suspected Variables." F. Struve assigned to the components magnitudes 2 and 4; Pickering, 3 and 5·2, combined, 2·9. J. Herschel found a difference of only one magnitude, Webb of 3½, Gore of 2½ magnitudes (Webb, "Celestial Objects," p. 386; see also NATURE, vol. xxiii. 206, 362). Their colours are yellowish-white and lilac, or (according to Dembowski) ashy green, and they belong to the first spectroscopic class. They are separated by an interval of 14″, but Burnham detected in 1881 a close, faint attendant upon the principal star (Memoirs R. A. Society, xlvii. 193).

θ Serpentis = Σ 2417.—The components are 21″·6 apart, and relatively fixed. Both emit yellowish-white light marked by the Sirian quality of absorption. They were together ranked by Tycho and Bayer as of third magnitude, by Montanari as of fifth, but, with noticeable subsequent brightening (J. Cassini, "Élémens d'Astr.," p. 74). Gould's estimates wavered from 4·1 to 4·6 magnitude, and gave strong evidence of variability in one of the stars ("Uranometria Argentina," p. 322). Gore thinks that its changes may prove to be modelled on those of Algol (Journ. Liverpool Astr. Soc., v. 110). The separate photometric magnitudes registered at Oxford were 3·9 and 4·2; at Harvard, 4·7 and 5·1, where, however, the difference of lustre between the stars was perceived, in 1878, to fluctuate from 0·34 to 1·69 magnitude ("Harvard Annals," xi. 136, xiv. 463). Dunér considered the principal star to be steadily of 4, the companion to vary from 4·2 to 4·7 magnitude ("Mésures Microm.," 1876, p. 112).

Σ 1875 is composed of two white stars at 3″·2, the preceding of about ninth, the following varying from 8·5 to tenth magnitude. Dunér had no doubt of the reality of these changes ("Mésures Microm.," p. 70; Struve, "Mens. Microm.," p. 73).

Atlas Pleiadum = Σ 453.—Found double at 0″·79 by Struve in 1827, doubtfully "wedged" in 1830, single with a power of 800 in a clear sky in 1836 ("Mens Microm.," p. 283). As single it has been seen by every subsequent observer, including Burnham, who at intervals during five years searched vainly for the companion detected and always fully believed in by Struve (Mems. R. A. Soc., xliv. 230). But during the passage of the moon across the Pleiades, January 6, 1876, Hartwig recorded the immersion of Atlas as non-instantaneous, a faint remnant surviving the chief part of the light for six-tenths of a second. He did not then know that the star had been marked at Pulkowa "duplex difficillima" (Winnecke, *Astr. Nach.*, No. 2074).

72 Ophiuchi = OΣ 342 is a somewhat similar example. An eighth magnitude companion at 1″·5 was discovered by O. Struve in 1842, but could rarely afterwards be seen, and excited vehement suspicions of pronounced variability ("Pulkowa Catalogue," No. 342). It was last observed at Pulkowa in 1876, and never elsewhere than at Pulkowa except once by Father Secchi at Rome in August 1859 (NATURE, vol. xvi. p. 194). Newcomb could find no trace of it with the Washington 26-inch on two exceptionally fine nights in 1874, nor Hall in 1876. Burnham was equally unsuccessful, and after much fruitless scrutiny recorded the star as "certainly single" in a "first-class night" of August 1880 (Mems. R. A. Soc., xliv. 276). Its spectrum, like that of Atlas in the Pleiades, is conspicuously of the first type.

β Cygni was found by Klein variable from 3·3 to 3·9 magnitude in 1862–63 (*Astr. Nach.*, No. 1663). Espin holds this star to belong to a distinct class of variables (exemplified by 63 Cygni) which change less than one magnitude in a period of several years (*Monthly Notices*, xliii. 271). Webb and Gemmill agreed, in 1881–82, in finding β Cygni much waned from its former brightness (*Astr. Reg.*, xx. 14, 46). The magnitudes of its components were determined at Harvard as 3·1 and 5·2—conjointly, 3. Their photometric difference, however, appeared, from Oxford measures of November 6, 1882, to be only 1·82 magnitude (*Monthly Notices*, xliii. 102). Although 34″ apart, and immovable, their physical union is decisively affirmed by the splendid contrast of their golden and azure tints, to which complementary absorption-spectra correspond (Huggins, Phil. Trans., cliv. 431).

δ Cephei forms, with a "cærulean blue," seventh magnitude companion at 41″, a pair resembling β Cygni (Webb, "Celestial Objects," p. 270). The large star varies regularly from 3·7 to 4·9 magnitude in 5d. 8h. 48m. The maximum of May 6, 1868, was, however, stated by Schmidt to have been barely indicated (*Astr. Nach.*, No. 1745). A minute attendant at 19″ was discovered by Burnham in 1880. The spectrum of the variable is of the solar type. It has virtually *no* proper motion.

α Herculis = Σ 2140 was divided by Maskelyne, August 7, 1777. The variability of the primary, discovered by Herschel in 1795, ranges from 3·1 to 3·9 magnitude in a period fluctuating between 26 and 103 days (Gore's "Variables," No. 129). The attendant is generally rated at the sixth, but Struve found it to change from fifth to seventh magnitude ("Mens. Microm.," p. 97). The colours of the pair are vividly contrasted orange and emerald. The large star shows a magnificent banded spectrum of III.*a* type; the smaller, one analogous to that of the companion of β Cygni in having its absorption almost wholly below the green (Huggins, Phil. Trans., cliv. 432). The common proper motion of the pair carries them in a century over a space nearly equal to the interval separating them (4″·5).

h 1470 = Lalande 38428.—Both stars are supposed to be variable, but have been little observed. Secchi estimated them of 7 and 8 magnitudes in 1856, and measured their distance at 23″·8. Physical relationship is indicated by their "superb" coloration in red and blue ("Catalogo di 1321 Stelle Doppie," p. 117; Webb

"Celestial Objects," p. 294). The spectrum of the red component resembles that of *a* Herculis (Espin, *Astr. Nach.*, No. 2825).

U Cygni = Schjellerup 239*a* was discovered by Knott, in 1871, to vary from 7·7 to below 11 magnitude in a period of 466 days (Gore's "Variables," No. 163). It had previously been remarked by Birmingham for its deep ruby tint (*Astr. Nach.* No. 1809). An attendant at 62″ appears to fluctuate in light from 8 to 8·7 magnitude, in colour from a decided blue to white and reddish (Birmingham, Trans. R. Irish Academy, xxvi. 300; Tarrant, Journ. Liverpool Astr. Soc. vi. 124; *English Mechanic*, xliv. 368; Gemmill, *ibid.*, xlvi. 340). The spectrum of U Cygni is of III.*b* type, but the zones are feeble (Dunér, "Étoiles de la 3e Classe," p. 73).

U Cassiopeiæ = OΣ (App.) 254.—A pair very similar to the preceding. The red star (= Schjellerup 280) varies from 7 to 9, the blue from 8 to 10 magnitudes, both in uncertain periods. Their distance, as measured by Dembowski in 1873, and by Burnham in 1881, is 58″·84 ("Publications of Washburn Observatory," i. 157).

U Puppis = Lalande 14551, found by Espin in 1883 to vary from 6 to 6·8 magnitude in 14d. 0h. 21½m. (*Monthly Notices*, xliii. 432). Burnham resolved it January 28, 1875, into two components, respectively of 6·5 and 8·5 magnitudes at 0″·8 (*Astr. Nach.*, No. 2062). Colour yellowish; spectrum of the solar kind. Proper motion insensible (Sadler, Journ. Liverpool Astr. Soc., v. 142). With a ninth magnitude star at 20″, it forms the fixed pair Σ 1097.

U Tauri is no longer included in lists of variables, the fluctuations noticed by Baxendell, 1865–71, having ceased to be perceptible (Schönfeld, *Jahresbericht*, Mannheim, xl. 51). It is unknown whether they affected one or both of two nearly equal components of 9·7 magnitude (distance 4½″), into which Knott divided the star, December 4, 1867 (Mems. R. A. Soc., xliii. 78). This interesting object has received little or no attention of late.

η Geminorum was discovered by Burnham at Mount Hamilton, November 11, 1881, to be made up of a third and a ninth magnitude star at 0″·96. "A splendid unequal pair," he remarked, "and likely to prove an interesting system" (Mems. R. A. Soc., xlvii. 204). He re-examined it at Dearborn a couple of months later, but we are not aware of any subsequent observation. The variability of η Geminorum in a period of 229 days was noticed by Schmidt in 1865. Its greatest extent of one magnitude is rarely attained, and the phases often seem nearly obliterated (Schmidt, *Astr. Nach.*, Nos. 1745, 1988, 2297.) The spectrum is an ill-marked specimen of Class III.*a*.

Y Virginis = Lalande 25086 was found by Schmidt in 1866 to vary from fifth to eighth magnitude in an undetermined period (*Astr. Nach.*, No. 1597). Ptolemy marked it of fifth, Abdurrahman Sûfi as approaching sixth magnitude (Schjellerup, "Description des Étoiles," p. 160). Piazzi catalogued it eighth, but observed it 6·7 and 7 magnitude. It figures in Lalande as of 6·5, in the Madras and Brisbane Catalogues as of sixth magnitude (NATURE, vol. xx. p. 248; "Harvard Annals," xiv. 456). Photometrically determined at Harvard, it came out of 5·7 magnitude. It is the only "Sirian" star showing considerable irregular fluctuations. Its duplicity was detected by Burnham in 1879, the components (0″·48 apart) being estimated as of 6·2 and 6·5 magnitudes. Re-measurements on three nights of 1881 gave no conclusive evidence of change (*Observatory*, iii. 92; Mems. R. A. Soc., xlvii. 190).

A. M. CLERKE.

NOTES.

THE medals of the Royal Society have this year been awarded as follows:—The Copley Medal to Prof. Huxley, for his investigations on the morphology and histology of vertebrate and invertebrate animals; the Rumford Medal to Prof. P. Tacchini for his investigations on the physics of the sun; and the Davy Medal to Mr. W. Crookes, for his investigations on the behaviour of substances under the influence of the electric discharge in a high vacuum. The Royal Medals have, with the approval of Her Majesty, been awarded to Baron Ferdinand von Mueller, for his investigations of the flora of Australia, and to Prof. Osborne Reynolds, for his investigations in mathematical and experimental physics. The medals will be presented at the anniversary meeting on November 30.

FREQUENT application having been made to Mrs. Spottiswoode for copies of papers by her late husband, the President of the Royal Society, she has decided to have them published in a collected form. The collection and editing of the mathematical papers she has intrusted to Mr. R. Tucker.

THE tone of the debate on the Education Estimates last Friday was eminently satisfactory. All who took part in it seemed to recognize that our system of elementary education is still very far from perfection. Sir John Lubbock evidently expressed the general feeling of the House of Commons when he complained that "the great faults of the present system were that it was too bookish and too dry." Mr. Mundella had a good deal to say—and said it well—on the necessity of the education of children being carried on to a much more advanced stage than that at which it now usually stops. "So long as the school life of the child was so short and limited," he said, "it was no use, in his judgment, talking about improved methods or an improved curriculum. So long as a child could enter a factory as a half-timer at ten years of age, or, as was the case in 8000 or 10,000 parishes in England, children were allowed to leave school after passing Standard IV., it did not matter what their curriculum was, or what their methods were, they could have no good results. It was impossible for them to force a number of compulsory subjects into a child who was to follow the plough-tail before he was eleven years of age. In the counties around London it was found that children left school after passing Standard IV., which they generally did about ten. There could not be a greater waste of money than to educate a child up to ten years of age at the expense of the State, and then turn him out into the world, the eventual result being that by the time he had reached thirteen he had forgotten everything he had learnt." After quoting from the report of Mr. Matthew Arnold as to the curriculum in force in Germany, showing that in Hamburg, for instance, there are thirteen obligatory subjects taught in the elementary schools, English being one of the subjects, Mr. Mundella pointed out that in Prussia no child leaves school until he is fourteen. Even after he leaves school, unless he can satisfy the school authorities, he must attend the continuation schools until he reaches sixteen or seventeen years of age.

ADMIRAL MOUCHEZ has received a magnificent set of photographs sent by the French Embassy at Pekin, illustrating Mr. Russell's lecture on the Pekin Observatory, of which we gave an account last week. These photographs will be exhibited in the astronomical museum of the Paris Observatory.

DURING the recent meeting of the British Association at Bath, Mr. G. J. Symons found in the Jenyns Library a manuscript meteorological register of considerable importance—namely, the original daily records kept by the Rev. James Cowe, at Sunbury Vicarage, Middlesex, from 1795 to 1839. It gives barometer, maximum and minimum temperatures, wind, rain, and remarks for each day. This record covers a period respecting which there has been much uncertainty as to both temperature and rainfall, and several meteorologists are of opinion that it should in some way be rendered generally accessible. The Rev. Leonard Blomefield (formerly Jenyns), to whom the manuscript belonged, has given his consent to its being copied, and an estimate has been obtained of the cost of copying it, and of preparing a lithographed reproduction as a foolscap folio volume of about 530 pages. This can be done, if sixty persons will subscribe a guinea each. As the volume will be one of great interest to all students of meteorology, Mr. Symons should not have much difficulty in obtaining the necessary funds. The sum of £24 has already been promised by various scientific societies and individual subscribers. Not one copy more than those subscribed for will be printed, so that the volume can only be obtained by subscription, and can never become cheap or common.

THE *American Meteorological Journal* for October contains an article by Mr. A. L. Rotch on the organization of the Meteorological service in Russia. Observations were first made there by the Academy of Sciences in 1726, but it was not until 1833 that a regular system was established. Weather telegraphy was begun in 1864, but little was done until 1872, when a daily weather report was commenced, but forecasts are not issued even now. The same number contains a summary of experiments by MM. C. Montigny and F. Dechevrens on the inclination of the wind, in contradistinction to its horizontal motion usually referred to. One interesting fact has come out of these experiments, viz. that the positive inclination (ascent) of the wind increases in proportion as the barometer falls, and *vice versâ*. We regret to see that the closing of the stations on Pike's Peak and Mount Washington, at least for the winter season, is an accomplished fact. The reason is said to be lack of funds, and the impossibility of using the observations for weather predictions. The detailed observations on Pike's Peak are about to be published by Prof. Pickering in the Annals of Harvard College.

