THURSDAY, MAY 19, 1892.

THE TELL EL-AMARNA TABLETS IN THE BRITISH MUSEUM.

The Tell el-Amarna Tablets in the British Museum, with Autotype Facsimiles. (London: Printed by order of the Trustees, 1892.)

DURING the summer of 1887, a woman belonging to the household of one of the "antica" dealers who live at or near Tell el-Amarna, in Upper Egypt, set out to follow her usual avocation of digging in the sand and loose earth at the foot of the hills for small antiquities. Every man, woman, and child in the neighbourhood spent, and probably still spends, a large portion of each day in this profitable pursuit, for in the winter season they were able to sell at good prices the scarabs, rings, fragments of beautifully glazed Egyptian porcelain, and other objects of this nature, of which there seemed to be an endless supply in the ground round about. From the time when Wilkinson made his first journey to this place, until quite recently, every traveller who has visited the spot has been able to bring away with him interesting and important antiquities, which have either revealed new facts in Egyptian history, or have served to illustrate and explain processes in the technical arts known to the Egyptians. In the early years of this century, when the scientific staff attached to Napoleon's expedition to Egypt was compiling the materials for the splendid map of Egypt afterwards edited by Jacotin, it was noticed that the "ruins of a large town" existed at Tell el-Amarna, and it is said that a superficial search made over this part of the country resulted in the finding of a number of fine objects which have since filtered into several European collections of Egyptian antiquities. But whatever things have been dug out from these ruins, or from the ground round about them, or however great their importance, nothing possessing the historical and scientific value of the antiquities discovered by the Tell el-Amarna woman in 1888 hath ever rewarded searcher before. The exact details of her search will never be known, neither can the exact spot where she made her great discovery be identified (for the Arabs took care to obliterate all traces of the diggings made by them on the spot after her "find"), but it is certain that in a small chamber at no great depth below the surface, she found a number of clay tablets the like of which had never been before dug up in Egypt. The number of these tablets and fragments is variously given, but it seems that the outside limit may be set at three hundred and thirty; in this matter, however, and indeed in making any statement which is based upon the word of many sellers of "anticas" in Egypt, the writer (and the reader) must protect himself by saying after the manner of the pious Muhammedan, "But God knoweth." Of this "find" the Trustees of the British Museum secured eighty-two tablets, the Gîzeh Museum in Egypt about sixty, and the Berlin Museum about one hundred and sixty pieces, of which a large number are fragments which give no connected sense. The authorities of this last institution published the texts from their own collection together with those from the tablets at Gîzeh by lithography under the editorship of Drs. Abel and Winckler, but the results already gleaned by scholars from this edition appear to be meagre when compared with the quantity of material which the originals offer for study.

The Tell el-Amarna tablets are different from all other known cuneiform documents. They lack the symmetrical form of the tablets from the libraries of the old Babylonian temples, or of those from the library at Kouyunjik, founded by the mighty kings of the last Assyrian Empire—Sargon, Sennacherib, Esarhaddon, and Assurbanipal; the material is, in many cases, ill-kneaded, and contains fragments of flint or other coarse materials; the colour of the clay varies from a light to a dark dusk tint, and from a flesh colour to dark brick-red. They are written in a hand which, to some extent, resembles the Neo-Babylonian writing used commonly in Babylonia and Assyria for about seven centuries before Christ. It possesses, however, characteristics different from those of any other style of cuneiform writing of any period now known to exist, and nearly every tablet contains forms of characters which have hitherto been thought peculiar to the Ninevite or Assyrian style of writing. The large, bold hand found upon some of the tablets suggests the work of the unskilled scribe, but more careful examination shows that it is the result of unconventionality rather than ignorance. The details of the peculiarities of spelling need not be discussed here, but the expert will find many rare and important examples of Assyrian orthography never dreamt of before. The Semitic dialect in which the tablets are written is very closely related to the Hebrew of the Old Testament, and the "Canaanite" forms of pronouns, &c., are of peculiar interest for the student of the Bible, for many of them are new, and they afford the means of explaining certain difficulties which now exist in Semitic grammar. Although these tablets offer a satisfactory solution of some difficulties, they raise many questions which will probably remain unanswered for some time, and among these there is one, not the least important, of how it happens that a governor of Egypt, who was a vassal, and ruling in Syria, should bear the name of Itagamapairi, which is neither Semitic nor Egyptian?

The Tell el-Amarna tablets are unique as an archæological "find," and they are also unique as a means of weaving together the threads of the histories of two or three of the greatest nations of antiquity at a critical period. As we are able to say, with comparative certainty, that they were all written between the years 1500–1450 B.C., they have an authority possessed by few of the documents coming down from this remote period. They partly fill, moreover, a gap in the history of the dynasties of Mesopotamia and Syria, for although much comparatively is known concerning the period in which the Assyrian Empire was founded—about B.C. 1800—and although we have annals of many kings between B.C. 1320 and 620, the history of the period between B.C. 1800 and 1320 is almost unknown.

The Tell el-Amarna tablets in the British Museum consist of a series of despatches written from kings of Babylonia, Alashiya, Mitani, Phœnicia, Syria, and Palestine to Amenophis III., and to his son, Amenophis IV., frequently named Khut-en-aten, or Khu-en-aten, and the "heretic king"; among them also is the draft of a despatch from Amenophis III. to a king of Karaduniyash. Many of them are of a personal and private nature, and these are, of course, the most interesting, for they reveal details of the family life of the great kings of the East, which the ordinary inscriptions have failed to preserve for us; the remainder refer to State business, and show beyond all doubt how close was the connection between the kings of Babylonia, Mitani, and Karaduniyash and the kings of Egypt, and also how great was the commerce and intercourse between these countries. It will be remembered that the Egyptians gained their first foothold in Syria under Amasis I., who, about B.C. 1700, brought the war of independence to a successful close, and marched into Sharuhen, a city to the south of Gaza, mentioned in Joshua xix. 6. His successor, Amenophis I., made no further advance into Syria or Mesopotamia; but Thothmes I., about B.C. 1633, marched into Northern Syria, called Ruthen, and set up a tablet to mark the limit of the frontier of Egypt. His son made no attempt to "enlarge the borders" of Egypt in this direction, and the "wild woman" Hatshepset was too much occupied with fitting out her expedition to Punt to trouble about such things; but when Thothmes III. ascended the throne of Egypt, about B.C. 1600, he at once set out to crush the rebellion which had broken out all over the country to the north-east of Egypt. Making his way by the peninsula of Sinai, he passed into Syria, and within a month from the time he set out he defeated the rebels, whose head-quarters were at Megiddo, and captured the city. During the next few years he marched through the country round about, carrying off spoil, and establishing the worship of Amen-Rā and other Egyptian gods in the principal cities. At a city on the Euphrates called Ni, he set up a tablet near one set up by his grandfather several years before, and it is clear that his hold upon Western Mesopotamia was no shadowy power. Indeed his conquest of the city of Ninip, and the worship of the gods of Egypt established there by him, is referred to by the inhabitants of that place when they write to Amenophis III. more than one hundred years later. When Amenophis III. ascended the throne of Egypt about B.C. 1500, he was, thanks to the bloody victories of his predecessors, able to assume the sovereignty of Western Mesopotamia and Syria without much fighting, and it seems that his expeditions to these parts were undertaken as much for the sake of the lion hunts which he conducted there as for the purposes of conquest. He boasts on his scarabs that in the first ten years of his reign he slew 102 lions with his own hand. That the country of Mitani offered fine opportunities for sport we know from one inscription which says that Thothmes III. slew 120 elephants there; and Tiglath-Pileser I. (B.C. 1120) boasts in his annals that on foot he slew 120 lions with his own hand in Mitani (Rawlinson, "Cuneiform Inscriptions," i. pl. 16, 76–79). While on one of these semi-warlike expeditions he fell in love with a fair-haired, blue-eyed, graceful girl named Thi, the daughter of parents whose names were Iuaa and Thuaa, and she was brought to Egypt in the tenth year of the king's reign, accompanied by another wife of Amenophis, and 317 of her ladies. Thi was evidently the Egyptian monarch's favourite wife; she became *par excellence* the "Queen of Egypt," and her son Amenophis IV. became King of Egypt. Amenophis III. also married a sister and daughter of Kallimma-Sin, King of Karaduniyash, and made proposals for another of his daughters, named Sukharti, while she was still a child, and he took to wife also the sister and daughter of Tushratta, the King of Mitani. A letter from Burraburiyash also reveals the hitherto unknown fact that his son married a daughter of the King of Egypt. One of the most interesting of these tablets is the draft of a letter from Amenophis III. to Kallimma-Sin, King of Karaduniyash, a country conterminous with Assyria; it is the only known letter of Amenophis in Babylonian, and is written upon a tablet of Nile mud. The subject of the letter is a proposal for the hand of Sukharti, whose father, Kallimma-Sin, writes back to Egypt asking what has become of his sister who married the King of Egypt many years before? In reply to this Amenophis invited Kallimma-Sin to send messengers to see and to converse with the lady, and to carry back news of her to her brother. An embassy was sent to Egypt, but its members were too young to be able to remember what the lady had been like, and they failed to identify her satisfactorily. Kallimma-Sin is not unwilling to discuss the marriage of his younger daughter Sukharti, but he points out that he usually gives his daughters to the "kings of Karaduniyash," who make handsome presents to himself and his messengers. Not to be defeated in his desire by the paltry question of gifts to the wife's relatives, Amenophis says that he is not only willing to give for Sukharti as much as all the other suitors could or would give put together, but he will send a gift to Kallimma-Sin in honour of this king's sister, who is now living with him in Egypt. This point satisfactorily settled, Amenophis proceeds to discuss the proposal of Kallimma-Sin for an Egyptian princess, and he plainly but forcibly tells him that "the daughter of the king of the land of Egypt hath never been given to a 'nobody.'" Kallimma-Sin replies, "Why not? Thou art king, and canst act as thou pleasest"; but, willing to be satisfied with a lady of less rank than a princess, he adds, "Surely there be daughters of nobles who are beautiful women in Egypt. Now, if thou knowest a beautiful lady, I beseech thee to send her unto me; for who here could say that she is not a princess?" What Amenophis finally arranged for "his brother Kallimma-Sin" we know not, but it seems that he gave him a large quantity of gold, and that he married Sukharti after all. The letters of Burraburiyash to Amenophis III. are scarcely less interesting, for they refer to old intrigues of the Canaanites, to commercial treaties, and they give some account of this king's gifts to the daughter of Amenophis who was about to marry his son.

The most important correspondent of Amenophis in the land of Mitani was Tushratta, whose sister and daughter he married, and who writes to his son-in-law with a mixture of affection and avarice amusing to contemplate. For example, having acknowledged the receipt of a letter from Amenophis, and said that its "contents pleased him so greatly that even if it were possible to dissolve all the friendship which had existed between them in times gone by, the words of this message alone would, for himself, suffice to re-establish their friendship for ever," he next begs him to send him much gold, and artfully refers to a gold libation bowl and vessels profusely decorated with gold ornaments which Amenophis had sent to his father, thereby hinting that similar gifts would be most acceptable to himself. In true Oriental fashion he says, "When my brother has sent the gold, if I ask, 'Is it enough?' the answer may be, 'Fully enough'; or I may ask, 'Is it the full amount?' and the answer may be, 'It is more than the full amount.'" In the latter case Tushratta declares that he will be "very glad"! In another letter Tushratta gives an account of his accession to the throne. It appears that when his father Shutarna died, his brother Artashumara became king, but was shortly after slain by rebels. Though quite young, Tushratta rallied his friends and supporters, and after some trouble succeeded in slaying his brother's murderers. Facts of this nature are of great importance for restoring the history of this long-forgotten country. It is an interesting fact that together with such letters there always arrived gifts, which consisted of horses, chariots, gold vessels, ornaments made of gold and lapis-lazuli, eunuchs and ladies for the king's household; and the relatives of the Mesopotamian princesses who had become wives of the King of Egypt never forgot to send them gifts of earrings of gold, choice oil for anointing, &c. Sad to relate, however, some of the writers of these letters complain that Amenophis did not send them gifts in return. In a third letter Tushratta mentions that the goddess "Ishtar of Nineveh, lady of the world," had gone down into Egypt during his own reign and during that of his father, and he begs Amenophis to increase the worship of this goddess in Egypt tenfold. A fourth letter of Tushratta is sent to the "Queen of Egypt," who can be none other than the blue-eyed, fair-haired Thi.