THE Pilot Chart of the North Atlantic Ocean for October, shows that the month of September was characterized by the occurrence of three West Indian hurricanes. By far the most notable of these was the great Cuban hurricane of September 1–7, referred to in NATURE, vol. xxxviii. p. 485. The first indications of this disturbance were noticed in the north-east trade-wind belt, east of the 60th meridian, on August 30 and 31. Taking a west by north course, the centre reached the Cuban coast on the night of September 3, spreading devastation on every side. After passing south of Havana on the 5th, a most remarkable feature was developed by a change of direction to the south of west, in violation of the usual law of motion, the storm reaching Mexico, near Vera Cruz, on the 7th. This unusual change of direction was apparently due to the fact that another well-defined storm originated in the same locality about the same time. This storm was central over the Bahamas on the 6th and 7th, while an area of very high barometer prevailed over the middle Atlantic States. There was a marked decrease in the amount of fog along the Transatlantic routes, which is attributed to the fact that only three depressions of any extent passed over those regions during the month. One of these, which developed hurricane force on the 12th in longitude 37°, subsequently passed north of the British Islands, after having crossed the entire ocean.

THE *Russian Gazette* of September 10/22, 1888, announces that the Committee of the Caspian Fisheries has deposited in the Astrakhan branch of the Imperial State Bank the sum of 5000 roubles (about £500) as a prize to be awarded for the discovery of means for the protection of fish against infection, and for the treatment of people suffering from the effects following the consumption of poisonous fish. The prize will be awarded to the person who will accomplish the following: (1) determine by careful analysis the physical and chemical nature of fish poison; (2) investigate by experiments on animals the action of fish poison on the heart, circulation of the blood, digestive organs, and nervous system; (3) determine the rapidity of the absorption of the poison in the digestive channels; (4) ascertain and describe the symptoms which distinguish healthy fish from those in a diseased condition; (5) indicate the measures to be adopted for preserving fish against the development of fish poison in them; (6) discover an antidote for, and the nature of the medical assistance to be rendered in cases of fish poisoning. Both Russian and foreign men of science may compete for the prize. Essays on the subject may be written either in the Russian, Latin, French, English, or German languages, and may be sent in print or manuscript not later than January 1/13, 1893, to the Ministry of Imperial Domains. The non-solution of questions Nos. 4 and 5 of the foregoing questions will not be considered an obstacle to the award of the prize in full; should the other four questions be satisfactorily dealt with. In case it be considered that not one of the essays or works submitted has solved the problem in its most essential parts, the Commission to which the essays will be submitted may award as a secondary prize the sum which shall have accrued as interest during the five years on the sum of 5000 roubles to the author of the work which shall have satisfactorily dealt with a portion of the programme, and which may facilitate a further study of the nature of fish poison.

THE following figures give some idea of the number of animals killed every year in Siberia for the sake of their furs. At the last summer fair of Irbit, which is a market for only a part of the furs exported from Siberia, no less than 3,180,000 furs of squirrels were offered for sale. Of these, 1,018,000 were killed in the forests of Yeniseisk, 455,000 in the Altai Mountains, 200,000 in Yakutsk, and 300,000 in Transbaikalia. A considerable number of the furs of squirrels killed in the last two provinces are exported directly both to China and to Russia, without passing through Irbit. It is worthy of note that this year there was a considerable decrease in the furs of the black squirrel. Only half a million of these furs were brought to the fair, as against more than a million in 1887. Of other furs there were 11,000 blue fox (*Canis lagopus*), from Obdorsk and Berezoff; 140,000 marmots, chiefly from the Altai; 30,000 polecats, 10,000 badgers, 1,300,000 hares, 2000 foxes, and numbers of bears and wolves. The extermination of fur-bearing animals goes on with such rapidity that there are whole regions where hunting has been completely abandoned in consequence of the complete disappearance of the Mustelidæ and the rarity of the squirrel.

THE November number of the *Kew Bulletin* contains valuable papers on Lagos rubber, Liberian coffee at the Straits Settlements, tea oil and cake, Demerara pink root, food grains of India (continued), Yoruba indigo, Trinidad ipecacuanha, treatment of vines in France, huskless barley, and ramie.

THE current number (vol. xxii. New Series, No. 5) of the Journal of the North China Branch of the Royal Asiatic Society is wholly occupied by the first part of a paper, by Mr. A. Henry, on the Chinese names of plants. This instalment contains 565 items. The names are those in colloquial use at Ichang, a town on the Yang-tsze, and the neighbourhood. First we get the Chinese name in Latin letters, then in Chinese characters; these are followed by the scientific name, which is in nearly every case taken from lists compiled at Kew, and by a general description of the plant, and occasionally the use to which it is put by the people. The second part will contain additions to the list, and notes concerning the plant-names that occur in Chinese botanical works.

The zinc, manganese, and cobalt salts of molybdic acid, H_2MoO_4, have been obtained pure and in fine crystals by M. Coloriano, of Bucharest. Although molybdenum is so interesting an element, forming as it does such a beautifully graduated series of oxides and their corresponding salts, it is rather remarkable that so little is yet known concerning the most important of these latter, the molybdates. On attempting to obtain the zinc, manganese, and cobalt molybdates by double decomposition, using solutions of known strength of the nitrates of the metals in question, and of ammonium molybdate, amorphous precipitates were thrown down, consisting of hydrated acid salts of molybdic acid. On digesting these precipitates for a short time with water, it was found that they became rapidly converted into a mass of crystals, which were eventually separated from the remaining amorphous substances, washed and dried. They were then subjected to analysis, and were found to be normal molybdates, containing water of hydration so firmly combined that the first traces only commence to be expelled at 150° C. and perfect dehydration cannot be effected lower than the temperature of boiling sulphur (447°). Hence it is concluded that the water present is of "constitution." The crystals of zinc molybdate, $ZnMoO_4 . H_2O$ or $MoO_2 \begin{cases} OH \\ O-Zn-OH \end{cases}$, are transparent and colourless, forming acicular stellar groups. They dissolve but sparingly in water, readily, however, in dilute acids. The manganese salt, $MnMoO_4 . H_2O$, is probably isomorphous with the zinc molybdate just described, the crystals being very similar in form, but distinguished by possessing a bright yellow colour. The cobalt compound, $CoMoO_4 . H_2O$, is also similar in constitution, but the crystals are very much more beautiful. They exhibit a magnificent violet colour, and are almost insoluble in pure water, though readily dissolved by even very dilute acids. All three salts are probably isomorphous, and are similarly attacked by alkalies. An analogous nickel salt was also obtained, the crystals being of precisely the same habit as the three salts above described; but owing to the extreme slowness with which the amorphous acid salt is converted into the crystalline normal one, sufficient quantities have not yet been obtained pure for analysis. From the description given, however, by M. Coloriano, it may be accepted that zinc, manganese, cobalt, and nickel form isomorphous normal molybdates each containing one molecule of water of hydration.

An interesting paper on "the nephrite question," by Dr. A. B. Meyer, is printed in the *American Anthropologist*. Dr. Meyer is of opinion that too much has been made of the fact that objects of nephrite and jade have been found in districts where these minerals in their natural state have not yet been discovered. It is rash, he thinks, to conclude that the objects must have been brought from a great distance. Prehistoric men may, he suggests, have found nephrite and jade in places where they have escaped our notice. "It may be that the people of prehistoric times continually sought the valuable material in a way quite different from the one we adopt. That boulders in the rivers formed their main source of supply is proved by the fact that a large number of the hatchets show the boulder characteristics, and they certainly left no stone unturned in their endeavour to find them, while we never think of looking for them in rivers. They may also have searched for still greater finds, the last view being supported by the fact that finds have been made as late as the last century in North Germany, in the sand near Potsdam, at Schwensal, near Merseberg, and at Leipzig, and these were evidently nephrite boulders of the North German diluviums. The remarkable block at Leipzig weighed over 38 kilogrammes; it is looked upon by Prof. Fischer and others as having been accidentally lost at that place, and they think that the raw material is of Asiatic origin. Considering that the block weighed nearly 100 pounds, this is not very likely, and I am of the opinion that this nephrite boulder came from Scandinavia, and that it was transported by ice."

Lieut. D. Bruun, of the Danish army, having had a moss dug out in Finderup, in Jutland, has made some interesting discoveries. In the moss were found trunks of oak, beech, and fir trees, from 6 to 30 inches in diameter. The branches had in some cases been cut off, but the bark remained. By the side of one of the oak trunks two earthen vessels were discovered, and near another a third, shaped like an urn. In the latter lay a sandal cut from a piece of leather, with flaps, and leather straps for tying to the ankle, the length of the sandal being 7 inches. It seemed as if the trunks of trees had been placed in a certain position for some purpose or another. About 20 feet further to the south, and at the same depth, viz. 6 feet, a yoke of oak was found, 5½ feet long and 3 inches thick, being fairly cylindrically cut out in the centre. At each end were holes, in one of which remained a strap of leather. Other implements of oak were also found, evidently used for carrying. Some of them seemed part of a wheel. Close to the yoke another earthen urn was discovered, which, like the three referred to, was surrounded with sprigs of heather and bramble. Formerly some horns of bullocks and the skeleton of a man in a fur coating were found in the moss. The various objects are now in the Copenhagen Museum, and are said to date from the early Iron Age.

During the past summer a great "kitchen-midden" at Grenaa, in Jutland, was the subject of research by the authorities of the Norse Museum at Copenhagen. It is situated a couple of miles from the sea in the midst of a wood. The layers in the midden were clearly defined, the numerous places of cooking being made conspicuous by ashes and remains of charcoal, together with fragments of coarse pottery. A large quantity of animal remains were found, viz. knuckles and bones, which had been split in twain or crushed and the marrow extracted. There were also many shells of oysters and other mollusks. The bones were those of deer, boar, seal, fox, wolf, dog, swan, and goose, with some of fish. Many flint weapons and implements were found, as well as some of horn and bone. Several of the latter had traces of ornamentation.

We have received the Report of the Survey of India for the year ending September 30, 1887. During the year, the trigonometrical party has extended the triangulation on the Madras coast 170 miles, this being part of the general scheme to complete the triangulation on the coasts of India and Burmah. The aggregate results of the topographical surveys amounted to 17,510 square miles, and the areas of forests to 34,289 miles. In Basti, close upon 2,000,000 plots were cadastrally surveyed, the extent of each only averaging 0·27 of an acre; in Gorakhpur, in a considerably larger area, less than 1,000,000 plots were surveyed. After a little preliminary difficulty, it was found possible to advantageously employ village natives in this work. Altogether, 4273 square miles were cadastrally surveyed. A new map of Calcutta, on a scale of 50 feet to an inch, has also been undertaken. The longitude determinations have been suspended, but the latitudes of five stations on the meridian of 80° have been completed. Advantage has been taken of the various military operations in Upper Burmah to record additional geographical information. The total number of maps issued amounted to 178,398. At Dehra Dun, photographs of the sun were taken for the Solar Physics Committee, South Kensington, on every available day—in all, sixty-three days being lost. Attempts were also made to photograph the corona by means of stained plates, but their success seems somewhat doubtful. As usual, the Report is accompanied by maps showing the extent of the various operations.

THE Sebastopol Biological Station, under Dr. Sophie Pereyaslavtseva, continues to bring out important biological works. In the last number of the *Bulletin* of the Moscow Society of Naturalists (1888, No. 2), Mrs. Pereyaslavtseva publishes (in French) the first instalment of a most valuable work which she has written in association with Miss Marie Rossiiskaya, on the embryogeny of the Amphipods, being a continuation of her previous studies in the embryogeny of Rotifers. The development of *Gammarus pœcilurus* is described in the first part of the work, and an idea of its detailed character may best be given by mentioning that the various stages of development of that one species are illustrated by no less than one hundred and twenty microscopical sections beautifully printed in colours. Two more representatives of Amphipods (*Caprella* and *Orchestia*) have been studied in the same way, while the lady students who work at Sebastopol under the learned lady-director of the station are now studying other species of Amphipods, and especially of *Gammarus*; so that a complete work on the embryogeny of that important zoological division is expected to be ready by the end of the autumn. For the present, Mrs. Pereyaslavtseva refrains from suggesting general conclusions, but at the end of her monograph she points out that throughout the embryonal development of *Gammarus pœcilurus* the cells of its tissues are endowed with amœboid movements. Those movements are less pronounced in the ectodermic and mesodermic layers, and yet the cells of the former are moving and protruding pseudopods even when the endodermic layer has taken the shape of a fully formed pouch, and its constitutive cells may be considered as epithelium. As to the cells of the mesoderm, they maintain the capacity of both locomotion and overlapping (*chevauchement*) even at very advanced stages of the development of the embryo—that is, until the elaboration of the muscular tissue has been completed. These phenomena have been noticed in all the three genera of Amphipods already studied, and most probably they are common to all Amphipods.

MESSRS. MARION AND CO. send us an account of a "detective camera" which has been planned to meet the requirements of the inexperienced as well as the experienced in photography. It has the appearance of a leather dressing-case or despatch-box, and has the special advantage that the person using it sees the exact picture he is to get on his plate, the same lens giving the image on the screen and taking the negative. Another "detective camera" of which Messrs. Marion and Co. have issued a description is in the form of a book, and can be used secretly, since there is nothing to indicate its real purpose.

IN an article on "Irregular Star Clusters" (NATURE, November 1, p. 13), it was stated, with regard to an apparent member of a scattered group in Ophiuchus, that its position "was found, by the comparison of photographs taken by M. von Gothard in 1886 with Vogel's measures of eighteen years previously, to have changed to the extent of 45″, or at the rate of 2½″ annually (*Astr. Nach.*, No. 2777)." Dr. H. Kreutz, of the Kiel Observatory, writes to us to say that more recent measures of Dr. B. von Engelhardt (*Astr. Nach.*, No. 2859) have proved this to be incorrect. The difference between Gothard's photographs and Vogel's measures was due to an error in Vogel's work.