Passing from the letters which refer to Amenophis's marriages contracted with Mesopotamian princesses, we come to those relating to the matter-of-fact business of the Egyptian Government of that day. These consist of reports of disasters to the Egyptian power and of successful intrigues against it, coupled with urgent entreaties for help, pointing to a condition of distraction and weakness in Egypt and her dependencies. Some of them must have been addressed to Amenophis III. towards the close of his long reign of about thirty-six years, but the greater number clearly belong to the reign of his son Amenophis IV., for the disorganized condition of the Egyptian provinces in Phœnicia and Syria which they reflect could only have come into existence when Egypt herself was torn by the rival factions which sprang up when that king endeavoured to substitute the worship of the Disk for that of Amen, the mighty god of Thebes. The chief cities of Phœnicia, Tyre, Sidon, Byblos, Aradus, and Simyra (which commanded the road to Aradus), representing the Egyptian power, were being daily attacked by the ever-increasing forces of the enemy, who, seeing the impotence or supineness of Egypt, grew bolder and bolder. Nor did the brave and loyal defence of such men as Rib-Adda, governor of Byblos, and Abi-Milki, King of Tyre, stave off for long the overthrow of the Egyptian power in Phœnicia. The desperate position of this latter loyal officer is almost pathetic in its hopelessness. In one letter to the King of Egypt he says, "My lord, my sun, my god, seven times and seven times do I prostrate myself at the feet of the king, my lord. I am the dust beneath the feet of the king, my lord, and that upon which he treadeth. O my king and lord, thou art like unto the god Shamash and to the god Rimmon in heaven. Let the king give counsel to his servant. Now the king, my lord, hath appointed me the guardian of the city of Tyre, the 'royal handmaid,' and I sent a report in a tablet unto the king, my lord; but I have received no answer thereunto." He then announces the delivering of the city of Simyra into the hands of Aziru the rebel, by Zimrida, governor of Sidon, who had also captured the city of Sazu, wherefrom Abi-Milki drew his supplies of wood and water, for neither existed naturally on the bleak rock of Tyre; in consequence many Tyrians died of want. Moreover, Zimrida, Aziru, and the people of Aradus attacked the forces of Abi-Milki in chariots by land and in ships by sea. In conclusion he sadly adds, "I am surrounded on all sides with foes, and I have neither wood to warm myself, nor water to drink; I send this tablet to the king by the hands of a common soldier, and may the king send me an answer speedily." When his condition becomes more desperate he sends another despatch, and with it a gift of five talents of copper, hoping thereby to extort an answer from the king of Egypt; in this he reports events with a Cæsar-like brevity thus:—"The king of the land of Danuna is dead, and his brother has succeeded him; there is peace in his land. One half of the city of Ugarit has been destroyed by fire. The soldiers of Khatti have departed Itagamapairi of Kadesh and Aziru have rebelled, and are fighting against Namyawiza. Zimrida, governor of Sidon and Lachish, is gathering together ships and men."

A letter of considerable importance is that of Akizzi, governor of Katna (Cana), for it refers to the origin of the worship of the sun in Egypt. It appears that the King of Khatti came to Katna, and carried off the image of the Sun-god, and Akizzi writes to Amenophis III., asking for money to ransom the image; he makes his appeal on the ground that Shamash the Sun-god, the god of his fathers, became also the god of the ancestors of Amenophis, and that they called themselves after his name. Now this clearly has reference to the title "son of the Sun," which was adopted by nearly every king of Egypt, and indicates that Akizzi believed that the worship of the sun was introduced into Egypt from Asia.

Space forbids our quoting more from these interesting documents, but sufficient has been said above to show what an important contribution to our knowledge of Oriental diplomacy about 1500 B.C. the Tell el-Amarna tablets offer. Incidentally they reveal many new facts of history; they offer a new field for the researches of the geographical student, and the identification of many towns and countries mentioned in the Bible and in the Egyptian inscriptions has already been obtained; they give us for the first time the names of Artatama, Artashumara, and Tushratta, kings of Mitani, and of Kallimma-Sin, king of Karaduniyash; they supply the reasons why and show how the Semites came to have such power in Egypt; and depict the inevitable anarchy which prevails in dependencies or colonies when the dominant power totters or declines.

We have already said that the Tell el-Amarna tablets are different from any other cuneiform documents known, and it is precisely this difference which has made their publication a difficulty. To make a satisfactory edition of these texts it was necessary to unite the skill of the Assyriologist with the accuracy of the photographer, for the former could only transcribe the characters more or less accurately, being powerless to give their exact shape and form, and the latter, while reproducing their exact shape and form, could only show the characters on the flat-sided tablets, those on the rounded edges remaining invisible. The Trustees of the British Museum, then, decided to print in cuneiform type a full transcript of the texts in characters as closely resembling the originals as possible, and in addition to give a number of characteristic specimens reproduced by the autotype process, so that the student who is unable to visit the Museum may be able to make himself thoroughly acquainted with the various complex and unusual forms of characters in which these tablets are written. In addition to the printed texts and autotype plates, a summary of the contents of each tablet is given, accompanied by notes, chiefly philological and geographical, which we believe will be of use to the reader. The summary is preceded by an introduction, in which the finding of the tablets and many points of interest concerning them are discussed in brief paragraphs. It will be remembered that some thirty years ago, when Sir Henry Rawlinson began to publish his monumental work, the "Cuneiform Inscriptions of Western Asia," he contemplated adding translations of all the texts given therein. It was, however, found impossible to do this satisfactorily; and notwithstanding Sir Henry's thirty years' additional labour on the Assyrian inscriptions, it would still be somewhat rash to publish word-for-word translations of such difficult texts as those from Tell el-Amarna. Plain, historical narrative, like the great Tiglath-Pileser inscription, could be and was well enough rendered into English by Sir Henry Rawlinson so far back as 1857; but letters and despatches of a new kind, containing words and forms hitherto unknown, cannot be thus treated. The summary of each tablet will tell the general reader what the tablet is about, and will help the student more than a literal translation of the verbose Oriental phrases would have done. In publishing these texts with autotype reproductions and summaries of contents, the Trustees of the British Museum have made a new departure, and we believe that the edition will be as useful to the general student of antiquity as to the cuneiform expert.

A TEXT-BOOK OF PHYSICS.

A Manual of Physics. By William Peddie, D.Sc., F.R.S.E. (London: Baillière, Tindall, and Cox, 1892.)

THE attempt made by Dr. Peddie to supply a manual of physics suitable for English students and English teachers is altogether worthy of praise, and his effort has undoubtedly been, on the whole, successful. The best works at present in use in higher schools and in colleges as text-books of physics are the well-known English translations of two French books, Ganot and Deschanel. These are, no doubt, excellent books in their way, and in the hands of able English translators the original French compilations have received great improvement. A recommendation also of these French books is to be found in the beautiful diagrams and pictures of experimental apparatus. These we miss in every English book, including the book before us. Nevertheless, even the modified and improved English translations are not altogether satisfactory for English teaching purposes, and Dr. Peddie's work, supplying a need which is very generally felt, will be most warmly welcomed.

The subject has been, on the whole, judiciously treated. It is compressed in an admirable way into very moderate compass. If, now and then, one feels regret that some particular portion has not been more fully dealt with, reflection on the moderate size of the book, and on the way in which each part is treated in the space prescribed to it by the author, often affords a timely and sufficient consolation.

While speaking about size and form, it may be remarked that the paper, the printing, and the binding, make this a pleasanter text-book to hold and to use than any which has appeared for many a day. In this respect the book can scarcely be too highly praised.

Commencing with four preliminary chapters, in which general laws are stated and explanations given as to certain necessary mathematical ideas and formulas, the author proceeds in chapter v. to the treatment of elementary kinematics; and in chapter vi. to the general principles of dynamics, including the general equations of fluid motion and of the equilibrium of a fluid. It is needless to say that these subjects are very briefly touched upon; but teachers will at any rate find a very succinct indication, to say the least, of the parts of mathematics and of dynamics which are most essential to a proper understanding of the physics which is to follow.

Chapters vii. to xiii. inclusive are devoted to properties of matter: general properties of solids, liquids, and gases are dealt with; a good account of gravitation is given; elasticity, diffusion, and the allied subjects, as well as cohesion and capillarity, are discussed; while in chapters xii. and xiii. we find a very fair account—short, of course—of atomic theories, including the modern kinetic theory of matter. Perhaps the chapters just referred to, on properties of matter, constitute the most thoroughly successful portion of the book. We cannot call to mind any book in which an account of these subjects so good, and in itself so complete, can be found. The remaining chapters—with the exception of the last two, which are devoted to the electromagnetic theory of light and "the ether"—treat in detail of sound, light, heat, electricity, and magnetism. It is in the last-named portion of the book that students will feel a want of fuller and more complete treatment. The subject of heat in particular will be felt by many to be unduly compressed, and the same must be said of parts at least of electrodynamics and electromagnetism.

A book such as we have described, covering so wide a field, and brought into the narrow limits of 500 small octavo pages, must obviously, if it be well arranged and well written, be an important contribution to our scientific literature. We have no hesitation in giving it high commendation. There is, perhaps, not much that is absolutely novel in the treatment of the subjects, or in the matter, but that is hardly to be expected in a manual of this kind: the novelty is rather to be seen in the idea of the production of such a book.

While thus giving to the author warm praise and congratulation, we cannot avoid noticing serious faults both of commission and omission. First it seems simply deplorable to drag quaternion notions and notation into an elementary book of this kind, unless it be to show how ridiculous the riders of the quaternion hobby can at times become. The explanations and definitions at the commencement of chapter v. will be nothing to the majority of learners and teachers but a mass of confusion thrown over one of the simplest and most important of subjects. To prove by quaternions the formula S = VT (space described in a given time with constant velocity), which needs only a knowledge of the multiplication table; or the formula $x = \frac{1}{2}gt^2$ for falling bodies, which can be explained by common-sense (but not by quaternions) to a boy of twelve in half an hour, is simply inexcusable. Wherever quaternions are introduced in this book we find an easy matter made difficult—if not, as in the case of simple harmonic motion, absolutely unintelligible. Unfortunately, Dr. Peddie is not the first writer who has contrived, by means of quaternions, to make a subject unnecessarily difficult and repulsive.

But by far the most serious defect of this book, and it is one which will greatly mar both its usefulness as a text-book and also its popularity as a somewhat elementary work for reading and consultation, arises from the failure of its author to catch, even in a remote degree, the spirit which has animated and directed the whole of the best experimenting in physics for the last twenty-five or thirty years. *Et ignem regunt numeri* is the motto of Fourier's great work; and a realization of the fact that numbers (not merely numerical ratios) must be sought for as the crown of physical laws is that which has given pre-eminent value to the labours of experimenters during the last half-century, and has forced workers in this great field into precision and definiteness. The example set by Gauss and Weber, Joule and Thomson, and by the British Association Committee on Standards of Electrical Resistance appointed in 1861, has revolutionized ideas as to what is the ultimate object of experimenting in physics; and we can no longer be satisfied with knowledge as to almost any physical phenomenon until we are able to apply to the phenomenon and to our laws the searching test of arithmetical calculation in absolute numbers.

Unfortunately, in the book before us there is no recognition of these necessary conditions for completeness of knowledge, and very little recognition of recent investigations of the kind here indicated. The failure will be felt most seriously in the important subjects of heat, magnetism, and electricity.

In electricity there is not to be found the resistance, whether in ohms or in C.G.S. units, of any wire of any material! There are pages of algebra on dimensions of units, to puzzle the unfortunate learner, but nowhere can he find what an ohm, or ampere, or volt is: unless, "*ohm* = 10^9 *C.G.S.*" can be taken as a definition, when the meaning of a C.G.S. unit is not explained. Faraday's laws of electrolysis, got fifty years ago, are stated; but the determinations of Lord Rayleigh and Kohlrausch of the amount of silver deposited by an ampere current in a second are not even referred to. Tait's thermo-electric curves, and some forms of galvanic cells are described; but how to find the electromotive force of any one combination in volts is not indicated. We must not multiply instances. It would be only wearisome. Magnetism, electro-dynamics, are treated in precisely the same way; and the student would find it impossible to calculate from data in this book how much heat is conducted across a stone slab in an hour under given conditions, or how much heat is lost from the surface of a sooted globe in a minute, though there is a great deal of exposition of laws of heat exchanges, and of the algebra pertaining thereto. Diffusion of matter is another subject which suffers from defective treatment in a similar way. The word "diffusivity," introduced by Thomson, is correctly defined on p. 131; but ten lines lower down the definition is departed from, and a column of relative numbers is substituted for the now fairly known absolute diffusivities. A very thorough change of all these parts of the book ought to be made in a reprint or new edition, in order to make the work conformable to modern knowledge and requirements.

It would be ungracious to point out too many minor faults in a first edition; but a few must be mentioned. Faraday seems to have been forgotten in connection with liquefaction of gases! and Melloni, though not perhaps absolutely trustworthy, surely deserved to have his name mentioned in connection with radiation of heat. Mayer's name is not mentioned; and, whatever Dr. Peddie may think on the subject of the celebrated controversy, no one will agree with him that the name should be *omitted*. We cannot help feeling that there is too much local colouring about many parts of the book. A book of this kind is sadly marred by want of proportionate distribution of treatment; even the occupation of space with minute treatment of a favourite subject becomes an injustice with regard to those subjects which are unduly curtailed for want of more space. We trust it will not hurt the feelings of anyone if we remark that the book should be a little more cosmopolitan, and a good deal less Scotch.

On p. 337, there is a mistake which will bear comparison with Lord Brougham's celebrated idea that people carry weights on their heads to have them farther from the centre of the earth, and therefore less attracted. The formation of ice in "very hot" countries on shallow pools is compared with Faraday's experiment of freezing mercury in a white-hot crucible. It is radiation, not forced evaporation, which is the cause of the phenomenon referred to.

We regret, also, that Dr. Peddie has thought it advisable to follow the example of Maxwell and others in changing Andrews's diagram right for left. There is no reason for doing so. The diagram was much better as Andrews originally gave it; and it would be better also without the dotted line said to separate the region in which liquid and gas can exist together from the regions in which the substance is entirely liquid or entirely gaseous. The former is a region concerning which there has been much speculation of an unprofitable sort. The elementary student need not be troubled with it, and it cannot be explained to him in a single sentence.