THE additions to the Zoological Society's Gardens during the past week include two White-tailed Eagles (*Haliætus albicilla*), British, presented by Mr. R. H. Venables Kyrke; two Short-eared Owls (*Otus brachyotus*), captured in the Red Sea, presented by Captain John Marr; a Little Grebe (*Tachybaptes fluviatilis*), British, presented by Mr. Howard Bunn; two Spotted Ichneumons (*Herpestes nepalensis* ♂ ♂), an Indian Otter (*Lutra nair* ♂) from India, a Sclavonian Grebe (*Podiceps auritus*), British, deposited; four Knots (*Tringa canutus*), European, purchased.

OUR ASTRONOMICAL COLUMN.

THE TOTAL SOLAR ECLIPSE OF AUGUST 29, 1886.—Part 5 of vol. xviii. of the Annals of the Harvard College Observatory, contains an account by Mr. W. H. Pickering of his expedition to Grenada in 1886 in order to observe the total eclipse of August 29; and some points in his report have recently been commented on by Mr. W. H. Wesley (*Observatory*, October 1888) and Mr. Ranyard (*Knowledge*, November 1888). Mr. Pickering's original plan of work had been a very wide one, and he took out a great variety of instruments with him, but no assistants besides his wife and a lady friend. It was very late in August before he arrived at Grenada, and this circumstance and the frequent obscuration of the sun before totality on the day of the eclipse caused several items of his programme to result in complete failure. The long focus photoheliograph and the actinometer under Mr. Pickering's own superintendence gave no results, but Mrs. Pickering secured three photographs with a couple of short-focus cameras, and Mr. Glean one with a telescope of 4 feet focus. One of Mrs. Pickering's photographs supplies some very curious features in the shape of some very faint extensions of the corona on the western side of the sun. One of these is a prolongation of a bright synclinal mass, and rises in a narrow jet to a height of 48′ from the limb, and then divides into three parts, two falling back towards the sun right and left of the centre ray, which attains a total height of 60′, then to bend over in a precisely similar fashion. Another extension further to the north rises to about the same height, 60′, and then curves downward again.

Mr. Pickering's spectrum photographs afforded little fresh information, but confirmed Prof. Tacchini's observation of "white" prominences; and two of his small coronal photographs were used to give a determination of the brightness of the corona. These gave the total actinic brilliancy of the corona with the surrounding sky as 700 units, or ten times that of the full moon with surrounding sky. But the *intrinsic* actinic brightness of the brightest part of the corona was only 0·03, whilst the average intrinsic brightness of the sky 1° from the sun on a fine day was determined to be 1200 times as great.

COMET 1888 *f* (BARNARD).—Dr. R. Spitaler has computed the following elements and ephemeris for this comet from observations made at Mount Hamilton, October 30, at Vienna, November 2, and at Hamburg, November 5:—

$$T = 1888 \text{ September } 10{\cdot}82914 \text{ Berlin M.T.}$$

$$\left.\begin{aligned} \pi &= 65^\circ\ 0'\ 12'' \\ \Omega &= 137\ 34\ 17 \\ \iota &= 55\ 17\ 10 \end{aligned}\right\} \text{Mean Eq. } 1888{\cdot}0.$$

$$\log q = 0{\cdot}16873$$

Error of middle place (O – C).

$$\Delta\lambda \cos\beta = -4''\ ;\ \Delta\beta = 0.$$

Ephemeris for Berlin Midnight.

1888.	R.A. h. m. s.	Decl. ° ′	Log Δ.	Log *r*.	Brightness.
Nov. 16	10 5 37	12 25·4 S.	0·2197	0·2414	0·96
20	10 9 56	11 34·3	0·2141	0·2487	0·95
24	10 13 50	10 39·0	0·2081	0·2561	0·94
28	10 17 46	9 38·2 S.	0·2018	0·2636	0·94

The brightness at discovery is taken as unity.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 *NOVEMBER* 18–24.

(**FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.**)

At Greenwich on November 18

Sun rises, 7h. 26m.; souths, 11h. 45m. 26·0s.; sets, 16h. 4m.: right asc. on meridian, 15h. 37·2m.; decl. 19° 25′ S. Sidereal Time at Sunset, 19h. 57m.

Moon (Full on November 18, 15h.) rises, 4h. 32m.; souths, 0h. 5m.*; sets, 7h. 49m.*: right asc. on meridian, 3h. 59·3m.; decl. 16° 30′ N.

Planet.	Rises.	Souths.	Sets.	Right asc. and declination on meridian.	
	h. m.	h. m.	h. m.	h. m.	° ′
Mercury..	5 28	10 31	15 34	14 22·4	11 43 S.
Venus ...	10 27	14 7	17 47	17 59·6	25 7 S.
Mars ...	11 41	15 34	19 27	19 26·1	23 28 S.
Jupiter ...	8 50	12 53	16 56	16 45·5	21 54 S.
Saturn ...	22 15*	5 41	13 7	9 31·6	15 38 N.
Uranus...	3 56	9 23	14 50	13 14·7	7 15 S.
Neptune..	16 22*	0 7	7 52	3 57·1	18 41 N.

* Indicates that the rising is that of the preceding evening and the southing and setting those of the following morning.

Variable Stars.

Star.	R.A.	Decl.		h. m.	
	h. m.	° ′			
S Ceti	0 18·4	9 57 S.	Nov. 19,		*M*
U Cephei	0 52·4	81 16 N.	,, 20,	0 47	*m*
Algol	3 0·9	40 31 N.	,, 19,	22 11	*m*
			,, 22,	19 0	*m*
λ Tauri...	3 54·5	12 10 N.	,, 18,	22 59	*m*
			,, 22,	21 52	*m*
ζ Geminorum ...	6 57·5	20 44 N.	,, 18,	23 0	*m*
			,, 23,	23 0	*M*
R Canis Majoris ...	7 14·5	16 12 N.	,, 18,	5 5	*m*
W Virginis	13 20·3	2 48 S.	,, 23,	1 0	*M*
S Coronæ	15 16·8	31 46 N.	,, 22,		*m*
β Lyræ...	18 46·0	33 14 N.	,, 18,	0 0	*m*
R Lyræ	18 51·9	43 48 N.	,, 18,		*m*
T Vulpeculæ ...	20 46·7	27 50 N.	,, 21,	0 0	*M*
Y Cygni	20 47·6	34 14 N.	,, 19,	2 30	*m*
			,, 22,	2 24	*m*
δ Cephei	22 25·0	57 51 N.	,, 18,	4 0	*m*
			,, 19,	19 0	*M*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A.	Decl.	
Near κ Leonis	140°	27° N.	Very swift.
,, θ Ursæ Majoris ...	143	50 N.	,, ,,
,, λ Ursæ Majoris ...	154	40 N.	Swift; streaks. The *Leo Minorids.*

GEOGRAPHICAL NOTES.

We are glad to learn from Denmark that Dr. Nansen has been successful in crossing Greenland. Dr. Nansen, it will be remembered, left the ship in a boat off the south-east coast of Greenland, 65° 2′ N., on July 17. He knew his party had to sail south among the ice for twelve days before they succeeded in landing to the north of Cape Farewell in lat. 61°. As he came out at Godthaab, on the opposite coast, in October, he has taken about three months on the journey, which was made in a line about sixty miles south of that he intended to follow. The section crossed by Dr. Nansen's expedition is in the south and narrow part of Greenland, Nordenskjöld's route having been much farther north, and almost in the centre of the land. Unfortunately, Dr. Nansen just missed the last ship from Greenland to Europe, so that he will have to remain at Godthaab till May next. Until then we must wait for full details.

The paper read at the first meeting this session of the Royal Geographical Society, on Monday night, was by Mr. H. H. Johnston, H.M. Vice Consul for the Oil Rivers, on the Niger Delta. The "Oil Rivers," Mr. Johnston said—so called from the fact of their producing the bulk of the palm-oil exported from West Africa—are the main rivers, creeks, and estuaries lying between the eastern boundary of the British colony of Lagos and the northern frontier of the German Protectorate of the Cameroons. They are chiefly branches of the Niger, and form the Niger delta, but some few of them have sources independent of that great stream; although close to the sea-coast, within tidal influence, the estuaries of these rivers are interconnected by a wonderful network of more or less navigable creeks. This system of natural canalization is here and there blocked with vegetable growth, sandbanks, fallen trees, or artificial obstacles constructed by quarrelsome or timid natives; but with a relatively small amount of labour and at a moderate cost, the creeks in places might be deepened and cleared, and inland navigation rendered practicable between Dahome and the Cameroons Protectorate. Mr. Johnston then gave a graphic description of these rivers as they present themselves to one arriving on the coast from Europe. Arriving from Europe by sea, it is generally by the soundings and discoloured appearance of the water that we become aware of the near approach to land, rather than by sighting any part of the shore. When within a few miles of the mouth of one of these rivers, the low coast-line is at first indicated by isolated trees, which appear islets of forest unconnected with each other, and distorted by the mirage of each horizon. Gradually these islets, which are really the loftier trees of the fringe of coast forest, become united in one line of purple green, divided only by the imposing gate of the estuary, for which our ship is bound. The bar of the river may be—as in the case of Old Calabar and Bonny—so deep as to be without danger, or it may be relatively shallow, as at Opobo or Akasa. Once over the bar and within the estuary, we find ourselves surrounded by a lake-like expanse of smooth water, the shores of which are fringed with lofty mangroves with their ghastly white blood-streaked trunks—streaked where the bark has been torn or frayed—and their graceful poplar-like foliage of a sad, dull, yellow-green. Behind the mangroves, however, generally show the dark and dense masses of inland forest, growing where the land has acquired firmness and lies just above the limits of high tide. As far as can be seen from the ship's deck, all and everything that is not yellow water is unvarying mangrove. As you ascend the river further and further from the sea, the mangrove loses its exclusive possession of the shores, even if this possession be not here and there broken by little islets of firm land covered with varied vegetation, and generally the sites of villages. Almost before the water has ceased to be brackish, the Pandanus or screw-pine begins to oust the mangrove, and below its fantastic whorls of spiny leaves the lovely Lissochilus orchids conceal the black mud with their leaves, and rear their stout flower-stems to a height of 6 or 7 feet. As the river is ascended still further, though the banks continue marshy, the now perfectly fresh water enables a varied forest to replace the mangrove and Pandanus, and here perhaps the most extravagant development of vegetation may be seen, recalling past geological epochs rather than the poor and mediocre aspects of Nature at the present time. There is not one prominent kind of tree, but an infinite variety of kinds. There is every type of foliage and every shade of green. At the base of the forest on the water-line grow great Arums of the genus *Cyrtosperma*, with flower spathes of pale green streaked with purple red. Above the Arums gleam out the white bracts of a species of *Mussaenda*, while higher up another *Mussaenda* exhibits huge creamy-white flowers without any bracts at all, and yet another species of this beautiful genus has blossoms of a vivid scarlet. Over the lower branches of the trees hangs a thick green veil of convolvulus, dotted at intervals with large mauve flowers. The Raphia palms are also a characteristic of this river-side forest. Ascending this typical river still further, the marshy banks gradually become firm dry land, and the ground even rises from the water into wooded heights. Gradually the river narrows, and the banks increase in height, and red clay now gives place to outcropping rock. Looking interiorwards beyond the vista of the winding river is the exhilarating prospect of a faint blue range of hills. All influence of the tide has ceased, and the current becomes more rapid. It may be hours, or it may be days or weeks, before we reach the outlying spurs of the first range of hills, the first ascent to the central plateau, over the rapids and falls which mark the change from the interior to the coast region. Here you are out of the forest region of West Africa, in the great park-lands of the interior. Mr. Johnston then went on to describe in detail some of the more important places and districts comprised within the British Protectorate of the Niger Territories.

In a paper read before the last meeting of the Berlin Geographical Society, Dr. von der Steinen described his second exploration on the Xingu, which began at Rio Janeiro in February 1887, and ended at Cuyaba, the capital of Matto Grosso, on December 31 last. The traveller summed up the main results of his journey thus: the topographical survey of the region through which he passed, numerous physical measurements, a complete grammar of the Bakairi of the Xingu, various vocabularies, and a rich collection of the most varied ethnological objects. During his long residence amongst the Xingu Indians, with whom he was on the most friendly and familiar terms, he was enabled to obtain a deeper insight into the manners and ideas of primitive man in the early stages of his culture than any other traveller. Unfortunately, a chest containing his geological specimens was lost, and many of the photographs were injured.

To the November number of *Petermann's Mitteilungen* Herr von Hesse-Wartegg contributes a paper on Lake Tacoragua, in Northern Venezuela, one of the few fresh-water lakes in South America. The oscillation in the extent of the lake is undoubted, according to the writer. Humboldt found it 56 kilometres long, and Herr von Hesse-Wartegg only 49. Yet, while the former estimated the area of the lake at 424 square kilometres, the latter gives it at 587. The author gives many interesting details, not only about the lake, but also about the region in which it is situated. To the same number Dr. O. Krümmel contributes a paper, in which he endeavours to solve the old problem of the Euripus.

THE last supplementary issue (No. 91) of *Petermann's Mitteilungen* contains, according to its title, an account of a journey from Hankow to Soochow, and of journeys in Central and Western China between 1879 and 1881. The contents of this particular paper are misdescribed, for it contains only the record of a journey in 1875 from Shanghai to Hankow on the Yang-tsze, thence by the Han River through the Hupeh, Honan, and Shensi provinces to Lanchow in Kansu, and thence to Soochow, close to the Great Wall and the Mongolian deserts, where Herr Michaelis, the writer, remained for some time, and carried out certain explorations in the neighbourhood. Possibly another part or other parts are to follow, of which there is at present no indication. Herr Michaelis was employed in 1874 as a mining expert by the late Viceroy and General Tso Tsung Tang, who had just then chased the Mahommedan rebels out of the Shensi and Kansu provinces, and was about to begin his famous march to Kashgar. He was to investigate the region both within and without the Great Wall for mineral deposits, and especially for gold. Herr Michaelis met Count Szchenyi and his party in Soochow, and naturally a good deal of the ground he traversed has already been described by Lieut. Kreitner, who was surveyor to the Szchenyi Expedition, in his well-known book, "Im Fernen Osten." The paper is accompanied by three excellent route maps.

MOLECULAR PHYSICS: AN ATTEMPT AT A COMPREHENSIVE DYNAMICAL TREATMENT OF PHYSICAL AND CHEMICAL FORCES.[1]

IV.

§ 16. *Electrical Actions.*

IT follows from the principle of the conservation of energy that the processes which give rise to electrical excitation can themselves be called into play by electrical action.

The heating of a conductor by the passage of an electric current is easily explained on the author's theory that electrical conduction is effected by means of molecular vibrations. The electric spark he considers to be due to the separation of particles of the conductor heated in this manner.

The author explains the Peltier effect in the following manner. Let a closed metallic circuit be formed, consisting of two metals, soldered together at the points I. and II., and suppose the circuit to be traversed by a current flowing through the junction I., from the less easily excited metal A to the more easily excited metal B. The molecules of the metal A will then, by hypothesis, easily be thrown into vibration; the metal A will therefore be more heated than B, and will, moreover, be a worse conductor of heat than B. The heat excited in A at the junction I. will therefore be carried to warm the junction II. in the same direction as the current; it will then accumulate at this junction, for A, being the worse conductor, will carry away less heat from the junction II. than is carried to it through B. The junction II. will therefore be heated, while the junction I. will be cooled.[2]

The direct production of light by electrical action has already been considered in § 14 (October 11, p. 581). It is clear that secondary luminous phenomena may also come into play.

Both chemical combination and decomposition may be effected by means of electrical action. The author selects, as an example of the former, the combination of a mixture of oxygen and hydrogen to form water when traversed by electric sparks, which he considers to be due to the absorption by the molecules of the radiant electrical energy proceeding from the positive pole. The motion of the atoms would be accelerated, and the number of impacts increased, giving rise to a series of phenomena similar to those described in § 8[3] (September 6, p. 460). The internal vibrations of the newly-formed molecule will tend towards a steady state, in which the internal energy is as small as possible. Hydrogen and oxygen will unite to form water, supposing the molecules of the latter to be less electrically sensitive than those of its constituents. We should therefore conclude, from the fact that combination occurs under these circumstances, that water is only very slightly sensitive to electrical excitation, which is in agreement with the observed fact that pure water is an exceedingly bad conductor of electricity.

The decomposing action of electricity is exhibited in electrolytic phenomena. These occur in the inverse order to the chemical actions which serve to produce the current. The action is supposed by the author to take place as follows. The fluid receives electrical energy from the positive electrode, which excites electrical vibrations in the molecules immediately surrounding it. These vibrations are transmitted through the fluid according to the ordinary laws of hydrodynamics, but this would not necessarily give rise to an electric current through the liquid, for an accumulation of electricity may take place even in non-conductors. In consequence of these vibrations, however, the molecular impacts will occur more frequently, and a new steady state will be set up, provided such is possible, in which the internal energy has a smaller value than before. Decomposition will therefore take place if the separate constituents are less sensitive to electrical vibrations than when in combination, as their electrical energy will then be less than that of the compound. One of the constituents will, however, be excited to a greater extent than the other, and the one which is least excited will be attracted more strongly by the anode than the more highly excited one. The latter constituent will not, therefore, move towards the kathode with a definite velocity, but will remain where it is, and re-enter into combination with the opposite constituent of a neighbouring molecule. This would appear at first to be in contradiction with the assumption that the compound is more sensitive to electrical vibrations than its constituents, but the apparent contradiction is explained by the consideration that the internal energy lost during the decomposition of the first molecule must reappear in the form of external energy—that is to say, in the form of heat; and the heat thus set free will supply the electrical energy necessary to cause the recombination. This gives an explanation of the "migration of the tons." From particle to particle during this migration, alternate transformations of electrical energy into heat, and of heat into electrical energy, take place. A certain amount of electrical energy will be lost during the process—namely, the amount transformed into heat during the decomposition of the first molecule, and the heat developed in the solution will raise its temperature to such an extent as to cause a recombination between the products of the decomposition set free at the electrode—a result which is in agreement with observation.[1]

§ 17. *Rotation of the Plane of Polarization.*

One of the principal arguments in favour of Maxwell's electromagnetic theory of light is, that it gives an explanation of the rotation of the plane of polarization by an electric current on the assumption of the existence of molecular vortices. It is therefore of considerable importance to determine how far the author's theory is capable of explaining the same phenomenon. Suppose a right-handed spiral to be wound round the axis of X, proceeding from the origin in the positive direction. A current flowing through the spiral away from the origin will then produce a north pole at the origin and a south pole at the other extremity of the spiral. Let a ray of plane-polarized light traverse the solenoid in the direction of the axis, then every point on the axis will move in a short rectilinear path perpendicular to it. Now an electric current has been defined as consisting in a disturbance of the molecular equilibrium of the conductor, propagated along the conductor with great velocity by radiation from molecule to molecule through the intervening ether. The electrical vibrations may be assumed to take place in the conductor in every direction, as in the case of heat-waves; and, as a special case, a disturbance of equilibrium taking place in a single direction only must give rise to an electric current, so that every motion of the ether in a definite direction must be equivalent to an electric current. Motions of any great extent do not come into consideration, for every disturbance in the equilibrium of the ether must consist in vibrations; but, however small the light-vibrations may be, they must be considered,

[1] A Paper read before the Physico-Economic Society of Königsberg, by Prof. F. Lindemann, on April 5, 1888. Continued from vol. xxxviii. p. 581.

[2] In the original, some confusing misprints occur in this paragraph, viz. p. 38, second line, *besser* should be *schlechter*, and in the third and fourth lines A and B should be interchanged.—G. W. DE T.

[3] Since the oxygen and hydrogen molecules are electrically excited to different degrees, they will attract one another. A hydrogen molecule will therefore impinge upon an oxygen molecule more often than upon another hydrogen molecule, thus increasing the chemical action.

[1] See von Helmholtz's "Wissenschaftliche Abhandlungen," vol. ii. p. 958, *et seq.*

in virtue of previous assumptions, to be extremely large relatively to electrical vibrations. The path described by an ether particle originally lying in the axis must therefore be regarded as an alternating electric current of finite length perpendicular to the axis. It must therefore be a current of varying velocity, the velocity having its maximum value when the particle is crossing the axis, and becoming zero at the extremities of its path. Such a current will be deflected by the north pole of the solenoid with a force proportional to the velocity, and therefore the half-vibration will assume the form of a semicircular arc as in the case of an electric arc deflected by a magnet, the ends of the arc coinciding with the ends of the original rectilinear path. The particle during the second half of the vibrations will be deflected in the opposite direction, and therefore will return along the other half of the circle. The effect of the electric current in the solenoid will therefore be to transform the plane-polarized ray of light into a circularly-polarized ray.[1]

The circular motion of the ether particles will be in the opposite direction to that of the current in the solenoid; the small circular current will therefore correspond to a small magnet with its south pole directed towards the origin. The north pole of the solenoid will therefore attract these circular currents, and diminish the rate of propagation of the wave of light along the axis, as each of the circles will tend to approach the north pole of the solenoid. The effect of this motion, again, will be to produce an induction current in the circle in the opposite direction to the former one, and the circle will come to rest in a new position determined by the condition that these two currents shall be in equilibrium. The induced current will be repelled from the north pole, and all these induced currents will form a second ray circularly polarized in the opposite direction to the former one, and having a greater rate of propagation than the original plane-polarized ray.

To obtain a mathematical representation of these results, suppose that we are looking from the origin along the axis of X with the axis of Y horizontally to the right and the axis of Z vertically upwards. The plane of XY may be taken as the plane of vibration of the incident ray, which will therefore be represented by the expression—

$$y = a\sin\frac{2\pi}{\lambda}(x - vt) = a\sin 2\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right) \quad . \ . \ (37)$$

This is equivalent to two opposite circularly-polarized rays of equal wave-length determined by the equations—

$$y_1 = a\sin 2\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right),$$

$$z_1 = -a\cos 2\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right);$$

and

$$y_2 = a\sin 2\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right),$$

$$z_2 = a\cos 2\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right).$$

Owing to the change in the velocity of propagation, λ will be altered, and therefore also T if the medium is isotropic; so that it will be more accurate to put—

$$y_1 = a\sin 2\pi\left(\frac{x}{\lambda_1} - \frac{t}{T_1}\right),$$

$$z_1 = -a\cos 2\pi\left(\frac{x}{\lambda_1} - \frac{t}{T_1}\right);$$

and $\quad . \ . \ . \ . \ . \ (38)$

$$y_2 = a\sin 2\pi\left(\frac{x}{\lambda_2} - \frac{t}{T_2}\right),$$

$$z_2 = a\cos 2\pi\left(\frac{x}{\lambda_2} - \frac{t}{T_2}\right).$$

Since the stationary node of the ray remains unaffected, we shall have—

$$\frac{1}{\lambda_1} + \frac{1}{\lambda_2} = \frac{2}{\lambda},$$

$$. \ . \ . \ . \ . \ . \ . \ . \ (39)$$

$$\frac{1}{T_1} + \frac{1}{T_2} = \frac{2}{T}.$$

[1] A circularly-polarized ray will therefore behave like a solenoid, and deflect a magnetic needle, affording an example of a direct action of light upon magnetism.

The electric current, consisting in the circular motion of one of the ether particles, will be of a special kind, as its velocity will be variable, the effect of which will be to increase its self-induction. Any one of these circles will be acted on by the other circles, which are indefinitely near to it, and the resulting attractive and repulsive forces will affect the elastic force of the ether which originally determined the vibrations, so that a current of variable velocity must be considered as equivalent to a series of distinct currents following each other in succession, and having their velocities determined by the corresponding accelerations. To investigate this action, consider the two rectilinear components (38) of each of the circular currents. The induction of any rectilinear element on the parallel elements can be neglected, as the actions on each side of any element will be equal in amount, so that it will only be necessary to consider the vertical component of the induction. This is proportional to the change in dz/dt—that is, to d^2z/dt^2. The elastic force on the point x in the direction $x + dx$ is therefore no longer of the form $P \, . \, dy/dx$, but of the form $P \, . \, dy/dx - B \, . \, d^2z/dt^2$, and therefore the force in the opposite direction obtained by replacing x by $x - dx$ is—

$$P\frac{dy}{dx} - P\frac{d^2y}{dx^2} + B\frac{d^2z}{dx^2} + B\frac{d^3z}{dxdt^2}.$$

So that the differential equation of the light-vibrations will be—

$$\rho\frac{d^2y}{dt^2} = l\frac{d^2y}{dx^2} - B\frac{d^3z}{dxdt^2}.$$

This equation will, however, be modified by the action of the molecules on the light-vibrations, and introducing the corresponding term from (6) (August 23, p. 405), we have—

$$\rho\frac{d^2y}{dt^2} = l\frac{d^2y}{dx^2} + 4\pi^2c_1(x_1 - y) - \frac{B}{2\pi}\frac{d^3z}{dxdt^2} \quad . \ . \ (40)$$

and similarly—

$$\rho\frac{d^2z}{dt^2} = l\frac{d^2z}{dx^2} + 4\pi^2c_1^1(x_1^1 - z) - \frac{B}{2\pi}\frac{d^3y}{dxdt^2} \quad . \ . \ (40a)$$

The action of the molecule is the same along both the axes, so we may put $c_1^1 = c_1$, and $x_1/y = \psi(T) = x_1^1/z$, where $\psi(T)$ is a known function of T^2 determined from equation (4) (August 23, p. 405).

Both the above equations will be satisfied by the functions y_1 and z_1 of (38), provided—

$$\frac{T_1^2}{\lambda_1^2} = \frac{\rho}{l} + \frac{c_1}{l}(\psi(T_1) - 1) + \frac{B}{l\lambda_1} \quad . \ . \ . \ . \ (41)$$

And y_2 and z_2 will also be solutions of—

$$\frac{T_2^2}{\lambda_2^2} = \frac{\rho}{l} + \frac{c_1}{l}(\psi(T_2) - 1) - \frac{B}{l\lambda_2} \quad . \ . \ . \ (42)$$

The quantities λ_1, λ_2, T_1, T_2, are determined by the four equations (39), (41), and (42).

The two waves (38) give together a new wave determined by the equations—

$$\eta = y_1 + y_2 = 2a\cos\phi \, . \, \sin 2\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right),$$

$$. \ . \ (43)$$

$$\zeta = z_1 + z_2 = -2a\sin\phi \, . \, \sin 2\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right),$$

where $\quad \phi = \pi\left(\frac{x}{\lambda_2} - \frac{x}{\lambda_1} - \frac{t}{T_2} + \frac{t}{T_1}\right).$

This new vibration will take place in the plane—

$$\eta\sin\phi + \zeta\cos\phi = 0,$$

which makes an angle $-\phi$ with the plane of XY—that is, with the plane of the original vibration.

If, therefore, d be the length of the solenoid, the plane of vibration will be rotated in the positive direction through the angle—

$$\psi = \pi d\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right) + \pi t\left(\frac{1}{T_1} - \frac{1}{T_2}\right).$$

As the plane is determined by the value of $\tan\phi$, this equation shows that as the time increases ψ will oscillate between certain fixed limits, the period of which being equal to $1/T_1 - 1/T_2$ will be too small to be observed. For all practical purposes we may assume $T_1 = T_2$, which will give as the angle of rotation—

$$\psi = \pi d\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right).$$

The assumption $T_1 = T_2$ is not in exact agreement with the foregoing equations for (41) and (42) give respectively—

$$\frac{T_2}{\lambda_1} = \frac{B}{2lT_1} + \sqrt{\mu_1^2 + \frac{B}{4l^2T_1^2}},$$
$$\frac{T_2}{\lambda_2} = \frac{B}{2lT_2} + \sqrt{\mu_2^2 + \frac{B^2}{4l^2T_2^2}}, \quad \ldots \ldots (45)$$

where μ_1 and μ_2 represent the indices of refraction of the medium for vibrations of the periods T_1 and T_2 respectively.

For $T_1 = T_2$, and therefore $\mu_1 = \mu_2$, it follows that—

$$\psi = \pi d\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right) = \frac{\pi B d}{lT^2} \quad \ldots \ldots (46)$$

that is to say, the angle of rotation is inversely proportional to the square of the period of vibration, a result which is in approximate agreement with observation.

We may bring this result into still closer agreement with experiment by observing that B itself is a function of T. Now B determines the inductive action of the solenoid on the small circle, and must therefore be the differential of a potential, and therefore inversely proportional to the square of the velocity of light. The latter is, however, not constant in the medium, as it is the reciprocal of the index of refraction, and therefore a known function of T.