On p. 95 there is a diagram of a cord being pulled through a tube. Perhaps it cannot be asserted that the diagram is absolutely wrong, because the cord is said in the text to be perfectly flexible. But the cord, passing round corners which look as if they were sharp angles, is so strikingly unlike anything which can be realized (and the results explained in this section can to a great extent be experimentally realized), that the diagram becomes at least misleading. If the corners are sharp by intention, then the diagram *is* absolutely wrong.

In spite of the faults and defects we have been obliged to notice, this book is, as we have said, an admirable attempt at a very worthy object, and with some remodelling it can be made into an excellent text-book. We wish it all success, feeling well satisfied that it meets a decided want.

OUR BOOK SHELF.

The Dietetic Value of Bread. By John Goodfellow, F.R.M.S. (London: Macmillan and Co.)

THIS book is another addition to the useful series of "Manuals for Students," published by Messrs. Macmillan and Co. The author states in his preface that the object of the work is twofold. First, to lay before the general public an account of the various kinds of bread, by which their merits may be judged; and, secondly, to afford technical information to students and others on the important subject of the true value of bread as a food. These objects have in every way been fulfilled. No one is more qualified to write such a book than Mr. Goodfellow, who by his previous writings has shown such a grasp of the subject with which he has to deal.

The first section of the volume is concerned with "Food, Diet, and Digestion." This is a very difficult matter to treat in a popular manner. It involves some of the most complicated problems of physiology. The author, however, has not shirked his task; anyone, however ignorant he may formerly have been on the processes by which food matters are rendered suitable for absorption and after-use by the human organism, if he reads through these pages carefully, cannot but help gaining much knowledge on the functions of the stomach and intestinal canal, and of the waste and work of the body.

The nature of the digestive fluids is not, of course, considered with the minuteness of detail necessary for a medical examination, but enough is said to render the following sections perfectly intelligible, although they are treated in a scientific manner.

"White Bread" is first considered. An introductory chapter is given describing the structure of the wheat grain, and the changes which flour undergoes when exposed to heat and the process of fermentation. Not only are the chemical and physiological properties of bread considered, but economical principles are gone into, and it is shown "that bread is one of the cheapest foods, not only with regard to the actual weight of nourishment obtained, but also with regard to the variety of the nutrient constituents; and the purchaser who expends his modest 2½*d.* in a 2-lb. loaf may rest assured that he could not spend his money to better advantage."

We further learn, however, that white bread is not a perfect food; those who partake of it should take care to supplement it largely with other foods, in order to make up for the lack of calcareous matter. On no account should it form part of the diet of children unless supplemented by milk or other foods rich in lime and phosphates.

Turning to "Whole-meal Bread," full descriptions are given of its composition, amount and nature of the salts present and their solubility; its digestibility, the waste present, and the action of bran on the intestine; its flavour, satiety, and dryness; and its effects on infants and children.

The ordinary whole-meal bread is not a desirable food, and far inferior to good white bread as regards the weight of actual nourishment and the thoroughness of the digestion. Its ingestion is often followed by diarrhœa, and the action of the bran increases the waste of food.

After a short consideration of some special forms of bread, such as "aërated," "bran," "rye" bread, &c., Mr. Goodfellow proceeds to speak of Meaby's Triticumina bread, of which he has a very high opinion, and believes that it is as near a perfect food as such a bread can be, and deserves the universal commendation which has been accorded to it by the medical and analytical world. "Germ," "diastase," "gluten" bread, &c., are then described, and the book finishes with short chapters on the diseases of bread and its medicinal properties.

To all who are interested in this subject, or wish to extend their knowledge of "the staff of life," we heartily recommend this volume.

Graduated Mathematical Exercises. Second Series. By A. T. Richardson, M.A. (London: Macmillan and Co., 1892.)

ON a previous occasion we have referred to the first series of exercises by Mr. Richardson. In these he led the student through a set of graduated examples, commencing with arithmetic and reaching those on cube root, compound interest, and quadratic equations.

In the present series, which is intended to be a continuation of the first, the relatively higher flights of mathematics have been dealt with. The problems have been arranged on the same lines, the more difficult of them being reached as advance is made, and include those on algebra, logarithms, trigonometry, mechanics, and analytical geometry.

An idea of the range over which each subject spreads can be gathered from the fact that all the problems will about suffice to cover such examinations as those of the Oxford and Cambridge Locals, and Army and Navy, allowing a small margin of safety.

Great care seems to have been taken to insure accuracy, every example having been worked out at least twice. For class work these examples will be found handy and a great saving of time, while for use at home the book should be widely employed.

Bibliothek des Professors der Zoologie und vergl. Anatomie, Dr. Ludwig von Graff, in Graz. (Leipzig: Wilhelm Engelmann, 1892.)

PROF. VON GRAFF is the lucky owner of a fine scientific library, which was formed mainly by Carl Theodor von Siebold, his father, and his grandfather, all of whom were professors. This library came into the possession of Prof. von Graff in 1882, and as it was too large for the modest dimensions of a German professor's house, he exchanged many books relating to practical medicine for zoological monographs and periodicals. At Graz the library is freely used by his assistants, pupils, and colleagues, and it is mainly for their benefit that the present catalogue has been issued. It consists of 337 closely printed pages, and is a compilation of considerable value, not only because it gives lists of authors and their works, but because of the admirable way in which the lists are arranged. The contents of the library are grouped under four headings—periodicals, auxiliary books (including works on University systems, bibliographical writings, dictionaries, &c.), *zoologia generalis*, and *zoologia specialis*.

The Canadian Guide-book. By Charles G. D. Roberts. (London: William Heinemann, 1892.)

TOURISTS and sportsmen in Canada ought to be very much obliged to Mr. Roberts for having provided them with this excellent Guide-book. The method he has adopted is that of Baedeker's Hand-books, and the result is in every way worthy of the models he has chosen. The work includes full descriptions of routes, cities, points of interest, summer resorts, fishing places, &c., in Eastern Ontario, the Muskoka district, the St. Lawrence region, the Lake St. John country, the maritime provinces, Prince Edward Island, and Newfoundland. In an appendix are given fish and game laws, and official lists of trout and salmon rivers and their lessees. The author generally compresses his information into as small a space as possible, but in dealing with the more interesting Canadian scenes has sought to make his descriptions lively and attractive. The volume is prettily printed, and is well supplied with maps and illustrations.

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.*]

A Question in Physics.

CAN there be a crowding of the particles of a gas to a much smaller compass without its being markedly heated? Can a gas expand without being cooled? It is probable that nearly every physicist will give negative answers to these questions, and yet the fact that such conditions may occur sometimes seems well established. The present writer, in 1889, attempted to determine the actual heating of air when compressed by a pump connected with the cylinder by a long tube, and found that the temperature was raised about 4° F. for a compression of 10 inches above atmospheric pressure. In like manner, on expanding this compressed air into the free atmosphere, it was found that the cooling was about 4°. These results were published in *Science*, vol. xv. p. 387, and were strongly combated by Prof. Ferrel and Prof. Marvin. Prof. Ferrel advanced, as applicable in this case, the well-known thermodynamic formula for the computation of the heat developed in a gas when compressed, as follows:—

$$\frac{t}{t'} = \left(\frac{p}{p'}\right)^{\cdot 291}$$

in which t and t' are the absolute temperatures corresponding to the pressures p and p'. Sir Wm. Thomson has given this formula in slightly different form, and with a larger exponent (see "Encyclopædia Britannica," vol. vii. p. 814). Prof. Ferrel found that, under the experimental conditions above, the heating should have been 43°, and the cooling 45°? (38°) (see *American Meteorological Journal*, vol. xii. pp. 339 and 340).

It seems very evident, however, that this formula can be used only when all the heat due to the work of compression is concentrated in the compressed air, and conversely when the air expands against an external resistance. An experiment by Joule will serve to elucidate this point. He determined the mechanical equivalent of heat by immersing the cylinder into which the air was to be compressed and the compressing pump in the same water-bath, and then determining the amount of compression and the total heat developed. This enables us to advance the proposition: *If air when compressed is to be raised to the temperature indicated by theory*, it is very *essential that all the heat developed in the work of compression should enter the air*. This seems self-evident; nevertheless, nearly all the errors that have entered the various discussions of this question have arisen from a neglect of this very obvious consideration.

In Joule's experiment let us suppose that the compressing pump had been in one bath, and the cylinder into which the air was compressed in another. Under these conditions, if no heat were lost, the first bath would have received very much the greater amount of heat. Now, if the compressed air in passing from the pump to the cylinder became cooled to the outside temperature, it is evident that all the heat due to the work of compression would have been disposed of outside the cylinder, and would not have been available for raising the temperature of the compressed air.

Instead of connecting the pump directly with the cylinder, let us take two cylinders of the same size, and connected by a tube. Compress the air in the first cylinder (A), to three atmospheres, the air in the other (B) being at atmospheric pressure. If we cool the air in A to the outside temperature, and then open the connection with B, the compressed air will rush from A to B, and an equilibrum will be established very quickly, the pressure in each cylinder being at two atmospheres. The air in A will be slightly chilled because of the work of imparting a certain velocity to the particles entering B, and the air in B will be slightly warmed from the impact of the particles rushing from A, but there will be no heating due to the work of an external force making the compression.

Instead of allowing the air in A to rush into B, suppose we open communication with the outside air. The resistance to the rush of air will be much less than before, and the chilling in A, due to the work of imparting a certain velocity to the air, would be slightly greater than in the previous case, but it is obvious that this will be vastly less than that given by the formula. We may say, then, that the conditions suggested by the questions above may be very easily brought about.

The compressed air in a cylinder has a potential energy or capacity to do work, and this energy may be transmitted to another cylinder having air at atmospheric pressure without loss, and plainly without imparting or losing any heat. We might compare it to the head of water in a pond. This water has a certain capacity to do work depending upon its head. We may enlarge the pond somewhat, and the capacity for doing work will remain almost unchanged. The extremely important bearing of these views upon problems in meteorology is very apparent. The convection theory of storms demands a cooling from the work of expansion in an ascending column of moist warm air; it would appear, however, that the cooling must be vastly less than has generally been considered probable.

H. A. HAZEN.

Aurora.

PERHAPS it may interest some of your readers to see a short abstract of the observations of aurora made here during the last months, this winter having been by far the richest in well-developed northern lights since the winter 1870-71. Beginning with the magnificent display of February 13, which lasted almost the whole night, sometimes with vivid red and green tints (it was first noted at 6h. 45m., and faded away in the moonlight between 15h. and 16h. astronomical time), and whose beams converged several times from a large part of the horizon towards the magnetic zenith (formation of corona was noted at 7h. 2m., 10h., and 13h.), we have had aurora on February 14, 15, 24, 25, March 1 (at 7h. high arch, with the highest part through α and β Cephei, 7h. 55m. corona, between 8h. and 10h. pulsating and flashing light, sometimes with apparently screw-formed motion), March 2, 3, 6 (at 10h. curtains and corona, yellow-green colours), March 24, 25, 26, 27, April 23, 24 (at 10h. 10m. curtains, yellow-green) April 25 (strong light visible through small openings in cumulo-stratus in the north). The last display was on May 1, with corona at 9h. 40m., after 10h. flashes, curtains, and beams, at 13h. beams. About 11h. there was a peculiar downward motion of reddish light near the north horizon.

The magnetic disturbances of February 13 were also the greatest we have had for some years. The magnetometers, of the Gaussian construction, are generally observed at 2h. and 21h., but on February 13 observations were made every hour from 11 p.m., in correspondence with Bosekop in Finmarken, where the German observers, MM. Brendel and Baschin, were taking magnetical observations and photographs of the aurora during February and part of January. In Christiania the perturbations were comparatively small in declination (westerly maximum 12° 35′ noted at 12h. 10m., minimum 11° 42′ at 15h. 18m., but neither of them absolute, the observations not being continuous); but the horizontal intensity, which had already begun to increase a little at 21h., February 12, varied by more than 0·03 C.G.S. units, a maximum of 0·171 having been noted at 2h. 30m., and a minimum of about 0·140 from 12h. 0m. to 13h. 20m.; as the mirror of the magnet was in both cases outside the scale, the values could only be roughly measured. At 16h. 0m. the bifilar had returned to the small end of the scale, but a nearly constant value of the horizontal intensity was only attained after 5h., February 14. The inclination had a maximum of 73° 18′ at 13h. 10m., from which it gradually diminished, with some fluctuations, towards the normal value, about 71° 0′.

With reference to Mr. Backhouse's observation of nacreous clouds in the morning of January 30 (NATURE, xlv. p. 365), I may add that the same beautiful but as yet mysterious phenomenon was seen here January 30 and 31, both days in the south-west after sunset. Since the display of December 1885, mentioned by Mr. Backhouse, it has been seen here every year, except 1888, mostly for a day or two in January or February.

H. GEELMUYDEN.

University Observatory, Christiania, May 3.

Wave-Propagation of Magnetism.

IN an interesting article in last month's *Philosophical Magazine*, Mr. Trowbridge has given an account of some experiments made by him with the view of examining for any indication of a definite rate of propagation in the magnetization of iron. In these experiments no indication was observed.