We may therefore put—

$$B = \mu^2 C, \ \psi = \pi \frac{Cd}{lT^2} \mu^2 \quad \ldots \ldots (47)$$

where C is a constant. The function μ^2 can be determined as in § 2 (August 23, p. 404). If we take Cauchy's approximate formula—

$$\mu^2 = a_0 + \frac{a_1}{T^2} + \frac{a_2}{T^4} + \ldots \ldots$$

we obtain an expression for ψ of exactly the same character as that which Boltzmann deduced from his experimental results.

The direction of the rotation depends upon the relative values of λ_1 and λ_2. For $T_1 = T_2$, (41) and (42) give $1/\lambda_1 > 1/\lambda_2$, and therefore $\psi > 0$. If, however, $T_1 > T_2$, and

$$\mu_i^2 = \frac{p}{l} + \frac{c_1}{l}\ (\psi(T_1) - 1),$$

then $\mu_1^2 < \mu_2^2$ for media of normal dispersive power, while for media of anomalous dispersive power $\mu_1^2 > \mu_2^2$, and *vice versâ* for $T_1 < T_2$. Now, it was found that the velocity of propagation, v_1, of the first wave was diminished, while that of the second wave, v_2, was increased, so that $v_2 > v_1$.

The equations (41) and (42) may be written—

$$\frac{1}{v_1^2} = \mu_1^2 + \frac{B}{l\lambda_1},$$
$$\frac{1}{v_2^2} = \mu_2^2 - \frac{B}{l\lambda_2}.$$

Therefore when B is small enough we shall always have $\mu_1 > \mu_2$, and therefore $T_1 > T_2$ in the case of anomalous dispersion, and $T_1 < T_2$ in the case of normal dispersion.

In the latter case—

$$\frac{1}{\lambda_1^2} = \frac{\mu_1^2}{T_1^2} > \frac{1}{\lambda_2^2} = \frac{\mu_2^2}{T_2^2}.$$

But in the former case it may be the reverse. The rotation of the plane of polarization will therefore be generally in the positive direction, being negative only in media of anomalous dispersive power, always supposing that B does not exceed a certain fixed limit. This result is confirmed by the observed fact that the lævo-rotatory substances, chloride of iron, and chromic acid, give anomalous dispersion. According to Kundt,[1] iron is dextro-rotatory in spite of its anomalous dispersion, which may be explained by a large value of B, and, as a matter of fact, the angle of rotation is exceptionally large. Maxwell's theory also led to the result that the angle of rotation is approximately inversely proportional to λ^2, but it gave no explanation of the decomposition of the ray into two circularly-polarized rays. Maxwell starts with the assumption of a circularly-polarized ray, and his λ appears to represent the wave-length of this ray, and is therefore different from the λ of the author. His theory rests on the assumption of the existence of molecular vortices, and therefore his differential equations are not the same as Lindemann's (40) and (40*a*).

[1] *Sitzungsberichte der Berliner Akademie*, February 1888.

It has been suggested that the electric current may possibly produce a structure in the medium, similar to that already existing in crystals which rotate the plane of polarization. Hitherto, however, this hypothesis has not been of much use in explaining the phenomenon, as no explanation has been given of the manner in which the ray is decomposed into two circularly-polarized rays such as occur, for example, in a crystal of quartz. The author endeavours, on the other hand, to explain the action of quartz on the hypothesis of an electro-magnetic effect of the ray of light passing through the crystal. There is, however, a difference between the two phenomena which has to be accounted for—namely, in the crystal the rotation is reversed when the direction of the ray is reversed, so that if the ray passes through the crystal, and returns along its own path, the total rotation is zero, while in the case of the solenoid the effect is to double the angle of rotation. The molecules of quartz must therefore be oppositely related to opposite directions, which seems to suggest that the arrangement may be due to the passage of the ray itself causing electric excitation in the quartz, and this is confirmed by the observed fact that quartz can be electrified by the action of light. Now suppose that the molecules of quartz are unequally susceptible to the electrical action of the ether in different directions, and suppose further that the molecules most sensitive to a ray in the direction of the axis are arranged in a spiral, having for its axis the principal axis of the crystal. Then a ray traversing the crystal in the direction of the axis will successively produce an electrical excitation at every point of this spiral, which will therefore act exactly as if the spiral were a conductor carrying a current. The effect on the ray will therefore be to decompose it into a pair of circularly-polarized rays differing in wave-length and in rate of propagation, and the plane of polarization will therefore be rotated. If the direction of the ray is reversed, the direction of the current in the spiral will be reversed, causing a rotation in the opposite direction.

§ 18. *Paramagnetism and Diamagnetism.*

According to the theory of the rotation of the plane of polarization which was developed in the last paragraph, an electric current traversing a medium excites small molecular currents, each one of which acts like a magnet. These currents as a whole cannot give rise to any magnetic action, since alternate currents flow in opposite directions, but this will not be the case if one set of currents is absorbed by the medium, and not the other, which will happen if one and only one of the wave-lengths λ_1 and λ_2, which together give the wave of length λ, is one of the critical wave-lengths for the molecules of the medium, while the other is not.

The existence of Amperian currents in magnets can be explained in a similar manner. Here the currents cannot be excited by the action of light, but it may be assumed that the molecules, even of rigid bodies, continuously perform small steady vibrations about their positions of equilibrium, and therefore come into collision with the neighbouring molecules on every side, thereby exciting the internal critical vibrations, which are visibly communicated to the ether when the substance attains the temperature of redness.

If such a substance is placed within a solenoid, the light-vibrations in the direction of its axis will remain unaffected, while the perpendicular ones will be decomposed into opposite circular vibrations; and the same thing will happen to the components perpendicular to the axis of vibration in any other direction, the components parallel to the axis remaining unchanged. If one of these currents is absorbed, and the remaining one is in the same direction as the current in the solenoid—that is, with a right-handed rotation—the substance will be paramagnetic, while if the rotation is left-handed the substance will be diamagnetic. In order that a sufficiently large number of vibrations should be absorbed, the substance must have a large number of critical periods, and therefore its spectrum must contain a large number of lines, a result which agrees with the fact that the spectrum of iron contains a larger number of lines than that of any other known element.

Whether a substance will be paramagnetic or diamagnetic will depend, in the first place, on the distribution of lines in its spectrum, and also upon the relative values of T_1 and T_2, calculated from equations (39) to (42), and therefore upon the other molecular constants which determine the relation between the wave-length and the period of vibration. The fact of the magnetic behaviour of a substance being partly determined by the values of these molecular constants would appear to make it impossible to predict its magnetic properties from the nature of its spectrum only. It is clear that, according to the author's theory, similar effects might be produced by mechanical vibrations, as by heat, for any excitation of the molecules to a sufficient extent must give rise to phenomena of the kind described.

The results obtained may be formulated in the following statement:—

If a body is traversed by an electric current in the positive direction, it will give rise to a series of pairs of oppositely-directed currents in the neighbourhood of any molecule, and each of these currents will be equivalent to a luminous vibration of definite wave-length. The body will be paramagnetic, when, in consequence of internal absorption, the excess of the right-handed current over the left-handed one is positive; and it will be diamagnetic if this excess is negative.

When a body is magnetized the internal energy of its molecules is increased, and therefore it will become heated—a result which is in agreement with observation. The magnetic saturation will increase as long as such an increase of internal energy can continue; but the limit of saturation will be attained when the molecular impacts have excited currents of the same kind as those which were absorbed, and of equal intensity.

The author explains permanent magnetism by assuming that the molecules of steel can have internal vibrations more easily excited by molecular impacts in some directions than in others. Suppose the sensitiveness to be very small in the direction of the axes of the molecules and very great in perpendicular directions, then vibrations perpendicular to the axis will be the most easily excited by magnetization, and will be transformed into circular vibrations. The planes of these circles will, in general, be inclined obliquely to the axis, and therefore every molecule will give rise to several circular vibrations in its neighbourhood, and the centres of these circles will lie upon a straight line nearly coinciding with the axis of the molecule. Every such circular vibration will be equivalent to a small magnet with its axis perpendicular to the plane of the circle, and the poles of these magnets lie in a straight line. There is therefore a molecular rotation in the direction indicated by Weber's theory. Again, when the axes of all the molecules have become parallel, there will be more frequent collisions between neighbouring molecules in a direction perpendicular to the axes than in the direction parallel to them. The critical relations will therefore be excited and communicated to the ether, giving rise to circular currents, which will again be partially absorbed. The magnetization will be permanent when the mutual action of the molecules and the ether is a steady one. This stationary motion requires a certain supply of external energy, which is continuously transformed into small vibrations of the molecules about their positions of equilibrium. It is an experimental fact that when this supply of energy is considerably diminished by cooling the magnet to a sufficient extent, the magnetism is greatly weakened.

According to this theory, the amount of light absorbed will be equal to the amount emitted, but the latter will have a different vibration-period from the former, since T may be different from T_1 and T_2, and the critical vibrations most easily excited by the molecular collisions will in general be of different period from those which are most easily absorbed. Therefore rapidly succeeding molecular impacts may give rise to luminous vibrations, the periods of which may be different from those proper to the molecules.

§ 19. *Lorenz's and Maxwell's Electro-dynamic Theories of Light.*

The author observes that he has preferred to base the explanation of electrical phenomena upon those of optics rather than the reverse, because optical phenomena are much more completely understood than electrical phenomena. Lorenz and Maxwell both endeavoured to explain optical by means of electrical phenomena. Lorenz[1] bases his speculations upon the resemblance between the differential equations of the motion of electricity and those which represent vibrations of the ether which can be made identical by the introduction of certain very small terms. His theory has not been sufficiently developed to admit of its application to the discussion of any definite problem. He comes to the general conclusion that the motions of light consist in electric currents, and that the latter consist essentially in rotatory vibrations of the ether about certain axes. In this point Lorenz's theory presents a certain similarity with that of the author, but in the former no distinction is assumed between the magnitude of electrical and luminous vibrations respectively.

[1] *Poggendorff's Annalen*, vol. cii. 1856.

Maxwell has developed his theory to a much greater extent. He, too, starts from the similarity in the differential equations, which are different from those of Lorenz, and also from the author's. Magnetic and electrical actions at a distance are attributed to the energy of an intervening medium, and explained by the assumption of the existence of a strain in this medium. The assumption of the identity of the electrically excitable intervening medium with the luminiferous ether receives strong confirmation from the fact that the ratio of the electro-magnetic to the electro-static unit of quantity is the same as the velocity of light. Maxwell arrives at the result that electrical as well as luminous vibrations are entirely transverse to the direction of propagation, but he does not obtain any further analogy between electrical and optical phenomena, and his explanation of the electro-magnetic rotation of the plane of polarization involves a series of complicated hypotheses respecting the action between matter and ether. Maxwell expressly excludes the consideration of molecular structure, and supplies its place by the hypothesis of molecular vortices.[1] A further important difference between the two theories is that while the author assumes that the material molecules suck up energy from the ether, Maxwell deduces the repulsive actions between two similarly charged conductors from an accumulation of electricity in the intervening medium, especially in the case of an optical excitation of the medium. He does not appear to have arrived at any definite distinction between electrical and luminous energy.

In the preceding investigations the molecules have always been assumed to be of the same size. If there should be any great difference in the sizes of molecules in the case of different substances, then the difference between optical and electrical phenomena would be entirely relative to the size of the molecules of the body considered, so that an ethereal vibration which would give rise to electrical excitation in one body might produce only optical effects in another. The different behaviour of different substances with regard to light and electricity may perhaps depend partly upon this condition as well as on the values of the critical periods and other molecular constants. An interesting question which arises is, What would be the effect of ether vibrations neither very large nor very small in comparison with the size of a molecule? The author has not suceeded in obtaining any definite answer to this question.

§ 20. *Concluding Observations.*

In concluding the paper the author observes that the only hypothesis which he has made use of is that space is filled with a continuous elastic medium—namely, luminiferous ether, the density of which is so small that it may be neglected in comparison with that of matter. The existence of this is sufficiently established from the known phenomena of light.

It is not found necessary to assume a difference in the elasticity of the ether in crystals in different directions, the existence of a special force of chemical affinity, of electric or magnetic fluids, or of molecular vortices.

Thomson's assumption with respect to the constitution of molecules and their relation to the ether explains the most diverse phenomena of physics and chemistry from a single standpoint—namely, the transference of energy between the molecules and the ether, in obedience at every stage to the law of conservation of energy.

The author then suggests that the theory may possibly provide a means of escape from the conclusion, known as the "Dissipation

[1] Maxwell's "Electricity and Magnetism," Arts. 111, 645, 794, 830, 832. In Art. 111 he says: "I have not been able to make the next step—namely, to account by mechanical considerations for these stresses in the dielectric." In Art. 806 the analogy which the author deduces between a solenoid and a circularly-polarized ray is characterized as faulty on the ground that two opposite circularly polarized rays do not neutralize each other, but produce a plane-polarized ray. The author points out, however, that it is only necessary that the electrical actions should neutralize one another. The simple relation deduced by Maxwell between the specific inductive capacity of a medium and its index of refraction does not follow from the author's hypothesis, and this relation has been shown to be only very roughly true.

of Energy," that the total energy of the universe will ultimately assume the form of uniformly-diffused heat of low temperature.

The attractions between the heavenly bodies must upon this theory be ascribed to their being electrically excited to different extents, and continually sucking up electrical energy from the ether. When, then, any one of them loses heat by radiation, it will take up electrical energy which may be transformed within it into other forms. The sun may thus receive compensation for the light and heat which it emits. In this way it seems quite possible that the universe may really be a conservative system. Indeed, the sun may receive a direct accession of light and heat from the electrical energy diffused throughout space, as this would take place if it receded from some other star with a velocity exceeding by a finite amount the velocity of light. This accession would take place when the relative velocity exceeded a certain value, and its effect would be to diminish this relative velocity until the accession of light or heat ceased, when the velocity would again increase, as in the phenomena of the vacuum tube.

The author considers that this might explain many hitherto unexplained changes going on in the sun, especially as it would necessarily involve the inequality in the intervals from maximum to minimum and from minimum to maximum, which is actually observed. It might also give an explanation of the phenomena of variable stars, as seems suggested by Secchi's observation that all red stars are variable.