It seems to me, however, that nothing of this sort is likely to be observed where the magnetizing force is as great as that used by Mr. Trowbridge, and that there are two classes of disturbances to be carefully distinguished. For example, in Prof. Ewing's well-known magnetic model, something which looks very like a definite rate is to be seen in the case of a disturbance not sufficiently large to cause toppling over of the "molecule magnets"; that is to say, to cause the little magnets to pass through their positions of unstable equilibrium. On the other hand, with a larger disturbance the phenomenon visibly partakes of a different character. Here, throughout the medium, there are to be seen at irregular moments what may be considered as cases of precipitation of energy, owing to the occurrence of these positions of unstable equilibrium.

These two stages should be carefully distinguished, for an essential in wave-propagation as opposed to a rate of precipitation of energy (such as a rate of ignition, &c.) is obviously that the medium should not be permanently altered.

In some experiments made by me, very much smaller alternating currents than those used by Mr. Trowbridge were employed. But the occurrence of spurious effects, simulating to a remarkable degree the interference nodes looked for, must have effectually obscured in my experiments the true phenomenon, supposing its existence. So that, considering the conditions of both our experiments, I still think the subject requires further investigation before coming to a decision in the matter. Indeed, when larger currents are used, no indication is to be found of even these spurious effects.

In Prof. Ewing's model, when the magnets point on the whole the same way (representing a high state of magnetization), the rate of propagation of a small disturbance affords a more definite problem. Tried experimentally, this latter case might afford more satisfactory results.

FRED. T. TROUTON.

Correction in "Island Life."

IN Dr. Merriam's recently published paper on "The Geographical Distribution of Life in North America," an important, and to me almost inexplicable error in my work "Island Life" is pointed out. It occurs at page 41 in the first edition, and is unfortunately repeated at the same page in the recently published new edition, and consists chiefly in stating that the moles (Talpidæ) are almost confined to the Palæarctic region. But a little further on in the same work (page 48 of first edition, and page 49 of second edition) it is correctly stated that there are three peculiar genera of moles in North America, and the same statement is made at page 115, and again at page 190 of vol. ii. of my "Geographical Distribution of Animals." At page 182 of vol. i. of the latter work, however, the error first appears, and it is this erroneous passage that has remained unnoticed till now, and was unfortunately repeated in "Island Life." In the same paragraph an error of a similar kind also occurs as to the distribution of the lynxes. To correct these errors pages 41 and 42 of the new edition of "Island Life" are being reprinted, and will be sent to all who possess the volume if they will forward a stamped and directed envelope to the publishers.

ALFRED R. WALLACE.

THE INTERNATIONAL CONFERENCE ON CHEMICAL NOMENCLATURE.

AT the meeting of the International Chemical Congress, held in Paris in the summer of 1889, a special Section was appointed to consider the unification of chemical nomenclature, and, after discussing a variety of propositions, some of which were adopted, it was decided to form an International Commission for the further study of the subject.[1]

The members resident in Paris, having been constituted a permanent committee of the Commission, have devoted an immense amount of time and care to the preparation of a scheme, and it was to discuss their report[2] that we met at Geneva on Easter Monday last. The French Committee had issued invitations, not only to members of the Commission, but also to many other prominent chemists, so that the meeting was a thoroughly representative one. It is worth mentioning, as an illustration of the sympathetic treatment accorded by public bodies in France to men of science, that the Paris-Lyons-Marseilles Railway Company granted a reduction of one-half on the fare over their line to members of the Congress.

Very happily, the local committee had arranged that all might stay at the one hotel—the Métropole—and it was here that we first met in friendly union on the Monday evening.[3] The next morning the Congress assembled at the Hôtel de Ville, M. Richard, the Cantonal Minister of Education, being in the chair. After an admirable address of welcome from this gentleman, who appeared to thoroughly appreciate the importance of the object in view, on the motion of Prof. Cannizzaro it was wisely decided not to follow the complimentary, but somewhat unbusinesslike, Continental practice so frequently adopted, of appointing a different chairman each day, but to have only one. M. Friedel, who had taken the chair at all the numerous meetings of the Paris Committee, having been chosen by acclamation President of the Conference, formal business was at once entered into, and, after the necessary interval for lunch, the sitting was resumed in the afternoon. We met in like manner on the two following days, and the final sitting took place on the Friday morning, but many had left before this. On Tuesday evening, by invitation of the local committee, we visited the theatre, a very beautiful building. On the Wednesday evening, we were entertained by them at a dinner at the Hôtel Métropole, on which occasion a very striking speech was delivered by Prof. von Baeyer, who, after point-

[1] The following chemists eventually consented to serve on the Commission:—MM. Béhal, Berthelot, Bouveault, Combes, Fauconnier, Friedel, Gautier, Grimaux, Jungfleisch, Schützenberger (all representing France), Graebe (Switzerland), Alexejeff and Beilstein (Russia), von Baeyer and Nölting (Germany), Lieben (Austria), Paterno (Italy), Franchimont (Holland), Armstrong (England), Istrati (Roumania), Calderon (Spain), Cleve (Sweden), Boukowski-Bey (Turkey), Ira Remsen (United States), and Mourgues (Chili).

[2] This report had been prepared by the following:—MM. Friedel (President). Béhal, Bouveault, Combes, Fauconnier, Gautier, and Grimaux.

[3] The following is the official list of those who took part in the Conference: —MM. H. E. Armstrong, professeur à la Central Institution, Londres, secrétaire de la Chemical Society; A. Arnaud, professeur au Muséum, à Paris; Adolphe von Baeyer, professeur à l'Université de Munich; Barbier, professeur à la Faculté des sciences de Lyon; Aug. Béhal, professeur à l'École supérieure de pharmacie de Paris; Louis Bouveault, docteur ès sciences, Paris; Stanislas Cannizzaro, professeur à l'Université de Rome; Paul Cazeneuve, professeur à la Faculté de médecine de Lyon; Alphonse Combes, docteur ès sciences, Paris; Alphonse Cosso, directeur de la Station expérimentale d'agriculture, à Turin; Maurice De Lacre, professeur à l'Université de Gand; Michel Fileti, professeur à l'Université de Turin; Emile Fischer, professeur à l'Université de Würzbourg; A.-P.-N. Franchimont, professeur à l'Université de Leide; Charles Friedel, membre de l'Institut, professeur à la Sorbonne, Paris; Dr. J. H. Gladstone, F.R.S., Londres; Carl Graebe, professeur à l'Université de Genève; Philippe-Auguste Guye, professeur à l'Université de Genève; Istrati, professeur à l'Université de Bucarest; Albert Haller, professeur à la Faculté des sciences de Nancy; Maurice Hanriot, professeur agrégé à la Faculté de médecine, Paris; A.-R. Hantsch, professeur à l'École polytechnique de Zurich; Achille Le Bel, docteur ès sciences, à Paris; A. Lieben, professeur à l'Université de Vienne; Léon Maquenne, docteur ès sciences, aide-naturaliste au Muséum, Paris; von Meyer, professeur à l'Université de Leipzig; Denis Monnier, professeur à l'Université de Genève; R. Nietzki, professeur à l'Université de Bâle; Emilio Noelting, directeur de l'École de chimie de Mulhouse; Emmanuel Paterno, professeur à l'Université de Palerme; Amé Pictet, privat-docent à l'Université de Genève; William Ramsay, F.R.S., professeur à l'Université de Londres; Zdenko-H. Skraup, professeur à l'Université de Graz; Ferdinand Tiemann, professeur à l'Université de Berlin.

Le Comité local d'organisation se composait de:—MM. Emile Ador, H.-W. de Blonay, Alex. Claparède, Professeur C. Graebe, Professeur Ph.-A. Guye, Alex. Le Royer, Professeur Denis Monnier, Amé Pictet, Fréd. Reverdin, Professeur Albert Rilliet, Edouard Sarasin.

ing out that experimental chemistry had been carried, early in the century, into Germany from France by Liebig, who was tutored by Gay-Lussac, proceeded to say that, although the science had now undoubtedly reached its highest development in Germany, it was more than probable that, in the future, circumstances would arise which would lead to some other nation—France, Russia, Italy, or England—coming to the fore. On this occasion, on the motion of M. Le Bel, it was unanimously decided to appoint M. Marignac Honorary President of the Congress, and a letter to him expressing our regret that ill-health prevented his taking part in its work was at once signed by all present. We were indebted in many other ways to the local committee, and there is no doubt that the success of the meeting was in large measure due to the forethought and hospitable care exercised by them on our behalf; absolute amity prevailed throughout, and it was clear that all were bent on co-operating to secure the carrying out to a successful issue of a very difficult but most important work. The great advantage to be derived from the personal intercourse which such meetings promote was soon apparent: gradually, the doubts which many entertained as to the possibility of devising a practical rational scheme of nomenclature were dispersed, and ere many hours had elapsed the sympathies of all present were enlisted on behalf of the work; thus a mission has been sent forth which will explain the enterprise to chemists generally.

The resolutions passed at the meetings are appended to this article. These, I think, are in no way to be taken as in all respects final, but they will serve to prepare the way and to indicate the lines on which the work is to be carried out. The position in which we found ourselves placed, in fact, was not one which justified our arriving at decisions which could fairly be regarded as binding. The report of the French Committee was placed in our hands only on the morning of the first meeting, and it was impossible to master its contents at so short a notice, and still less to criticize and test the application of its recommendations in detail. That the scheme would serve but as the basis for discussion was soon evident, when at the very outset a system of nomenclature for the hydrocarbons was adopted very different and far more significant than that recommended in the report; and numerous other departures from its recommendations were carried in the course of the proceedings. Again, some of the most active members of the Congress had confessedly paid attention only to special groups of compounds, and had not tested the application of proposals which they strenuously advocated to compounds of other groups; but as a nomenclature admirably adapted to one class may be open to all sorts of objections when applied to another, the general bearing of recommendations made with reference to special groups will have to be fully considered before they can be finally adopted. The resolutions relating to fatty acids (Nos. 18, 19) are of this kind, and their adoption was warmly opposed by an important minority on the ground that, however well they might be adapted to acids pure and simple derived from open-chain hydrocarbons, their application to acids derived from closed-chain hydrocarbons and acids containing other radicles in addition to carboxyl was beset with difficulty. In order to name an acid in accordance with this resolution, the formula of the corresponding hydrocarbon must be constructed from that of the acid by changing carboxyl into methyl; for example, citric acid, $CH_2(CO_2H).C(OH)(COOH).CH_2(COOH)$, would have to be regarded as a derivative of methylpentane, and would be named methylpentanoltrioic acid, numerals being added to indicate the positions of the hydroxyl and carboxyl groups; in like manner, mellithic acid, $C_6(COOH)_6$, would be named hexamethylbenzenehexoic acid, although no methyl is present in it. The mental effort involved in visualizing the formulæ from such names as these would appear to be far greater than if they were respectively named propanoltricarboxylic acid and benzenehexacarboxylic acid, or simply propanoltri-acid and benzenehex-acid, the use of the term *acid* being understood to imply the presence of carboxyl. A decision on points such as these can only be arrived at after careful study of the general effect of such a proposal, and there was no time for such a comparison during the brief debate possible at a Conference. In some cases, there can be no doubt that the full force of objections raised to proposals in favour of which a majority subsequently voted was not felt, owing to the difficulty which necessarily arises at an international Conference if the language used be not equally familiar to all present, and consequently full expression cannot be given by all to their views. Moreover, although it is easy to criticize destructively even at short notice, constructive criticism under such circumstances is very difficult; consequently a proposal may be accepted even in face of serious objections to its adoption simply because nothing better can be suggested at the time. An instructive case of the kind arose on discussing thio-compounds. The proposals in the French report were not regarded as altogether satisfactory, and an amendment was suggested and carried which to many appeared most undesirable: the next morning, when the time came to confirm the resolutions arrived at on the previous day, the discussion was reopened, and a slight modification of the original proposal was suggested, which was recognized to be an improvement, and the objectionable resolution was rescinded. Clearly at such meetings much must depend on the right expression being found by happy inspiration at the right moment.

The one resolution which covers all others and which defines the nature of the task to be undertaken is the first. Whatever name we may choose to apply to a substance colloquially, it is clearly an absolute necessity of the times that every compound should bear a *systematic* name of such a character that it can be at once translated into the corresponding formula; and that, *vice versâ*, a name corresponding to any particular formula may be devised which we may count on finding in the *official* register, if the compound thought of have been described. The value of such a systematic nomenclature to original workers as well as to students cannot be over-estimated, and few who are qualified to take part in such a work will grudge the time they may spend on it. There was considerable difference of opinion at the meeting as to whether a systematic nomenclature should be devised merely for the purpose of an official register, or whether the object aimed at should be a system of wider application: the majority, I believe, came to the conclusion that it should certainly subserve the one, but if possible both purposes. There can be little doubt, however, that the future student will cut the knot by declining to burden his memory with a double vocabulary in the case of all but the commonest substances, and that therefore there is but one course open to us (cf. Res. 26).

Although sufficiently conservative to retain methane, ethane, propane, and butane, the Congress decided not to adopt the proposal to continue the use of the names formic, acetic, propionic, and butyric for the first four acids of the acetic series, which was advocated by a substantial minority on the ground that their retention would facilitate the change from the old to the proposed new system. This is one of the questions demanding careful consideration. Many will, no doubt, prefer to retain old unsystematic names as far as possible, but it is easy to see that the desire to avoid change may carry us too far in this direction; it will undoubtedly be very inconvenient to the present generation of chemists to abandon familiar and cherished names, but nevertheless it may be a wise course to boldly face the difficulty, rather than inflict on coming generations a partially illogical and unsystematic nomenclature. The argument that the present familiar names may still be used colloquially is, as I have already said, scarcely a justification of the dismissal of such names from the official nomenclature, as our successors may be expected to object more and more decidedly to a multiplex system as chemical science progresses, and to insist on the adoption of the official as the sole system : the extent to which familiar trivial names shall be retained in the official system is therefore a matter of great importance.

As one aim and object must be to devise a system which is significant and logical throughout, no considerations must be allowed to prevail which will defeat this, and it will not suffice to quote present usage in support of illogical proposals; but this has been done. Thus the Congress decided (Res. 46) to name compounds of the type $R'.N_2.R'$ *azo*-compounds, while retaining the name *diazo*-chloride for $C_6H_5.N_2Cl$. It matters not to us that the manufacturers have chosen to call the colours derived from *di*azo-compounds azo-dyes ; if substances such as $(C_6H_5)_2S$ are termed *thio*, and compounds such as $(C_6H_5)_2S_2$ *di*thio-compounds (Res. 43), we are bound to be consistent, and apply the significant term diazo- to substances containing two nitrogen atoms. Resolution 46 ought therefore to be in part rescinded. I call attention to this case as an illustration of the tendency to break away from uniformity in favour of what may fairly be termed popular prejudice, which will require to be most carefully guarded against if the various sections of our system are to harmonize.

It will be gratifying to English chemists that the principle advocated for many years past by our Chemical Society, and enforced in its "Instructions to Abstractors" —that particular terminations should be regarded as indicative of particular functions, and should therefore be restricted to particular classes of compounds—has been legalized and extended by the Congress. This is a step of great importance, as we may expect that it will affect even trivial names, and that in future names will be given to new substances which will to a certain extent afford a clue to their nature; the hopeless confusion which now reigns supreme in the pages of the *Berichte*, for example, owing to the disregard of this principle by our German colleagues—who have hitherto been, as a rule, almost uniformly neglectful in matters of nomenclature—will, it may be hoped, ere long give way to more orderly treatment.

But the importance of applying this principle logically was not fully grasped even at the Congress, inasmuch as it was decided to affix the termination *ine* to acetylenic hydrocarbons, notwithstanding that this termination is admittedly indicative of basic properties. If, however, a suitable suffix ending in *ene* could be thought of, there would probably be little difficulty in securing its acceptance, in which case unsaturated hydrocarbons generally would have names ending in *ene*, and saturated hydrocarbons names ending in *ane*, and these terminations could be reserved exclusively for hydrocarbons.

It will be obvious from the foregoing remarks that although a solid foundation for our future system of nomenclature has been laid, much remains to be done before a mature design, perfect in all its details, can be presented for adoption. At the meeting the hope was expressed that a decision might be speedily taken, to enable Beilstein to utilize the proposals in the preparation of the third edition of his marvellous work ; but it is clear that we are not yet so far advanced as to make this possible or even desirable, and it would be most unfortunate if Beilstein were at the present juncture to promulgate a system which is manifestly incomplete : nothing can be worse in such a case than to consent in haste, when it is evident that this would surely involve repentance at leisure.

Those of us who are interested in the work, and competent to advance it, must now test in detail the application of the proposals which have been provisionally adopted, and we must assist in contributing to the ultimate establishment of a system on the broad lines of policy laid down for our guidance at the Congress. As it is not improbable that in the future, owing to the extended use of our language, the major proportion of chemical students will speak English, it is essential that due attention be paid to the matter here in England, so that a system may be devised which we can make use of without difficulty.

HENRY E. ARMSTRONG.

Résolutions prises par le Congrès.

1. A côté des procédés habituels de nomenclature, il sera établi un nom *officiel* permettant de retrouver chaque corps sous une rubrique unique dans les tables et dictionnaires.

Le Congrès exprime le vœu que les auteurs prennent l'habitude de mentionner dans leurs mémoires, entre parenthèses, le nom officiel à côté du nom choisi par eux.

2. On décide de ne s'occuper, pour le moment, que de ce qui concerne les composés de constitution connue, et de remettre à plus tard la question des corps à constitution inconnue.

3. La désinence *ane* est adoptée pour tous les hydrocarbures saturés de la série grasse.

4. Les noms actuels des quatre premiers hydrocarbures saturés (*méthane, éthane, propane, butane*) sont conservés ; on emploiera les noms dérivés des nombres grecs pour ceux qui ont plus de quatre atomes de carbone. Ces noms désigneront les hydrocarbures normaux.

5. Les hydrocarbures à chaîne arborescente sont regardés comme dérivés des hydrocarbures normaux, et on rapporte leur nom à la chaîne normale la plus longue qu'on puisse établir dans leur formule.

6. Le numérotage des chaînes latérales partira de l'atome de carbone terminal le plus rapproché d'une chaîne latérale ; dans le cas où les chaînes latérales les plus voisines des extrémités seraient placées symétriquement, la plus simple décidera du choix.

7. Lorsqu'un résidu se substitue dans une chaîne latérale, on emploie *métho-*, *étho-*, etc., à la place de *méthyl-*, *éthyl-*, préfixes réservés pour le cas où la substitution se fait dans la chaîne principale.

8. Dans les hydrocarbures ayant une seule *double liaison*, on remplacera la terminaison *ane* de l'hydrocarbure saturé correspondant par la terminaison *ène* (ex. éthène) ; s'il y a deux doubles liaisons, on terminera en *diène* (ex. propadiène), s'il y en a trois, en *triène*, etc. Si cela est nécessaire, la place de la double liaison est indiquée par le numéro du premier atome de carbone sur lequel s'appuie cette double liaison.

9. Les noms des hydrocarbures à *triple liaison* se termineront pareillement en *ine*, *diine* et *triine* (ex. éthine pour acétylène. propine pour allylène, hexadiine pour dipropargyle).

10. Dans le cas où il y aurait simultanément des doubles et triples liaisons, on emploiera les désinences *énine*, *diénine*, etc.

11. En ce qui concerne les hydrocarbures saturés à chaîne fermée, ils prendront les noms des hydrocarbures saturés correspondants de la série grasse précédés du préfixe *cyclo* (ex. cyclohexane pour hexaméthylène).

12. Les atomes de carbone d'une chaîne latérale seront désignés par le même chiffre que l'atome de carbone auquel la chaîne est attachée. Ils porteront un indice qui indiquera leur rang dans la chaîne latérale en partant du point d'attache.

Dans le cas où deux chaînes seraient attachées au même atome de carbone, les indices de la plus simple d'entre elles seront accentués.

Le même mode de numérotage est adopté pour les chaînes latérales des chaînes fermées.

13. Les hydrocarbures non saturés seront numérotés comme les hydrocarbures saturés correspondants. Dans le cas d'ambiguïté ou d'absence de chaîne latérale, on placera le nº 1 au carbone terminal le plus rapproché de la liaison d'ordre le plus élevé.

14. Le numérotage des hydrocarbures est conservé pour tous leurs produits de substitution.

15. On nommera les alcools et les phénols du nom de l'hydrocarbure dont ils dérivent, terminé par le suffixe *ol* (ex. pentanol, penténol, etc.).

16. Quand on a affaire à des alcools ou à des phénols polyatomiques, on intercalera, entre le nom de l'hydrocarbure fondamental et le suffixe *ol*, une des particules *di*, *tri*, *tétra*, etc., suivant l'ordre de la polyatomicité (ex. propane-triol pour glycérine).

17. Le nom de *mercaptan* est abandonné, et cette fonction sera désignée par le suffixe *thiol* (ex. éthane-thiol).

18. Dans les acides de la série grasse, le carboxyle sera considéré comme faisant partie intégrante du squelette de carbone.

19. Le nom de tous les acides monobasiques de la série grasse est tiré de celui de l'hydrocarbure correspondant suivi du suffixe *oïque*.

On désignera les acides polybasiques par les terminaisons *dioïque*, *trioïque*, *tétroïque*, etc.

20. Les résidus monovalents des acides seront dénommés en transformant en *oyle* la terminaison *oïque* de l'acide.

21. Dans les acides monobasiques à chaîne normale saturée ou symétrique, le carbone du carboxyle porte le n° 1.

22. Les acides dans lesquels un ou plusieurs atomes de soufre remplacent autant d'atomes d'oxygéne du carboxyle seront désignés comme suit : le soufre simplement lié à un atome de carbone sera désigné par le suffixe *thiol* ; si la liaison est double, on emploiera le suffixe *thion*. Exemples :

$CH_3.CO.SH$ Acide éthane-thiolique.
$CH_3.CS.OH$ Acide éthane-thionique.
$CH_3.CS.SH$ Acide éthane-thionthiolique.

23. Le Congrès donne son adhésion à la proposition suivante sans émettre de vote définitif à ce sujet :

Les éthers-oxydes seront désignés par les noms des hydrocarbures qui les composent, reliés par le terme *-oxy-* (ex. pentane-oxy-éthane pour oxyde d'éthyle et d'amyle).

24. Les anhydrides d'acides conserveront leur mode actuel de désignation d'après le nom de leurs acides (ex. anhydride éthanoïque).

25. (12 *bis*). Dans le cas de deux chaînes latérales attachées au même atome de carbone, l'ordre dans lequel ces chaînes seront énoncées correspondra à leur ordre de complication.

26. Une discussion plus approfondie sur la nomenclature des composés à fonctions complexes est ajournée, et l'étude de cette question est renvoyée à la Commission internationale, pour qu'elle prépare sur ce point un projet qui sera présenté à un prochain Congrès ; la Commission cherchera à concilier les exigences de la nomenclature parlée avec celle d'une terminologie applicable aux dictionnaires.

27. On conservera les conventions habituelles pour les sels ou éthers composés.

28. Les lactones seront désignées par le mot *olide*, indiquant que c'est un anhydride interne d'alcool et d'acide. La position de la fonction alcoolique, par rapport au carboxyle de l'acide alcool d'où dérive la lactone, pourra être exprimée par les lettres grecques α, β, γ, δ, à côté du numérotage habituel des chaînes latérales :

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         O————————CO
         |         |
CH3—CH—CH2—CH2
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1.4 pentanolide ou 1.4 γ pentanolide.

29. Les acides lactoniques dérivant d'acides bibasiques seront nommés comme les lactones dont ils dérivent, en ajoutant le suffixe *oïque*, caractéristique des acides.

30. La discussion sur les chaînes fermées est ajournée jusqu'au moment où la publication des idées de M. Armstrong, sur ce sujet, aura permis à la Commission internationale de les comparer avec les propositions de M. Bouveault.

31. Dans la série aromatique et tous les corps renfermant une chaîne fermée, toutes les chaînes latérales seront considérées comme des substituants.

32. Aldéhydes. Seront désignées par le suffixe *al* (méthanal, éthanal).

Aldéhydes sulfurées : suffixe *thial*.

33. Acétones : suffixe *one* ($CH_3.CO.CH_2.CH_3$, butanone 2).

Diacétones, triacétones : suffixes *dione*, *trione*.

Acétones sulfurées : suffixe *thione*.

34. Quinones : Le suffixe *quinone* sera conservé pour les corps homologues de la quinone ordinaire.

Les corps ayant plusieurs fois le chaînon CO.CO seront des diquinones ou triquinones.

35. Ammoniaques composées : pas de changement (ex. éthylamine, éthène-diamine).

Les corps où le groupe bivalent —NH— ferme une chaîne formée de radicaux positifs seront appelés *imines* (ex. éthène-imine).

Phosphines, arsines, stibines, sulfines : la nomenclature en usage est conservée.

36. Hydroxylamine : ce nom est conservé.

37. Oximes : seront désignés en suivant les règles actuellement admises ; les corps *isonitrosés* seront nommés comme oximes.

(Ex. $CH(NOH).CH_2.CH_2CH_3$ 1 Butanoxime
$CH_3.CH_2.C(NOH).CH_3$ 2 Butanoxime.)

38. Amides : ce nom sera conservé (ex. Ethanamide
$NH_2.CO.CH_2.CH_2.CO.NH_2$ Butane-diamide
$COOH.CO.CH_2.CH_2.CO.NH_2$ Acide butanamidoïque).

Imides : seront conservées.

Amidoximes : ce nom sera conservé.

(Ex. $CH_3.C(NOH).NH_2$ Ethanamidoxime.)

Urée : le mot générique *urée* sera conservé, on l'emploiera comme suffixe pour les dérivés alcoylés de l'urée, tandis que les dérivés par substitution acide seront des *uréides*.

Les corps dérivant de deux molécules d'urée seront désignés par les suffixes *diurée*, *diuréide*. Les uréides acides prendront le nom d'*acides uréiques*. On rejettera les désinences *uramique* et *urique*.

39. Amidines : ce suffixe sera conservé.

(Ex. $CH_3.C.NH.NH_2$ Ethanamidine).

Pour les dérivés, le nom sera dédoublé, et l'on fera précéder du nom du groupe substituant, soit amino, soit amidine, suivant le cas.

(Ex. $CH_3.C(NC_2H_5).NH_2$ Ethanaminoéthylimidine.
$CH_3.C(NH).NHC_2H_5$ Ethanéthylamino-imidine.)

Guanidines : le mot générique *guanidine* est conservé, mais différentes guanidines seront nommées comme dérivés substitués de la diamidocarbo-imidine.