The author states that he makes these suggestions with diffidence, as speculation upon cosmical phenomena based upon the limited data at our disposal is apt to be misleading ;' witness, for example, the limitation to which Weber's law was found to be subject.

He points out that, if Newton's law of gravitation be considered only as a first approximation to the law of attraction between the electrified bodies of the universe, then every case of gravitational attraction, including the weight of terrestrial substances, may be considered as due to electrification. The molecular attractive forces may also be due to the same cause. The differences in the electrical excitation of the molecules of various substances would then play an important part in the phenomena of chemical combination (see footnote to § 16).

The rigidity of a body would then be determined by the differences in the electrification of its molecules. These differences would naturally be determined by external circumstances, and would be greatest in the direction of the normals to the surface.[1]

G. W. DE TUNZELMANN.

[1] The foregoing paper in the original form is itself a very condensed abstract of an extensive research, the author only having a limited amount of space placed at his disposal in the journal in which it was published. This may account for the reasoning, in some parts of the paper, appearing somewhat general and difficult to follow.—G. W. DE T.

LEARNED SOCIETIES IN RUSSIA.

AT a recent meeting of the French Geographical Society, M. M. Venukoff read a short paper on the learned Societies of Russia. Besides the Geographical Society, the Army Staff, the Academy of Sciences, and other Government institutions, there are in Russia several learned bodies engaged in the exploration of those countries which are still but little known. Though many of the explorers do not go for geographical purposes properly so called, yet these non-geographical explorers frequently obtain results of the greatest interest to geography. M. M. Venukoff is a member of many of these Societies, and at the outset of his paper he proceeds to name some of his colleagues who have in recent years rendered great service to geography ; amongst the members of the Naturalist Society of St. Petersburg, MM. Korotneff, Nicolsky, Lidsky, Yaschenko, and Kouznétoff. The first-named has travelled in the Malay Archipelago, where he has studied chiefly the invertebrate animals, but has at the same time made scientific observations of every kind. In the month of June 1887, he visited the country around Krakatão, where already several little hamlets have sprung up on the site of the town of Anjer, which was destroyed by an earthquake in 1883. These poor huts were surrounded by a luxurious vegetation, while the neighbouring portions of the sea were still covered with pumice-stone and altogether deserted by fish. At Billiton Island the traveller met the interesting tribe of Secasses, the fishermen of their state, who, with rare exceptions, inhabit floating-houses—that is, their junks—and even those among them who possess huts build them on the sea on piles, and never on *terra firma*. They are distinguishable from the Malays by their tall figure, their curly hair, and projecting cheek-bones ; finally, strange to say, they almost all stammer. They are a very honest race, gentle, kind, joyous, and hospitable, and it is said that robbery is unknown among them. M. Korotneff describes the tides of the Sunda Sea, which are very complicated, and several other interesting phenomena. M. Venukoff then passes to M. Nicolsky, a famous Russian zoologist, who has pursued his researches in Lake Balkash. He assigns as the cause for the remarkable difference between the fish faunæ of the two districts of Tchui and Ele that the basin of Lake Balkash is separated from the Tchui valley by plateaux and mountains of a very ancient formation. Besides, Balkash is 280 metres above the sea-level, the Sea of Aral is scarcely 50 metres, and the height of the plateaux between Balkash and Tchui is 370 metres at least, and so it is difficult to see how the two great lakes were formerly part of one sea. Balkash, Sassyk-Kul, Ala-Kul, and even Ebi-Nor probably formed, and within the modern epochs, a single vast basin of fresh or slightly brackish water, for their fish fauna is identical with that of our days. In spite of its great extent and its latitude, which is the same as that of Bordeaux and Venice, Lake Balkash freezes every year from the month of November up to the middle of April, and the ice sometimes is as thick as 80 centimetres. A fact worthy of observation is that the steppes which surround the lake vary very much according to their position. Those on the north-west are clayey, and completely bare during the summer, and covered with pools in the spring ; those on the south-east are formed of beds of sand, in which there are no pools, but where water is to be found below a certain depth. Thus the desert in the latter case is not so dry as it is to the north and to the west. From the point of view of a zoologist, M. Nicolsky finds that the north and west of Lake Balkash are marked by the presence of jerboas and of larks, whilst at the south of the lake there are numerous reptiles and tortoises ; some hares and mice dwell there also, but there are no birds. M. Venukoff does not follow M. Nicolsky into the remainder of his report, as it deals chiefly with the natural sciences ; but he remarks that M. Nicolsky shows all the qualities of Humboldt and Mr. Wallace—abundance of well-established facts, and great breadth of view in explaining them. M. Lidsky travelled in Karateghin and in part of Bokhara. Having arrived in the month of June at Schahrisiabz, M. Lidsky wished to journey to Hissar by the Sangardak Hill, but this being prevented by the snows, he was forced to make a detour and enter the valley of the Sourkhan by another route. From this vast prairies stretch away as far as the Oxus, inhabited not by men, but by jackals, for the waters of the Sourkhan flood the plain each year. In rising from this valley, he soon arrived at Garma, and then at Karatag, the summer residence of the Bey of Garma, which is usually hidden from the heat and the fevers which prevail in Garma in the hot season. There, and at Fezabad, M. Lidsky saw fish the skin of which was of exactly the same shade as the water which holds them, and which abounds in clayey soils—that is, of a red colour. Beyond Fezabad the traveller pushed into the high valley of Dachti-Bidona, which is really a plateau separating the basin of the Sourkhâb from that of the Kiafirningan. M. Lidsky describes Karateghin, which is 150 kilometres in length and 50 in breadth, as a fertile country in its lower parts, and thickly covered with forests in the mountainous regions. Unfortunately this oasis is separated from all the neighbouring countries by high peaks, so that the journey from Garma to Samarkand, for example, passes over Mount Pakchif, which is at least 3850 metres above the sea-level. The cold is so great at the top of the mountain that beasts of burden and even men are frequently overcome by it ; travellers are often compelled to throw before them long strips of felt, on which they walk—a singular and a very slow and painful mode of progression. In 1877, M. Yaschenko made a journey in Russian Lapland, between Kola and Kandalaschka. According to him the lakes of this region belong to the basin of the White Sea or to that of the Arctic Ocean, and have identical fauna ; but the terrestrial animals are not everywhere the same. There are places where bears abound ; there are others where the principal enemy of man is the glutton. In latter years the inhabitants have remarked that the reindeer are changing their habits, and are beginning to prefer the forests to the *tundras*, or spaces covered with lichens, which make their favourite food. The reason of this change is to seek a more favourable shelter from the hunters ; in the open, whole herds may be taken, but in the forest it is only possible to hunt one or two at a time.

M. Kouznetoff has pursued zoological and physical geography researches on the Sea of Azov. This little basin, of which the length does not exceed 350 kilometres, and its breadth 170 kilometres, and its depth scarcely 14 metres, abounds in fish, and attracts continually to its shores crowds of fishermen. Its water is brackish rather than salt, for its percentage of salt is only 1·19, while that of the Black Sea is 1·75, and the Mediterranean more than 2·3 per cent.; and consequently the real sea-fish are not to be found in the Sea of Azov. *Gourmets*, however, would find that the sturgeon is very numerous here, and has delicious flesh. We can see by this short account that the study of geography is making great strides in Russia. Three years ago, General Tillo, in drawing up his magnetic charts of Eastern Europe, discovered certain anomalies in the distribution of the magnetic elements around Koursk and Kharkov. During the summer of 1887, M. Piltchikoff, Professor at Kharkov, made inquiries into these anomalies, and he has just published a book in which the theory of terrestrial magnetism started by Gauss is developed.

RESEARCH LABORATORY OF THE ROYAL COLLEGE OF PHYSICIANS, EDINBURGH.

FOR some years the question of equipping a research laboratory occupied a very prominent position in the discussions of the Royal College of Physicians, Edinburgh, and last year the Committee appointed by the College was able to throw the plans into a feasible and at the same time thoroughly acceptable shape. Within a very short time suitable premises were acquired, the necessary structural alterations were at once commenced, a Superintendent was appointed, and apparatus was orde.ed and fittings were put in hand to be ready for use as soon as the building should be prepared for their reception. The premises are well adapted for the purpose for which they were acquired. They consist of a three-storied house, No. 7 Lauriston Lane, near the Royal Infirmary, to which had been added a large detached room in the back court. There are also commodious out-houses and a plot of ground of considerable size at the rear of the building.

The room in the back court is set apart for experimental physiology. It is 32 feet in length, 18 feet in breadth, and 14 feet high, and is well lighted by seven windows, three of which, facing to the west, are fitted with tables for microscopic work.

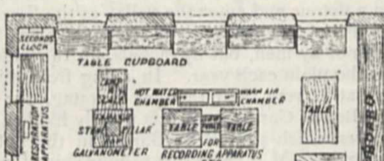

FIG. 1.

Near the south end of this room is a stone pillar bedded in the ground, so arranged as not to be affected by movements in the room. (There being no thoroughfare in the lane, no disturbance can arise from wheel traffic.) Around it is fixed a table to which the galvanometer wires are attached. The galvanometer is placed on the stone pillar in a glass case with a hinged door, and is always kept ready for use, short wires being carried from the table to the instrument. A hinged lamp table and brass rods over which curtains are hung complete the galvanometer fittings. Work-tables occupy the remainder of the centre of the room. Electrical, time-marking, and other apparatus, tuning-forks, perfusion apparatus, shunts, compensators, constitute the greater part of the instruments in this room. The sink and drainage apparatus in the room may be taken as a type of those throughout the whole house. It consists of a large earthenware sink, on one side of which is a grooved draining-board covered with lead, the grooves all leading to the sink. A swan neck tap supplies the water; to this tap are two nozzles, to one of which is wired a piece of india-rubber tubing, used to connect the Geissler exhaust-pump, and similar apparatus; the other nozzle gives a steady unbroken jet of water three-eighths of an inch in diameter. The wall behind the sink is leaded for about 3 feet up; at the upper part of this are a couple of shelves, the upper one perforated, for draining flasks and bottles, the lower one grooved, and with a gentle slope to carry all moisture to the sink. Below these shelves are a couple of rows of wooden pegs fixed into the wall at an angle of 45°. These are very useful for draining all kinds of glass vessels. In the main building in the lower flat is a large entrance lobby, to the left of which is a part of the laboratory assistant's quarters.

A large room on the first floor, set apart for Committee meetings, is used as a library and museum. On the second floor is the chemical room, fitted with a good supply of water and gas. On the top floor are three splendidly-lighted rooms, all of which are devoted to microscopic work. In the south room the apparatus necessary for bacteriological research is collected. Two large projecting roof or dormer windows face east and west respectively. Each is fitted with a table covered with a sheet of plate-glass, on the under surface of which are painted three strips, the first, 4 inches broad, black; then a similar white band, and then a

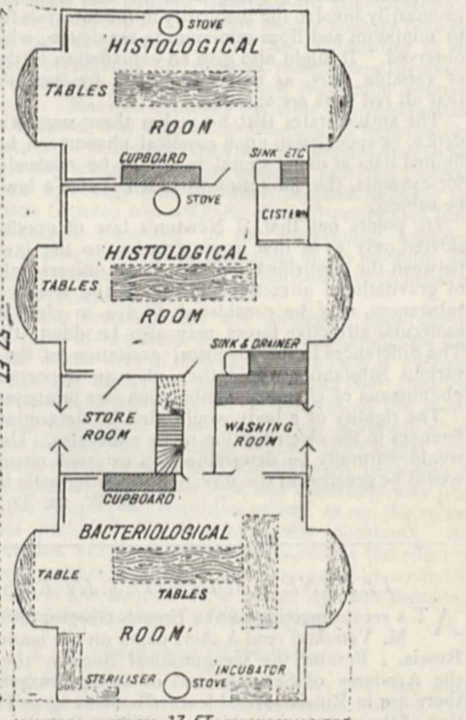

FIG. 2.

broad black band extending to the back of the table. On each side are shelves from the floor for about 5 feet up. These are within reach of anyone sitting at the table. On each side is a drawer 3½ inches deep; but the remainder of the space under the table is left quite open, in order that earthenware jars for the reception of chemicals, washings, and *débris* may be accommodated. On the left side is fitted a rack for test-tubes, and in front and to the right are stands for ordinary histological reagents. Above the level of the table in front are four small shelves, on which are placed covered vessels for clean and dirty slides and cover-glasses. A syphon arrangement for distilled water, a bell-jar with counterpoise running on a brass rod, a Bunsen burner, and a lamp, complete the fittings at this table. One of Browning's microspectroscopes has also been fitted up in this room. Racks, for series of Hesse's tubes, and shelving complete the fittings here; but opening out from it is a small room with a sink and large sloping drainer, at which most of the glass apparatus is washed. The other two rooms in this flat are fitted up for histological work, with window tables, sinks, cupboards, spirit vessels, and shelving, each for two workers. In connection with the histological department, apparatus for micro-photography has been fitted up by Mr. Forgan.

The arrangements for conducting the work are somewhat as follows:—The College has established and will maintain the laboratory for the prosecution of original research. To facilitate such work the Council of the College "appoint a scientific Superintendent, who must devote such portion of his time as may be determined by the Council to the work of the laboratory, where, under the supervision of the Curator and Committee, he shall himself undertake the prosecution of original research, and be prepared to assist, if required to do so, in the work of other investigators. Under like supervision, he shall also be prepared to furnish the Fellows of the College with reports upon such matters as the histology of morbid specimens, and of the chemical and microscopic characters of urines," in which work he is assisted by the resident assistant.

The laboratory is open without fee to Fellows and Members of the College, "to any Licentiate who shall obtain the sanction of the Curator and Committee to use the laboratory for the purpose of scientific research," and "to any medical man or investigator who shall obtain the sanction of the Council of the College, as well as of the Curator and Committee, to use the laboratory for the purpose of scientific research."

The whole of the expense of establishment and maintenance has been and will be defrayed from funds placed at the disposal of the Committee by the Council of the College. Of this, an initial grant of £1000 was made with which to adapt and furnish the house, and buy apparatus, instruments, and chemicals. In addition to this, an annual grant of £650 is made, from which all salaries, rent, and taxes are paid, and stock is kept up. Of these sums, only about £830 of the original £1000, and £600 of the annual grant, were spent during the first twelve months, so that the whole equipment and fittings of the laboratory, together with the current expenses during that period, cost only £1430.