40. Bétaines : suffixe *taïne*.

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(Ex. N(CH3)3—O     Ethanoyltriméthyltaïne.)
     |      |
     CH2————CO
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41. Nitriles : la question est laissée en suspens pour la série grasse. Pour la série aromatique, on adopte le préfixe *cyano* (comme nom de substituant).

42. Carbylamines : la nomenclature actuelle est conservée.

43. Sulfones : ce nom est conservé.

(Ex. $C_6H_5.SO_2.C_6H_5$ Benzène-sulfone-benzène.)

Sulfures : on les désignera en intercalant *thio* entre les noms des deux composés saturés (décision provisoire).

(Ex. $C_6H_5.S.C_6H_5$. Benzène-thio-benzène.)

Disulfures : seront désignés de même par *dithio*.

44. Ethers isocyaniques : suffixe *carbonimide*. Ex. Ethylcarbonimide désignera le cyanate d'éthyle de Wurtz ; on dira de même éthylthiocarbonimide pour le dérivé sulfuré correspondant.

Cyanates : ce nom est conservé aux vrais éthers qui, par saponification, donnent de l'acide cyanique ou ses produits directs d'hydratation. On remplacera le nom de sulfocyanate par celui de *thiocyanate*.

45. Corps nitrés : rien à changer à la nomenclature actuelle.

46. Corps azoïques : les dénominations *azo* et *diazo* seront conservées, mais le mode d'énonciation de ces composés sera modifié comme suit :

(Ex. $C_6H_5.N_2.Cl$ Chlorure de diazobenzène.
$C_6H_5.N_2.C_6H_5$ Benzène-azo-benzène.
$C_6H_5.N_2.C_6H_4.N_2.C_6H_5$ Benzène-azo-benzène-azo-benzène.)

THE GEOLOGY OF BARBADOS.[1]

THE oceanic series of Barbados forms a group of beds which is clearly marked off from the Scotland series below, and the coral limestone above. The oceanic deposits do not, however, appear everywhere as a continuous band between the two other formations, because the elevation of the island from oceanic depths was accompanied by a considerable amount of faulting, and tracts of the oceanic deposits were dropped down between blocks of the Scotland series. Although this faulting

[1] "The Geology of Barbados. Part II. The Oceanic Deposits." By A. J. Jukes Browne and J. B. Harrison. Abstract of paper printed in the Quarterly Journal of the Geological Society, May 1892.

interferes with the continuity of the oceanic deposits, it is abundantly clear from numerous sections that they rest unconformably upon the Scotland series, and are as distinct in respect of age as they are in respect of lithological composition, and a greater contrast in all respects can hardly be imagined than these two formations present.

The oceanic series is more than 300 feet thick, and is divisible into five portions, which, however, blend into one another. These are, in descending order—

(1) Grey siliceous mudstones, consisting chiefly of fine volcanic dust, with a few fragments of siliceous organisms.

(2) Very fine-grained argillaceous earths, often red or pink, but sometimes yellow or buff; these are analogous to modern oceanic "red clays."

(3) Pulverulent chalky marls and earths, being consolidated foraminiferal oozes passing down into calcareo-siliceous earth with Radiolaria; proportion of carbonate of lime, 80 to 44 per cent.

(4) Siliceous Radiolarian earth, consisting mainly of Radiolaria, with sponge spicules and Diatoms, and a small amount of fine calcareous matter.

(5) Calcareo-siliceous earths, with 25 to 40 per cent. of carbonate of lime passing down into purer chalky earth, with 60 to 80 per cent., which is in some places converted into limestone by the infiltration of calcite.

There is a considerable variation in the amount of chalky matter even on what appears to be the same horizon, and within short distances. The whole series is more calcareous in the northern than in the southern part of the island.

Interstratified layers of volcanic sand and dust occur at several horizons, some of them being light grey pumiceous and felspathic sand, and others a mixture of such material with Radiolarian earth stained brown by what seems to be petroleum.

With respect to organic remains, the calcareous earths have yielded *Foraminifera* in abundance, a preliminary examination of six samples by the late Dr. H. B. Brady resulting in the discovery of 81 species. The siliceous earths have furnished the specimen of *Cystechinus crassus* recently described by Mr. J. W. Gregory, and they abound in Radiolaria, as is very well known. Certain marls and limestones on Bissex Hill prove to consist mainly of *Globigerina*.

The bearing of these fossils is discussed with regard to (1) the age, (2) the conditions of depth, at which the deposits were formed. The age is Pliocene, or Pleistocene, while stratigraphical considerations make it most probable that they are of Pliocene date.

The depth of water indicated by the Foraminifera is from 500 to 1000 fathoms, according to Dr. Brady. The *Cystechinus* is considered by Mr. Gregory as strong evidence for a depth of over 1000 fathoms, and is quite consistent with a depth of over 2000; while the Radiolaria are, in Prof. Haeckel's opinion, most nearly allied to those which occur in the deepest parts of modern oceans, *i.e.* about 3000 fathoms.

The coloured clays are remarkable for the almost complete absence of carbonate of lime; they correspond in all essential points to those modern argillaceous oozes which occur at from 2500 to 3000 fathoms, and have little or no carbonate of lime.

The available evidence points to the conclusion that the depth of water varied from 1000 to 2500 fathoms, and there may have been two epochs at which it was over 2000 fathoms.

Radiolarian deposits have for some years been known to exist in Trinidad, and the authors, having obtained samples, are able to announce that these closely resemble the Barbadian earths in general aspect, in chemical composition, and in microscopical structure. Similar earths also appear to exist in Hayti.

Finally, they discuss the changes in physical geography which are indicated by the existence of these deposits, and their probable equivalent in part of the white limestone of Jamaica; and they infer that the whole Central American and Caribbean region was deeply submerged during the Pliocene period, and that during this time there was open and free communication between the Atlantic and Pacific Oceans. The separation of the two oceans, and the deflection of the Gulf Stream, were changes accomplished by the upheaval of which evidence was adduced in a former paper, and this upheaval is a comparatively recent event.

The minute structure of the rocks is described in reports presented by Mr. W. Hill and Miss C. A. Raisin; the former showing that the Barbados chalk is similar in all essential points to the Chalk of England.

EDUARD VON REGEL.

THE learned and genial Director of the St. Petersburg Botanic Garden, Dr. Eduard von Regel, died on April 27, in his seventy-seventh year. He was the son of a Gotha parson, and developed a taste for gardening while still quite young. During the hours that might have been given to play he was usually engaged at his favourite pursuit in his father's garden. After the usual course of education, he spent several years in various botanic gardens, and about 1842 he was appointed "Obergärtner" in the Botanic Garden at Zurich. Here, in conjunction with Dr. O. Heer, the celebrated palæontologist, one of whose daughters he subsequently married, he at once founded a Swiss journal for agriculture and horticulture, and was exceedingly active in promoting horticulture, both in writing and practically. In 1852 he founded the now well-known and still flourishing *Gartenflora*, which, however, he ceased to edit after 1885. He soon gained fame, and when the important post of Scientific Director of the St. Petersburg Botanic Garden became vacant in 1855, it was offered to and accepted by Regel, and held by him to the last. There he found a wide field for his energy and abilities: but although he accomplished much meritorious botanical work, Russia is far more indebted to him for the improvements he effected in horticulture generally than for his botany. At the time when he first went to St. Petersburg, gardening was at a very low ebb, and the vast strides that have since been made in this industry are very largely due to his untiring efforts. He wrote treatises, introduced superior varieties of fruits, vegetables, and flowers, and succeeded in gaining the influence and support of exalted persons for his projects both botanical and horticultural. It was mainly through his exertions, we believe, that the first flower-show was held in St. Petersburg. This was in 1858, and now such a thing is no uncommon event. He was also instrumental in getting botanists attached to the Russian exploring expeditions in Central and Eastern Asia, whereby the gardens and herbaria, not only of Russia, but of Europe, have been greatly enriched, and botanical science advanced. Regel himself elaborated many of the dried collections thus obtained, besides describing a large number of plants cultivated in the garden from seeds or bulbs sent thither by various travellers. One of the best of his numerous writings is a monograph of the genus *Allium*—"Alliorum adhuc cognitorum Monographia,"—the number of species described exceeding 250, including a large number previously undescribed, the fruits of the explorations in Asia. He was also joint author of an enumeration of the plants collected in Siberia by Semenoff, Radde, Stubendorff, and others. Although gradually declining in health during the last year or so, he continued to discharge the duties of his office; and although not so active with his pen as formerly, he contributed some descriptions of new plants to the *Gartenflora* as recently as February of the present year. Dr. Regel was the recipient of many honours in his adopted country, and he was elected a foreign member of the Linnean Society of London in 1890. This is the second of her few prominent botanists that Russia has lost within a year.

NOTES.

THE annual meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, 25 Great George Street, London, on Thursday and Friday, May 26 and 27, commencing each day at 10.30 a.m. Sir Frederick Abel, F.R.S., the President, will deliver an address on Thursday, May 26. The following papers will be read and discussed on the same day, as far as time permits:—(1) On experiments with basic steel, by W. H. White, F.R.S., Director of Naval Construction and Assistant-Controller of the Navy; (2) on the production of pure iron in the basic furnace, by Colonel H. S. Dyer, Elswick Works, Newcastle-on-Tyne; (3) on experiments on the elimination of sulphur from iron, by E. J. Ball, and A. Wingham, London; (4) on platinum pyrometers, by H. L. Callendar, London. On Friday, May 27, the following papers will be read and discussed:—(5) On the manufacture and application of chilled cast iron (Gruson's system), by E. Reimers, Technical Director of the Gruson Works, Madgeburg; (6) on valves for open hearth furnaces, by J. W. Wailes, Calderbank, near Glasgow; (7) on the calorific efficiency of the puddling furnace, by Major Cubillo, Trubia Arsenal, Spain; (8) on a practical slide-rule for use in the calculation of blast furnace charges, by A. Wingham, London; (9) notes on fuel, and its efficiency in metallurgic operations, by B. H. Thwaite, Liverpool.

THE annual meeting of the Society of German Men of Science and Physicians will be held at Nürnberg from September 12 to 18. At the same time and place there will be a meeting of the German Mathematical Association. In connection with these meetings there will be a mathematical exhibition, including models, drawings, apparatus, and instruments used in teaching and in research in pure and applied mathematics. The project has the support of the Bavarian Government, and those who are organizing the exhibition have secured the co-operation of various competent men of science, and of the mathematical departments of some colleges, besides that of prominent publishers and well-known technical institutions. Space will be granted free of charge to exhibitors.

PROF. ELISHA GRAY, Chairman of the Committee on the Electrical Congress to be held in connection with the Chicago Exhibition, is about to visit all the important electrical centres in the Old World. He will attend meetings of the different electrical organizations, and hopes to strengthen the interest of European electricians in the Exhibition.

WE learn from *Science* that Mr. Timothy Hopkins has made provision for the endowment and maintenance of the seaside laboratory at Pacific Grove recently established under the auspices of the Leland Stanford Junior University. The Hopkins Laboratory will be under the general direction of Profs. Gilbert, Jenkins, and Campbell. It will be open during the summer vacation, and its facilities will be at the disposal of persons wishing to carry on original investigations in biology, as well as of students and teachers. Microscopes, microtomes, and other instruments necessary for investigations will be taken from the laboratories of the University.

THE great surgeon Richet has been succeeded in the Paris Academy of Sciences by Dr. Guyon.

THE distinguished mycologist, M. Roumeguère, of Toulouse, died on February 29 at the age of sixty-three. He had been for fourteen years sole editor of the quarterly *Revue Mycologique*, and was the author of a number of mycological works, the best-known being "Cryptogame illustrée, Champignons d'Europe," with 1700 illustrations.

AN interesting course of lectures is being delivered in connection with the Palestine Exploration Fund. They are being given in the lecture-room of the Royal Medical Society. On Tuesday, Canon Tristram lectured on the natural history of Palestine. The following are the remaining lectures of the course:—May 31, twenty-seven years' work, by Mr. Walter Besant; June 7, the Hittites up to date, by Dr. W. Wright; June 21, the story of a "Tell," by Mr. W. M. Flinders Petrie; June 28, the modern traveller in Palestine, by Canon Dalton.

THE members of the Geologists' Association will make an excursion to Down on June 18. The directors will be Mr. W. E. Darwin and Mr. W. Whitaker, F.R.S. Having arrived at Urpington, the party will walk up the valley to Green Street Green, where shells and bones have been found in the gravel that forms the bottom of the dry upper part of the valley of the Cray. The walk will be continued through High Elms Park to Down (3½ miles from the station). From Down a short stroll eastward gives a good view of a fine chalk valley. An opportunity will be taken for examining the clay-with-flints which caps the chalk over the higher grounds. The formation of this clay will be discussed, with a notice of Darwin's remarks thereon, and with reference to other like deposits. The general geology of the district will also be described, and the marked features caused by the clayey covering over the chalk, by the fine escarpment of the lower London Tertiaries, and by the London Clay hills beyond. By permission of Mrs. Darwin, the house and grounds rendered classic as the residence of Charles Darwin (Down House) will be shown to members, and Mr. De B. Crawshay will exhibit specimens of the flint implements that have lately been found over the high grounds of the neighbourhood. Messrs. Allen will exhibit others. The return journey will be made across the Tertiary escarpment at Holwood Park, and then down the dip-slope of the Blackheath Beds, over Hayes Common to Hayes (a walk of four miles).

ON Saturday afternoon, May 28, Prof. H. Marshall Ward will begin at the Royal Institution a course of three lectures on some modern discoveries in agricultural and forest botany.

ORCHID-LOVERS find much to admire in the latest of Mr. William Bull's exhibitions. An enthusiastic writer in the *Times* describes Mr. Bull's orchid-house as "at present a dream of beauty."

EARLY on Tuesday morning some parts of West Cornwall were visited by an earthquake. The *Times* says that in the village of Manaccan, in the Lizard district, the shock was so severe that the villagers almost without exception were awakened from their sleep by the shaking of their beds and the rattling of articles in their rooms. Their houses, too, distinctly shook, and in one case a person who was awakened from his sleep saw the door of his bedroom thrown wide open. At Redruth, some 12 or 15 miles distant, the shock was also felt. At first it was thought there had been an explosion somewhere in the neighbourhood.

DURING the past week a complete change of weather conditions has taken place over the British Isles. The anticyclone which had lain over the country with such persistency for several weeks showed signs of giving way on the 12th, and during the two following days a large but shallow depression spread over the kingdom from west and north-west, while the wind shifted to south-westward with unsettled and showery weather. The temperature, though cooler, was somewhat high for the time of year, the maxima varying from nearly 60° over Scotland to 65° and 70° over England and Ireland. Solar halos were observed on several days, and thunder was reported from the North Foreland on the 13th. Subsequently the westerly winds increased in force, especially in Ireland, and the sea became rough on our exposed western coasts. Some decrease of temperature also occurred, the maximum readings after Sunday only reaching about 60° in a few places. The conditions have been favourable to rain, but the fall has been slight, except in the north and west, and there is still a large deficiency in nearly all parts of the United Kingdom.

The Royal Meteorological Society has published a third edition of "Hints to Meteorological Observers" (42 pages large octavo). It is pointed out in the preface that meteorological observations, to be of scientific value, must be made on a uniform plan, otherwise the results will not be mutually comparable. The directions given are clear and concise, and the various instruments, both desirable or necessary, for a station of the second order, at which observations are taken at least twice daily, are plainly illustrated. The work also comprises several tables which are essential to the proper reduction of the observations recorded. No one can doubt that, notwithstanding the regulations laid down by several Conferences, there is still want of uniformity, not only when comparing observations of one country with another, but even among the observers of our own country. Take, for instance, the observation of rainfall, temperature, sunshine, cloud, and fog. It would be easy to show that the methods employed by various observers differ considerably, especially as to what constitutes a rainy day and how snow is measured, while the estimation of fog is very uncertain. Sunshine values by various kinds of instruments are hardly comparable *inter se*, and the accurate observation of clouds, whether of height, motion, amount, or description, is undoubtedly difficult, and presents a stumbling-block to many observers. Therefore, we cannot but welcome the exertions of the Meteorological Society to obtain uniformity. The work in question will be found very useful for the purpose, and might perhaps be rendered more so, in future, by the addition of the most approved pictures of clouds, and fuller information as to the importance of their careful observation.

The Report of the Department of Marine (Ottawa) for the fiscal year ended June 1891, contains a report upon the Meteorological Service of Canada for the period extending from October 1, 1890, to October 31, 1891. This Service is divided into two branches: (1) the collection and utilization of observations taken simultaneously for the purposes of weather prediction, and (2) the reduction of observations taken by volunteer observers and others for climatological purposes. The publication of the results obtained from the second division has been continued annually, since the establishment of the Service in 1872; but it is now proposed to deal with the accumulated observations, and to publish them in a serviceable and readable form. This will be the first authoritative Government publication on the climate of Canada; and it will be useful for immigration purposes, and for showing the suitability of the climate, in various localities, for raising agricultural crops. It is expected that the work will require three years to complete. Among the stations in connection with the Canadian Service is one at Bermuda, towards the maintenance of which an annual contribution is paid to the Government of that island, and cable messages are received daily in the interests of the shipping on the Atlantic coast. The Cable Company transmit the messages at half the ordinary rates. Many severe storms have occurred in Canada since the last report, and in each instance warnings were issued from Toronto; of these 80·7 per cent. are stated to have been verified. Warnings of approaching snowstorms were also issued to railways, and it is proposed to extend this service to Manitoba, and as far west as Qu'Appelle.

An excellent paper on "The Art of Internal Illumination of Buildings by Electricity," was read by Mr. W. H. Preece, F.R.S., in the rooms of the Royal Institute of British Architects on Monday evening. In the course of his remarks Mr. Preece noted that the electric light was not always absolutely safe. Security was to be obtained only by good design, perfect materials, first-class workmanship, and rigid inspection. Imperfect materials erected by cheap contractors had led to many disasters. On the other hand, it was stated that no fire had occurred in buildings fitted up under the rules and regulations, and inspected by the officers, of the insurance companies in this country. In Mr. Preece's opinion, everything ought as much as possible to be kept in view, and the conductors ought not to be hidden under wainscots or floors or above ceilings. The glow lamp excited by three watts per candle was at present the most perfect source of domestic light, and when the patent expired—in a year or two—would be obtainable at about one-third of the present price.

Mr. W. B. L. Hamilton, writing in the American journal *Electricity* on "Electricity in the United States Navy," says the latest use of the electric motor in taking the place of human energy in the manipulation of the death-dealing Gatling gun has been found to work with great success. The Crocker-Wheeler Motor Company, at the request of the United States Navy Bureau of Ordnance, constructed a special type of motor, which is attached to the breech of the gun. Hitherto the services of two men have been necessary in the working of these guns—the gunner, whose duty is to train the gun and drop the shot, and another man to operate the crank which sets in motion the mechanism which causes the balls to hail down upon the enemy. The adaptation of the Crocker-Wheeler motor not only does away with the services of the latter, but enables the gunner to train and operate the gun at will by touching an electric button. So completely is the Gatling gun under the control of the gunner, that he is enabled to fire either a single shot, or to fire them at the rate of 1200 per minute.

Science of April 29 prints the following account of a fire-ball, by C. C. Bayley:—"A telephone wire was supported on cedar posts 20 feet high and 20 rods apart. During August, 1889, we had a thunderstorm, during which there was a sharp and heavy crash. Several of the poles were found to have been struck, and portions to have been taken out through their entire length. One of these portions, of the size of a medium rail, was thrown into an adjoining field some rods from the pole. Portions from the others were smaller and more or less shattered. Near the southernmost pole struck, a family were in a house with doors and windows open, and a luminous ball seemed to leap from the wire, pass through the open door and a window, and pursue its course some rods through the open space behind the house. A boy in the room grasped his thumb and cried out, 'I'm struck,' and Mr. Hewett felt a sensation of numbness in his left arm for some time. A girl seized her shawl and rushed out of the house to chase the ball. She reported that she pursued it some distance, while it bounded lightly along, until it seemed to be dissipated in the air without an explosion. The size of the ball was about that of the two fists, and its velocity about that of a ball thrown by the hand."

We learn, from a Florentine source (*La Nazione*, May 3), that in the spring of the year 1890, Mrs. Zelia Nuttall, of the Peabody Museum of American Archæology and Ethnology, Cambridge, Mass.—whose interesting memoir on "Ancient Mexican Shields" was recently noticed in these columns—recognized the great importance of an anonymous Spanish-Mexican MS. preserved in the National Central Library of Florence.

This MS. has never been published. It is entitled "Libro de la vida que los Yndios antiguamente hazian, y supersticiones y malos ritos que tenian y guardavan" (*MSS. Magl.*, Class III., Pal. 11, Cod. 3). It treats of the costumes and religious rites of the ancient Aztecs, and is full of coloured designs which Mrs. Nuttall has had reproduced in *fac-simile* by photographic lithography. It is her intention to publish this MS., at her own cost, accompanied by a preface, an English translation of the text, and illustrative notes. It will be dedicated to the approaching Congress of Americanists, which will be held in Spain this autumn to celebrate the fourth centenary of the discovery of America. An edition of 200 copies will be issued, and held on sale at the Peabody Museum of American Archæology.

AN interesting paper on the uses and applications of aluminium was read by Mr. G. L. Addenbrooke before the Society of Arts on May 11, and is printed in the current number of the Society's Journal. Referring to the applicability of aluminium to opera and field glasses, he said there was an example on the table of a glass made in 1864, which had ever since been in constant use. In 1870 the wheel of a carriage passed over it, but it was afterwards straightened out and made usable. It has made two voyages across the Atlantic, two across the Pacific, and has had other shorter experiences of the sea air, besides lying on one occasion for some time in salt water. Mr. Addenbrooke has kept strips of aluminium for two or three weeks in salt water, and has noted very little effect.

TOWARDS the end of last year—from November 21 to December 5—the members of the Victoria Field Naturalists' Club made an excursion to the Australian chains of hills called the Grampians. The excursion seems to have been remarkably pleasant, but the scientific results did not quite come up to the expectation. According to an account given in the Club's Journal, the botanists were far and away the most successful. A really good collection of plants of the district was obtained. In bird life there was little observable that is not so elsewhere nearer Melbourne; neither was there any great variety of snakes or lizards, and to the collectors of these, as also to the entomologist, the excursion was especially disappointing. From the well-known extensive variety of flowering shrubs in the Grampians, coupled with the fact that several are peculiar to the district, it was fully expected that at least a few clearly representative Lepidoptera or Coleoptera would be secured, but not a specimen of either family was seen that is not common in and around Melbourne.

MR. E. H. PARKER, the British Consul at Kiungchow, in Hainan, a large island off the southern coast of China, mentions a curious phenomenon in connection with the tides of that port. The tides inside the inner harbour, he says, require several years of careful observation before they can be tabulated. It appears certain, however, that there are always two tidal waves a day, though one is so much more considerable than the other that the effect is often practically that of one single tide in the twenty-four hours. The easterly and westerly currents through the straits are not necessarily connected with the rise and fall of the water, either there or in port. The phenomenon of "slack water" (*morte eau*) is also observable every ten days or so at Haiphong, and is probably owing to much the same causes as at Hoihow. At Tourane in Tonquin, too, it is popularly thought that there is usually but one tide within the twenty-four hours. This tide is felt away up to the citadel of Quangnam. In the Gulf of Tonquin the incoming tidal wave flows from the south, a fact which perhaps accounts for the singular circumstance that the westerly current in the Hainan Straits always sets for sixteen hours. One at least of the tidal waves from the east which pass Hoihow cannot get through the straits to Tonquin so soon as that portion of the same wave which takes a circuitous course by way of Annam.

THE Pacific Coast Fisheries of the United States appear to be in a most flourishing condition. According to a recent census bulletin, they employed 13,850 persons in various capacities in the last federal census year; 6,498,239 dollars were invested in them, and the products were valued at 6,387,803 dollars. The canning of salmon is the most important fishery industry in the Pacific States.

SISAL grass, according to a Mexican authority quoted in the new number of the *Board of Trade Journal*, is likely to prove a very important source of wealth for Mexico. It grows in long, narrow blades, often to the length of four or five feet, and these, when dry, curl up from side to side, forming a flexible string, stronger than any cotton cord of the same size ever manufactured. It is in great demand among florists and among manufacturers of various kinds of grass goods; and it is said to be capable of being applied to many new uses. Ropes, cords, lines of any description and any size may be manufactured of it, and a ship's cable of sisal grass is one of the possibilities of the future. It is almost impervious to the action of salt water, and is not readily decayed or disintegrated by moisture and heat. It takes its name from the port of Sisal, in Yucatan, through which it was formerly exported.

A PAPER on modern aërial navigation was read by Captain J. D. Fullerton, R.E., before the Royal United Service Institution on Friday last. His object was to show that the science of aëronautics was based upon simple rules and common sense, and not upon wild and vague theories opposed to all principles of nature. He divided aërial navigation into two distinct branches: (1) ballooning, or navigation by means of machines lighter than air; and (2) aëration, or navigation by means of machines heavier than the air. Proceeding to discuss the first branch, the lecturer sketched the history of attempts at propelling balloons. Describing the requirements of a proposed war balloon, he said these were: (1) that it should be able to carry three or four passengers, a supply of explosive shells, and a machine gun or two; (2) that it should be able to travel at the rate of about 30 miles an hour on a still day, which would enable it to keep up with almost any warship afloat. In regard to aëration, Captain Fullerton said the chief characteristics of this system were that a large supporting surface, either in the form of wings or in that of an aëroplane, was used to carry the weight; that the lifting or supporting power of this surface was dependent upon its velocity and the angle of inclination which it made with the horizon; and that the horizontal resistance to motion depended upon the velocity and angle of inclination in the same manner. The great difficulty both in ballooning and aëration was to get a sufficiently light motor.

THE first number of a new journal, called the *Canal Journal*, has been issued. Its aim will be "to assist the cause of canals and inland navigation generally." It promises to be of considerable value and interest to the class of readers for whom it is especially intended.

THE German publisher, Friedrich Brandstetter, announces that he will issue in the course of the present year a second and improved edition of Dr. J. J. Egli's "Nomina Geographica." The number of explained names has been much more than doubled.