CYCLONES AND CURRENTS.

MR. S. R. ELSON, an experienced pilot of the Hooghly Pilot Service, and author of "The Sailor's East Indian Sky Interpreter," writes as follows with reference to the article on the incurvature of the winds in cyclones, published in NATURE, vol. xxxviii. p. 181:—

So deeply is [the] "old and exploded error of facts," the eight-point theory of storms, rooted in the minds of some, that, ignoring the reiterated warning voice of science, they will have none other. Do they lean towards it because it is so very simple to look at on paper, and so easy of application? I fear that is about the truth of it. So very easy, that Piddington, somewhere in his writings, says of a certain old salt whose ship had been dismasted in a cyclone, that if even a junior P. and O. Company's midshipman had had the handling of his vessel, she would have come through the storm scatheless (the P. and O. midshipman, it must be presumed, having been schooled in Piddington's theory)—a reflection which we, with our more extended knowledge, now perceive was very hard on the old experienced captain. Yet there is the proclaimed peril of using this theory staring mariners sternly in the face.

But there is one more cogent element of trouble and danger besetting the anxious mariner, which, although taken note of in Mr. Pedler's recent Report on the Meteorology of the Bay, is not generally considered when judging, as Piddington used to do, of a shipmaster's proper or improper management of his vessel in a cyclone, and which will probably account for the numbers of vessels, perhaps widely separated before the cyclone came on, which unaccountably get foul of the comparatively small space called the "eye of the storm" as it progresses on its fell course, and so have to bear the brunt of the dreaded rear hurricane wind from south-west or west—that is, the great indraught towards the very centre of the waters in which they float.

This whirling indraught, drift, or set of the sea is on the move long before even the air motion above has gained force enough to impel it, as is so well shown by the westward set at the Hooghly Pilot Station, which usually gets up some time before every cyclone in the Bay, whether far or near. But the worst of it is, when the vessel is out of sight of any fixed object, or the skies are overcast so as to preclude sights being taken, the force and direction of this inset cannot be calculated and allowed for in the dead reckoning as a "course and distance." And it is only after the gale is over, and a sight can be taken, that the captain is very much astonished to find his vessel's position is so far out of her dead reckoning.

I myself, as a pilot, have experienced this perplexity on more than one occasion at the head of the Bay; and, besides, the published records and logs of vessels involved in these storms show this whirling inset of the sea most conclusively.

Mr. Blanford's rules for finding the bearing of the centre of storms are evidently calculated to suit all winds; but some account should be taken of the fact that, in and off the Hooghly River at least, whether the cyclone is passing up to the eastward towards Chittagong, coming straight on towards the Hooghly, or passing across the Bay to the westward towards False Point, or Balasore, the first wind blows invariably from north-east until the hard part of the storm is close upon you. No special reason has yet been advanced as to why this should be the case; yet so it undoubtedly is, as was noticed first by the late Mr. Wilson concerning a cyclone some years back, and as the meteorological registers and logs of ships during later storms well show, and which, years ago, I drew attention to in my little book, "The Sailor's East Indian Sky Interpreter."

Some authorities of the present day advise, when caught in a cyclone, that vessels should run with the wind more or less on the starboard quarter in the northern hemisphere; but, taking into consideration the now generally acknowledged wind's incurvature, and the great inset of the sea which I have drawn attention to above, there is no safety but with the wind on the starboard beam; always provided, of course, that circumstances of smooth water and sea-room allow of it. As a decisive proof of the advisability of this plan, I may mention that I was in pilotage charge of an inward-bound sailing-ship on the immediate advent of, and during, the Midnapur cyclone of June–July 1872, in which my brother, also a pilot, lost his life, on the foundering of his storm-battered ship, the *Rothsey*, in Balasore Bay. Starting from the Pilot's Ridge on the morning of June 27, under close-reefed topsails and with squared-in yards, we stood away on a south-south-east course, with a hard west-south-west gale blowing (wind on starboard beam), for thirty-six hours, and by so doing raising the rapidly-falling barometer from 29·30 to 29·50 inches, and, as I expected, getting into more moderate weather.

"Look to leeward for the weather," is the old Dutch sailor's advice, and doubtless there is a power of wisdom in the old saw, which seems to chime in better with the modern theory of eleven to twelve points rather than with the old eight-point theory. And, whilst thanking Mr. Blanford for his latest valuable contribution on marine meteorology, as set forth in his letter above alluded to, and looking forward to his promised forthcoming work on the weather and climates of India, I would point out that his directions about finding the bearings of the centre of cyclones of the Bay of Bengal seem to be just a little perplexing to some who read them, when he speaks, as he does, of the wind being three and four points before the beam, while referring to a human being standing with his back to the wind, &c. Of course, what is meant is, supposing a vessel has her stern to the wind, or running with the wind right aft, the centre will be three and four points before the "port" beam; or, in other words, if the wind is, say, north-east by north, the centre of the storm will bear south-south-east or south by east, and not south-east by east, or south-east, as it appears is still stubbornly taught by those who should know better.

A vessel in the northern hemisphere on the starboard tack, unless she happens to be sailing on the same course as the storm, and slower than it is travelling, is invariably going out of bad weather into finer, and out of bad into worse weather when on the port tack.

But much has to be said with regard to this rule of keeping the wind on the starboard beam, with a view of hastening the vessel's distance from the centre and from the hurricane belt of a cyclone. In the first place, on the left-hand semicircle, each squall, as we have above noticed, bursting down from aloft, comes from the right hand of the surface wind, which it displaces, and the vessel necessarily comes up in it, provided the storm is stationary, or is not fully developed; but if it has obtained much velocity, its onward progress will counteract this effect, and the wind will remain stationary in direction, or the ship will actually "break off," and, consequently, be more and more in the "trough of the sea"—a position sometimes critical for a ship if she is deep laden, and a high cross-sea is running, as there probably will be under the circumstances. In this case the only alternative left open to the shipmaster is to so reduce his sail that the vessel will not forereach (or lay to) on the port tack, and wait until the storm passes on.

But on the right-hand semicircle the case is very different, and the starboard-tack rule is the proper one to adopt both with regard to the wind-shifts and also to the fact of the vessel always coming more and more "head on" to the sea—an all-important consideration.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. Francis Darwin, F.R.S., of Trinity College, has been appointed Reader in Botany in succession to Dr. Vines. Mr. E. H. Douty, M.A., of King's College, has been appointed Senior Demonstrator in Anatomy; and Messrs. W. S. Melsome, Fellow of Queen's College, and Mr. R. W. Michell, of Gonville and Caius College, Junior Demonstrators of the same.

The elections to the Council of the Senate this year may be regarded as generally favourable to science; Dr. Peile, Prof. Macalister, Dr. Routh, Prof. Browne, and Mr. E. Hill, being six of the eight elected. Dr. Lea, however, was unsuccessful, this being his first candidature.

SCIENTIFIC SERIALS.

American Journal of Science, November.—On the deflection of the plumb-line and variations of gravity in the Hawaiian Islands, by E. D. Preston. The observations for gravity were carried out in 1887 on Mount Haleakala on the Island of Maui, which is rather over 10,000 feet high with one of the largest extinct craters in the world on its summit. From these researches it appears that deflections of the plumb-line are greater on insular than on continental mountains, presumably owing to the lighter surrounding sea-water; that gravity is not in defect, because it is here estimated from the true sea-level, and not from a sea-level elevated by continental attraction; that deflections are greater in the vicinity of extinct volcanoes than near active ones; and that the so-called "hidden causes," which in the Himalayas give a variation of gravity several times as great as those arising from the attraction of the mountains themselves, do not exist in the Hawaiian Islands.—Mineralogical notes, by S. L. Penfield and E. S. Sperry. Beryl and phenacite are here studied for the purpose of determining the presence of alkalies in these crystalline bodies. Analytical studies are also given of several other rare minerals, such as a specimen of monazite and oligoclase from North Carolina, sussexite from New Jersey, barium feldspar from Pennsylvania.—The absorption spectra of certain blue solutions, Part 2, by F. B. Pitcher. Here it is shown that blues and violets obtained by absorption in pigments and solutions, differ in several respects from those colours which approximate in hue to the longer wave-lengths of the spectrum. As a rule they are much less completely saturated, and they show irregularities of composition rarely met with in absorption reds and yellows.—An instrument for demonstrating the laws of transverse vibrations of cords and wires, by George S. Moler. The apparatus here described was designed to meet a want, felt in the laboratory, for an improvement over Melde's method of producing transverse vibrations of cords and wires.—Rhætic plants from Honduras, by J. S. Newbury. These fossils, chiefly from the San Juancito district, are clearly Upper Triassic, and greatly resemble those of the coal-bearing strata on the Yaki River, Sonora.—Energy and vision, by S. P. Langley. In this investigation the author has had mainly in view the assumption of H. F. Weber and others that the luminosity of a colour is proportionate to the energy that produces it, an assumption which is shown to be absolutely groundless.—Mr. J. H. Long has a paper on circular polarization of certain tartrate solutions, and Mr. W. E. Hidden sends some notes on some specimens of xenotime from New York and North Carolina.

Bulletins de la Société d'Anthropologie, tome xi. Série 3 fasc. 1 (Paris, 1888).—On aphasia, by M. Hervé, who draws attention to a case recorded by Larrey sixty years ago, of a soldier, wounded at Waterloo on the left frontal, who lost his memory of words, more especially nouns. After death the ball was found close to the dura mater, but separated from it by the portion of bone embedded with it at the moment of the accident. The case is curious as having been recorded so long before Broca's discovery of the localization of speech.—Monstrosity of the left upper extremity, by M. Variot. The relatively small but otherwise normally formed left hand appears to proceed directly from the stump of the flattened shoulder with no trace of arm, or forearm. The body presents no other anomaly.—The history of the various modifications effected in the ship's rudder, by M. O. Beauregard.—On certain customs, connected with phallic worship, common to the Abyssinians and the ancient Spartans.—On cannibalism and its assumed origin. The consideration of these questions at an earlier meeting by M. de Nadaillac has been again made the subject of an animated discussion between himself and M. Mortillet; for, while the latter believes that this practice must originally have emanated from some perverted religious idea, M. de Nadaillac refers it solely to the promptings of famine, which is capable of engendering in man, if not mania, a depraved taste, and bestial inclinations, which civilization has never been able wholly to eradicate. The absence of animals adapted for human food he considers to have been a powerful factor in widely remote lands, as Mexico, Tierra del Fuego, New Zealand, the Pacific Islands, &c., where the people under various stages of civilization and barbarism have alike practised cannibalism, whether as a national rite or a social custom. The discussion supplies an exhaustive treatise on the subject, which at a subsequent meeting of the Society was again considered at great length by Dr. Bordier, who concludes his comprehensive essay by showing that, as the dental system in man, as in the other Primates, does not allow us to assume that in his primitive condition he was carnivorous, we must consider cannibalism as an acquired and not an original custom.—Communication, by M. D'Acy, regarding Palæolithic mortuary deposits in rock-caves. This paper gave rise to a discussion as to the age of human remains found at Solutré, Furfooz, Spy, Mentone, &c., M. de Mortillet regarding them in opposition to M. D'Acy as Neolithic, rather than Palæolithic.—On the choice of a fixed point of departure for cranial measurements, by Dr. Fauvelle. This the writer considers is to be sought at the base of the cranium, at the cerebral extremity of the vertebral column, where alone one definite point can be found which is always the same in the entire series of the Vertebrata, being indicated in the embryo by the anterior terminus of the dorsal cord, and in the adult by the posterior portion of the first cervical nerve.—The present number of the *Bulletins* contains the ordinary annual report of the statutes, rules, &c., of the Society.

Fasc. 2.—Continuation of the discussion on cannibalism reported in the previous number, and treating specially of the character and adaptability of the dental system in man.—On woman in relation to cannibalism in Polynesia, by M. Letourneau. The exclusion of women from cannibal feasts in some members of this group is referred to a greedy desire on the part of the chiefs to reserve such enjoyments for themselves. Human flesh being early tabooed to women, they gradually acquired a strong distaste for it, which in course of time was transmitted as an hereditary characteristic even to their male descendants, some of whom, as the majority of the Tahitians, had begun to manifest a repugnance for this species of food as early as the time the islands were first visited by Captain Cook.—On the ethnology of Le Rouergne, by M. Durand de Gros. The author regards this district as chiefly Iberian in character, and considered that the whole of the Department of Aveyron, with L'Hérault and La Lozère, forms the eastern confines of a remarkable linguistic region, comprising the whole of ancient Aquitania. He points out that the Garonne is a phonetic frontier, to the north of which all forms of local *patois* possess the letter *f*, while on the opposite side that character is replaced by *h*, the *filha*, *ferre* (*fille*, *fer*), of the peasants on the right bank, being pronounced *hilha*, *herre*, by those on the left. The paper supplies much interesting matter in regard to the various linguistic currents that have been successively incorporated in the main stream of the vernacular through consecutive immigrations; Latin, Celtic and Teutonic suffixes being often associated with some alien root in the names of families and places. The brachycephalic character of the district is at present very strongly marked, while the crania belonging to ancient times, as those found in the dolmens of La Lozère, are without exception dolichocephalic.—On the stature of the Parisians, by M. Manouvrier. A comparative analysis of the results yielded for the twenty arrondissements of Paris shows that, other conditions being equal, affluence, and the absence of want and of the necessity for excessive labour, have a favourable influence on the stature of a man. It is found, moreover, that while the mean height of Frenchmen belonging to families in easy circumstances does not notably alter, it is being very sensibly diminished among the poor.—On the skull of an adult gorilla, by M. Hervé.—On prehistoric discoveries in Portugal, by M. de Mortillet, who reports the recent inauguration at Lisbon of a course of lectures on archæology by M. da Silva, to whom we are indebted for the discovery of a deposit near Leiria, in which flat hatchets and other instruments have been found, all of which are of pure copper.—The Neolithic Age at Champigny, on the Seine, by M. E. Rivière. The finds at this station have been rich in flint and other stone instruments, with fragments of coarse pottery, but they contain few bone remains, these belonging moreover, with the exception of the elk, to ordinary domestic animals. No human bones have been obtained.—On certain anthropological researches in the Caucasus, by M. E. Chantre. This communication supplies an interesting summary of the author's important work on the anthropology of the Caucasian district, which is based on the result of personal observations, and a careful study of the human and other remains derived from numerous ancient tribal burial-places, and is copiously provided with tables of comparative cephalic and other anthropometric determinations.—On a prehistoric station at Aragua, Venezuela, by M. Marcano.—A prehistoric necropolis at Saint Ellier (Maine-et-Loire) by M. Bonnemère.—On the mammillated menhirs of Sardinia, by M. de Mortillet.—On aphasia, by M. Ploix. This paper, which is mainly based on the deductions of Broca, gave rise to repeated discussions, in which Dr. Fauvelle and others took an active part in defending their special views as to the localization of speech.—Communication, by M. Hervé, on his memoir entitled "Broca's Convolution in the Primates." The writer demonstrates the claims of Leuret to be regarded as the first who recognized in the brain of the Simiadæ the prototype of the convolutions of the human brain, his discovery of a cerebral type common to all the representatives of the group of Primates having preceded by thirty years the researches of Darwin, Huxley, Vogt, and Broca. —On the efficacy of the poisons used in olden times in Europe, and still employed by Negritos and others, for tipping arrows and other weapons, by M. Laborde.—On a case of congenital blindness and deafness, with mutism, reported in New York, and communicated by M. de Nadaillac.—On cannibalism in Madagascar, as recorded in the work of M. de Flacourt in 1650, by M. Beauregard.

SOCIETIES AND ACADEMIES.

London.

Linnean Society, November 1.—Mr. W. Carruthers, F.R.S., President, in the chair.—Prof. Bower exhibited and made remarks upon some adventitious buds on a leaf of *Gnetium gnemon.*—Mr. John Young exhibited (1) a rare bird (*Pluvianellus sociabilis*), unobserved for fifty years, and lately rediscovered by him in Patagonia; (2) a cluster of nests formed of lichen (*Usnea*) by a swift, as supposed of the genus *Collocalia*, from a cave in Eimeo, one of the Society Islands; (3) remarkably elongated tail feathers of domestic cock (11 feet in length), artificially produced by the Japanese; (4) nest and eggs of the snow bunting (*P. nivalis*), taken during the past summer in Scotland.—Mr. Thomas Christy exhibited a new method of transmitting light to a microscope by means of a curved rod of glass.—The Rev. R. Baron read a paper on the flora of Madagascar, in which he gave an interesting account of his explorations and collections in that country.—In another paper, entitled "Further Contributions to the Flora of Madagascar," Mr. J. G. Baker, F.R.S., described the principal novelties brought home by Mr. Baron, and paid a well-deserved tribute to his energy and ability as a botanical explorer.

Mathematical Society, November 8.—Sir James Cockle, F.R.S., President, in the chair.—At the commencement of the meeting the Chairman feelingly dwelt upon the loss the Council and the Society had sustained by the recent decease of Arthur Buchheim (see NATURE, vol. xxxviii. p. 515).—The gentlemen whose names were given in a recent issue having been elected on the new Council, the new President (J. J. Walker, F.R.S.) took the chair, and called upon the retiring President to read his address on the confluences and bifurcations of certain theories.—Other communications that were made were:—Cyclotomic functions, § 1, groups of totitives of n; § 2, periods of nth roots of unity, by Prof. Lloyd Tanner.—On a theory of rational symmetric functions, by Captain P. A. MacMahon, R.A.—The factors and summation of $1^r + 2^r + \ldots + n^r$, by Rev. J. J. Milne.—Raabe's Bernoullians, by J. D. H. Dickson.—Certain algebraical results deduced from the geometry of the quadrangle and tetrahedron, by Dr. Wolstenholme.—On a certain atomic hypothesis, by Prof. K. Pearson.—On deep-water waves resulting from a limited original disturbance, by Prof. W. Burnside.

Entomological Society, November 7.—Dr. D. Sharp, President, in the chair.—M. A. Wailly exhibited a large and interesting collection of Butterflies recently received from the Gold Coast and other parts of West Africa. The collection included about forty-seven species belonging to the genera *Papilio, Diadema, Salamis, Romalæosoma, Charaxes, Harma, Eurypheme, Junonia, Aterica, Hypanis, Eurytela, Mycalesis, Cyrestis, Nepheronia, Mylothris, Belenois*, &c. M. Wailly stated that several of the species were undescribed, and were not represented in the British Museum collections.—Mr. Jenner-Weir exhibited four bred specimens of Ant-lions, two of which were from Saxon Switzerland, and the other two from Fontainebleau. He stated that he believed the specimens belonged to two distinct species. Mr. McLachlan said that the specimens all belonged to one species, viz. *Myrmeleon formicarius*, Auct. = *europæus*, McLach.—Mr. W. C. Boyd exhibited an example of *Pterophorus zetterstedtii*, taken at Sydenham. He remarked that this species had hitherto only been recorded from Lynmouth and Folkestone.—Mr. Enock exhibited specimens of *Cecidomyia destructor* (Hessian Fly), illustrating the life-history of the species, and made remarks on them.—Mr. Wallis Kew exhibited a specimen of *Dytiscus marginalis* having a small bivalve shell attached to one of its legs. The bivalve had apparently attacked the *Dytiscus* and refused to relax its grasp. A discussion ensued, in which Dr. Sharp, Mr. Stainton, and Mr. Kew took part.—Mr. W. E. Nicholson exhibited several specimes of *Acidalia immorata*, Linn., caught by him near Lewes. Mr. Jenner-Weir observed that the species had only recently been added to the British list, and that it was remarkable how so comparatively large a species could have been hitherto overlooked. It was also remarked that a specimen of this species from the collection of the late Mr. Desvignes had been exhibited by Mr. Stevens at the meeting of the Society in November 1887.—Dr. Sharp exhibited a large number of species of Rhynchophora, collected by Mr. George Lewis in Japan.—Mr. F. P. Pascoe read a paper entitled "Descriptions of New Longicorn Coleoptera."—Dr. Sharp read a paper entitled "The Rhynchophorous Coleoptera of Japan."

Paris.

Academy of Sciences, November 3.—M. Janssen in the chair.—Essay on the theory of the Belleville carriage-spring, by M. H. Resal. This spring, devised about twenty-five years ago, has yielded excellent results in its application to railway rolling-stock. Here the principle of its action is worked out theoretically.—On the advantages of the use of electric light in the observations of marine zoology, by M. de Lacaze-Duthiers. An account is given of the system of electric light now in use at the Arago Laboratory of the Banyuls station, by means of which the author has been enabled to carry out some of his most important recent observations on marine life. The transparent animals especially can be studied with great advantage in a luminous atmosphere, revealing even the embryonic organisms, which cannot be detected in ordinary light.—Positions of Barnard's comet (September 2, 1888) measured at the Observatory of Besançon, by M. Gruey. The observations were taken jointly with M. Hérique for the period from October 11–17.—Observations of Barnard's new comet (October 30), and of Palisa's new planet, 281, made at the Paris Observatory (equatorial of the west tower), by M. G. Bigourdan. The positions of the comparison stars and the apparent positions of the comet and of the planet for November 3 are given.—On a triple determination of the latitude of the Gambey circle, by M. Périgaud. These determinations, effected by means of the new mercury bath described in the *Comptes rendus* for March 16, 1888, show that the latitude of the circle is as nearly as possible 48° 50′ 10″·9. It also appears that the latitude does not vary with the seasons, the result obtained in October 1888 being identical with that previously determined by the same instrument in June 1887.—On a means of studying the slight deformations of liquid surfaces, by M. J. B. Baille. Fizeau's extremely delicate method of measuring minute distances is susceptible of a large number of applications, and is here employed accurately to determine all the deformations of a liquid surface, however slight be the actions causing them. By this process the author has been enabled to observe the surface deformation of magnetic and diamagnetic fluids under the action of a weak magnet. He also shows that, as a copper wire traversed by a strong current attracts iron, it also attracts the surface of the perchloride of iron in solution.—On the occlusion of gases in the electrolysis of the sulphate of copper, by M. A. Soret. The author's researches lead to the conclusion that the electrolyzed copper always contains a certain quantity of gas, almost exclusively hydrogen. It retains a little carbonic acid and sometimes a very slight quantity of carbon oxide. A certain relation exists between the quantities of gas occluded and the conditions of temperature and acidity; consequently the quantity of gas present in the metal is variable, and the proportion 4·4 volumes, given by Lenz (*Journ. prakt. Chem.*, cviii. p. 436), is applicable only to the particular case studied by that physicist.—On tin, by M. Léo Vignon. If a zinc plate be plunged into an aqueous solution of one of the tin chlorides, the latter metal is precipitated by the zinc according to certain known thermo-chemical relations. The tin so precipitated possesses some special properties, which are here studied for the first time. An inquiry is also made into the cause of this modification of the fundamental properties of tin. The result of this inquiry is that the modified tin, which is infusible, is a mixture of metallic tin and of the anhydrous protoxide of tin.—On the homopterocarpine and pterocarpine of red sandalwood, by MM. P. Cazeneuve and L. Hugounenq. These two extracts of red sandalwood, described in the *Comptes rendus*, civ. p. 1722, are here methodically studied under the action of the chief reagents. Their respective formulæ are now shown to be $C_{24}H_{24}O_6$ and $C_{20}H_{16}O_6$, and there can be no longer any doubt that pterocarpine is a lower homologue of homopterocarpine.—On a substance at once acid and basic contained in cod-liver oils, by MM. Arm. Gautier and L. Mourgues. This substance, to which the authors give the name of morrhuic acid presents considerable interest owing to its double function of an acid and an alkali, as well as for its relative abundance and its origin, which is probably connected with the vegetable lecithines. It is present in these oils under the form of an unstable and complex combination, behaving like the ordinary lecithines—that is, it is modified, especially when heated in the presence of acids and alkalies, liberating glycerine, phosphoric acid, and a complex acid. It corresponds to the formula $C_9H_{13}NO_3$.—M. V. Marcano describes a fermented drink (*yaraque*) extracted by the wild tribes of the Upper Orinoco from Cassava; M. Martinaud studies the analysis of the yeast of beer; and M. Émile Rivière reports on the human and animal remains found in the Caves of Baumias de Bails and Saint-Martin in the Alpes Maritimes.

BERLIN.

Physiological Society, October 26.—Prof. du Bois-Reymond, President, in the chair.—Prof. Wolff spoke on the growth of the lower jaw. Notwithstanding the opposition of some observers, Flourens's view of the growth of bone by apposition and absorption is still widely applied to the lower jaw, and Humphry's experiments on the growth of the ascending branch of the same have been advanced in support of this theory. The speaker had therefore made a large number of experiments on goats and rabbits, by firmly attaching two wire rings to the bone while the animals were still young; one ring was placed at the *pars incisiva*, the other at the angle of the lower jaw. His conclusions are based upon the results of forty-two experiments; of these twenty-three showed an increase of 7 to 9 mm. in the distance between the wire rings in three to six months, while in twelve other cases a distinct but smaller increase in the distance between them was observed, so that only seven cases yielded no positive result. Bearing in mind the value which must always be attached to a few positive results even when opposed by many negative, it appears that the above-mentioned large preponderance of cases in which an increase in the distance between the marks was observed fully justifies the conclusion that the lower jaw grows by expansion. This proof of the interstitial growth of bone, together with the proved adaptability of all bones to the statical conditions of the demands made upon them, will, Prof. Wolff hopes, put an end to the idea that bone-tissue is inactive, and replace it by the theory he has so long held that bone is capable of active vital growth even in old persons.—Dr. Hans Virchow gave an account of the results of his experiments on the development of blood and the blood-vessels in the chick. In especial he pointed out that the blood is developed very early in the mesoblast, and takes up a peculiar position in the same. He next spoke on the yolk-sac of the chick. After he had explained the chief points and results of his researches, he was obliged to defer the rest of his communication to the next meeting, owing to the lateness of the hour.

AMSTERDAM.

Royal Academy of Sciences, October 27.—M. Behrens discussed the origin of the volcanic lakes in the Eifel Mountains, and demonstrated that they could not have originated in the crumbling down of extinct volcanoes. He endeavoured to show that the Eifel Lakes must be regarded as incomplete volcanoes, and that they were formed by the softening and continuous blasting of the sedimentary rocks, only a little lava having been brought to the surface.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

The Butterflies of the Eastern United States and Canada, with special reference to New England, Part 1: S. H. Scudder (Cambridge, Mass.).—Index Catalogue of the Library of the Surgeon-General's Office, United States Army, vol. ix. (Washington).—The Invisible Powers of Nature: E. M. Caillard (Murray).—Thermodynamique: J. Bertrand (Paris, Gauthier-Villars).—Untersuchungen über Dammerungserscheinungen: J. Kiessling (Hamburg, Voss).—University College, Nottingham, Calendar 1888–89 (Nottingham, Sands).—An Introduction to Entomology, Part 1: J. H. Comstock (Ithaca).—Annual Report of the Secretary for Mines and Water Supply, Victoria (Melbourne, Brain).—Foreign Aviary Birds, &c.: Dr. K. Russ (Dean).—Macaws, Cockatoos, Parrakeets, and Parrots: Sir T. D. Lauder and Captain T. Brown (Dean)—Euclid's Elements of Geometry, Books I.-IV.: A. E. Layng (Blackie).—Questions and Examples on Elementary Experimental Physics: B. Lœwy (Macmillan).—Practical Metallurgy and Assaying: A. H. Hiorns (Macmillan).—Gleanings in Science: G. Molloy (Macmillan).—Sitzungsbericht der K. Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Classe (Mathematik, Physik, Chemie, Mechanik, Meteorologie, und Astronomie, Heft 3–10), (Mineralogie, Botanik, Zoologie, Geologie, und Paläontologie, Heft 1–10), (Physiologie, Anatomie, und Theoretischen Medicin, Heft 1–10) (Wien).—The Meteorite of November 20, 1887: H. G. Fordham (Hertford, Austin).—Mineralogical Magazine, October (Simpkin).—Notes from the Leyden Museum, October (Leyden, Brill).—Journal of Physiology, vol. ix. No. 4 (Cambridge).

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