FURTHER details concerning the nature and chemical behaviour of acetyl fluoride, CH_3COF, the new substance whose preparation and physical properties were described in our note of last week (p. 40), are contributed by M. Meslans to the current number of the *Comptes rendus*. It may be remembered that this interesting substance was shown to be liquid at temperatures below 19°·5, and gaseous at temperatures superior to this, its temperature of ebullition, both the liquid and the gas being colourless, and endowed with an odour somewhat reminding one of that of carbonyl chloride. In contact with water, acetyl fluoride is found to react eventually in a manner similar to its well-known analogue, acetyl chloride, forming hydrofluoric and acetic acids.

$$CH_3.COF + H_2O = CH_3.COOH + HF.$$

But there is a considerable difference in the degree of energy with which the decomposition occurs, for while the behaviour of acetyl chloride is almost violent, acetyl fluoride only reacts with great slowness. When a small quantity of the fluoride if dropped into water the two liquids do not mix, and the globule of fluoride only disappears after long standing. Strong solutions of potash or soda, however, decompose it rapidly, with formation of fluoride and acetate of the alkali. The action of caustic lime upon acetyl fluoride is interesting; the gas is rapidly absorbed by it, and calcium fluoride and acetic anhydride formed.

$$2CH_3.COF + CaO = CaF_2 + (CH_3.CO)_2O.$$

Ammonia gas reacts with considerable energy with the liquid, producing a white crystalline mass, consisting of ammonium fluoride and acetamide, $CH_3.CONH_2$. The latter may readily be isolated in good crystals by extraction with ether and subsequent evaporation. The gaseous fluoride reacts with ammonia in the proportion indicated by equation—

$$CH_3.COF + 2NH_2 = CH_3.CONH_2 + NH_4F;$$

that is, two volumes of ammonia react with one volume of acetyl fluoride gas. Aniline likewise acts with energy upon the liquid, forming hydrofluoric acid and acetanilide, $C_6H_5.NH.CH_3.CO$. The action of absolute alcohol is peculiar; it dissolves the liquid fluoride in all proportions, but after an interval of a few hours, interaction occurs with production of hydrofluoric acid and acetic ether. The latter may readily be separated by the addition of water.

$$CH_3.COF + C_2H_5OH = CH_3.COOC_2H_5 + HF.$$

Acetyl fluoride is much more stable in presence of alkaline acetates than its chlorine analogue. Even after four hours' heating in a sealed tube to 100° with sodium acetate, only a small proportion of sodium fluoride and acetic anhydride were formed. Still more stable is acetyl fluoride towards sodium amalgam, there being no appreciable reduction to aldehyde or alcohol. Metallic sodium is likewise without action upon liquid acetyl fluoride, but when heated to redness in the gaseous fluoride, the metal decomposes it with incandescence, sodium fluoride being formed and carbon deposited, together with a few drops of a liquid whose characters have not yet been ascertained. From these reactions it is evident that acetyl fluoride is a substance of a much more stable character than its analogue, acetyl chloride.

The additions to the Zoological Society's Gardens during the past week include an Egyptian Ichneumon (*Herpestes ichneumon*) from North Africa, presented by Dr. J. Anderson; a Ring-tailed Coati (*Nasua rufa*), a Kinkajou (*Cercoleptes caudivolvulus*), a Blue-bearded Jay (*Cyanocorax cyanopogon*) from Brazil, presented by Mr. J. E. Wolfe, C.M.Z.S.; two Laughing Kingfishers (*Dacelo gigantea*), from Australia, presented by Mrs. H. M. Stanley; two Grey Hypocoliuses (*Hypocolius ampelinus* ♂ ♀) from Scinde, presented by Mr. W. D. Cumming; two Ravens (*Corvus corax*), British, presented by Mr. Gregory Haines; a Crowned Horned Lizard (*Phrynosoma coronatum*) from California, presented by Mr. R. Thorn Annan; a Common Fox (*Canis vulpes*), British, three Palm Squirrels (*Sciurus palmarum*) from India, a Brown-throated Conure (*Conurus æruginosus*) from South America, deposited; a Grey-headed Porphyrio (*Porphyrio poliocephalus*) from Persia, purchased; a Persian Gazelle (*Gazella subgutterosa* ♂), a Vulpine Phalanger (*Phalangista vulpina* ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

Latitude Observations at Waikiki.—The *Hawaiian Gazette* for March 8 contains an account by Mr. Preston, of the U.S. Coast Survey, of the latitude observations which are being made at Waikiki on the island of Oahu, Hawaii. In it we read:—"The motion of the pole is, of course, extremely small, and the effect is that here in Honolulu we are about 50 feet nearer the equator now than we were some months ago. This change does not, however, go on indefinitely, but the motion is such that the pole returns at the end of a year to nearly its original position. Besides this annual movement, there seems to be reason to believe that there is a secular change extending over a period of at least sixty years." But no definite conclusions can be arrived at until the observations made at Honolulu are discussed in connection with those made on this side of the earth. In order to test the theory that changes of latitude are produced by the movements of large masses of molten matter in the interior of the earth, the force of gravity is measured on every night that latitude observations are made. As this is done with the idea of detecting variations, the relative and not absolute intensity is all that is required. The arrangement employed is such that if from any cause the acceleration due to gravity should be increased by only one five-hundredth of an inch, it could be easily measured. The observations will be completed in the fall of the year, but the final results cannot be known before the latter part of 1893.

Motion in the Line of Sight.—*Astronomy and Astro-Physics*, No. 104, contains a very important contribution by Mr. W. W. Campbell, on the reduction of spectroscopic observations in the line of sight. The paper contains an explanation of the construction and use of the tables, the limit of precision adopted being one-hundredth of a mile per second. The first table gives the velocities of the star corresponding to a known displacement of one tenth-metre in the various parts of the spectrum, from which the velocity corresponding to any observed displacement can be directly obtained. The formula

$$v_s = V_s \Delta\lambda$$

gives this velocity corresponding to any measured $\Delta\lambda$, V_s being taken directly from the tables.

Table II. gives the earth's orbital velocity, V_a, and the deviation, i, when the sun's longitude is ⊙. These values are obtained from the formulæ—

$$\tan i = \frac{e \sin(\odot - \Pi)}{1 + e\cos(\odot - \Pi)}$$

and
$$V_a = \frac{a}{\sqrt{1-e^2}} \cdot \frac{2\Pi}{T}[1 + e\cos(\odot - \pi)] \sec i,$$

and when found are substituted in the equation—

$$v_a = - V_a \sin(\lambda - \odot + i)\cos\beta.$$

By tabulating V_a and i as functions of ⊙, their values can be very easily found, and v_a consequently reduced from the last-mentioned equation.

The value of the lunar correction has been taken into account here, omitting any errors due to ellipticity of the orbit and its inclination to the ecliptic. Its value is obtained from the formula—

$$v_d = - 0{\cdot}29 \sin t \cos\delta \cos\phi,$$

the latitude used being that of Mount Hamilton, but corresponding corrections for any other latitudes can be found from these by multiplying them by $\frac{\cos\phi'}{\cos\phi}$, where ϕ' is the new latitude required.

The Late Partial Eclipse of the Moon.—Fine weather was generally prevalent during the partial eclipse of the moon on May 11, affording many observers a good opportunity for noting any new features connected with such an occurrence. Considering that the eclipse was only a partial one, it may be rather difficult to decide whether it should be classed in the category of "bright" or "dark" eclipses. Undoubtedly it was not a very dark one, for during the greatest immersion the whole surface of the moon could be distinctly seen, especially with the help of a telescope, with which craters could be picked out. On the hypothesis that "dark" and "bright" eclipses are brought about owing to the different states of the solar atmosphere, the present one should have been at any rate more inclined to be "bright" than "dark," for as we are approaching a spot maximum the sun's atmosphere is becoming more and more disturbed. At the time of greatest obscuration the blood-red tinge, caused by the absorption of our atmosphere, became very apparent, but this gradually wore off as the brighter part of the moon made its appearance.

From a series of photographs of the eclipsed moon taken at intervals of about a quarter of an hour, the penumbra in some of them was very distinct, especially in those taken near the time of greatest obscuration, the exposures then being comparatively long. At mid eclipse an attempt was made to obtain a photograph of the whole disk of the moon, as it appeared so distinct and clear on the ground glass, but even an exposure of 12s., using extra rapid dry plates and a 30-inch reflector, was not sufficient to bring it out, although the extent of the bright crescent and penumbra was very much increased.

DECLINATIONS OF STARS FOR REDUCTION OF VARIATIONS IN LATITUDE.—No. 263 of the *Astronomical Journal* contains the declinations of thirty-six stars, which have been obtained with the prime-vertical transit of the United States Naval Observatory. The observations were made for the determination of the constant of aberration, and consequently at the periods of maxima aberration effects, but their present publication, as Prof. S. J. Brown states, is owing to the "many requests for the observed declinations of these stars for use in discussing probable secular and periodical changes in latitude." The stars in this list are comprised in the zone 36° 37′—38° 40′. The communication contains a brief account of the methods of reduction employed, together with a reference to the instrumental adjustments.

The same number of the *Journal* contains also some results of the observations of α Lyræ, made during the years 1862–67 with the same instrument as mentioned above. The discussion of these observations was first made when Euler's value of 306 days for the periodical variation of the latitude was in vogue, but Prof. S. Newcomb, in the present case, has taken Mr. Chandler's new value, and gives, briefly, the following results:—

Mean declination of α Lyræ for 1865·0, assuming the latitude of the centre of the Observatory to be 38° 53′ 39″·25	38° 39′ 35″·56
Correction to Struve's constant of aberration...	+ 0″·006
Hence, constant of aberration	20″·451
Parallax of α Lyræ	+ 0″·24
Coefficient of sun's azimuth in declination ...	+ 0″·507
Coefficient of sin N	s = + 0″·086
Coefficient of cosine N	c = − 0″·087

the value of N being assumed zero at 1864·50, increasing 308° annually.

The expression which he gives for the variation of the latitude of Washington is

$$\delta\phi = 0''{\cdot}122 \cos 308^\circ (t - 1864{\cdot}94),$$

the distance between the poles, or the semi-amplitude of the variation of the latitude, being 0″·122.

COMET 1892 DENNING (MARCH 18).—The following elements and ephemeris are given for this comet in the *Astronomische Nachrichten*, No. 3089, computed from three observations made at the Hamburg Observatory:—

T = 1892 May 11·22042 Berlin M.T.

$$\left.\begin{array}{l} \omega = 129^\circ\ 18'\ 34''{\cdot}4 \\ \Omega = 253\ \ 25\ \ 41{\cdot}6 \\ i = 89\ \ 42\ \ \ 4{\cdot}3 \end{array}\right\} \text{M. Equator 1892·0.}$$
$$\log q = 0{\cdot}294619.$$

Ephemeris for 12h. Berlin M.T.

1892.	α App. h. m. s.	δ App. ° ′	log r.	log. Δ.	Br.
May 19	3 49 27	+52 13·5			
20	52 26	51 57·7			
21	55 22	51 41·8	0·2947	0·4423	0·80
22	58 15	51 25·9			
23	4 1 5	51 10·0			
24	3 52	50 54·1			
25	6 37	50 38·2	0·2948	0·4466	0·79
26	9 19	50 22·3			

The brightness at the time of discovery is taken as unity.

COMET 1892 SWIFT (MARCH 6).—The elements and ephemeris of this comet are given in the *Edinburgh Circular* (No. 26), from which we make the following extract:—

1892.	R.A. h. m. s.	Decl. ° ′	log Δ.	log r.	Br.
May 19	23 23 44	+31 52·2			
20	26 16	32 22·2			
21	28 47	32 51·6	0·1522	0·1035	0·53
22	31 16	33 20·4			
23	33 44	33 48·7			
24	36 10	34 16·5			
25	38 34	34 43·7	0·1628	0·1166	0·47
26	40 56	35 10·4			

The brightness at the time of discovery is taken as unity.

The comet is situated in the constellation of Pegasus, and on the 22nd will form very nearly an isosceles triangle with β Pegasi and α Andromedæ, the comet then lying nearly midway between η Pegasi and σ Andromedæ.

GEOGRAPHICAL NOTES.

M. LOUIS LÓCZY, in his annual address to the Hungarian Geographical Society at the commencement of the current session, expressed surprise that scientific geography was so little appreciated in England. "It is sad to see," he said, "that, despite the efforts of the oldest of Geographical Societies, the great Universities of Oxford and Cambridge have not yet established chairs of geography, and that lectureships even have only been established with difficulty."

IN the Report of the Mississippi River Commission, the extent of the levees confining the river below Cape Girardeau (Missouri) is given as 1300 miles. During the high water of 1891, the levees gave way in five places, and the total length of the breaches made in the embankment was about one mile. By far the most serious gap was that at Ames Plantation, opposite New Orleans, which attained a width of 1665 feet, and a maximum discharge of about 91,000 cubic feet per second. It overflowed 2000 square miles, one-tenth being cultivated land. The cause of this crevasse was a badly constructed rice-flume, and as the great Nita crevasse of 1890 had a similar origin, the Commission has resolved to discountenance the use of such flood-gates in future. All of the crevasses of 1891 put together discharged less water than the Nita crevasse alone in the previous year, and it was only one out of about fifty breaks which occurred during the great floods.

A NEW map of Dahomey, on the scale of 1 : 500,000, has been prepared by M. A. L. d'Albeca, and published as a supplement to the new journal, *La Politique Coloniale*. All available data have been employed in its preparation, much being of course derived from itineraries unchecked by observation.

CAPTAIN GALLWEY, Vice-Consul for the Oil Rivers Protectorate, has succeeded in tracing a channel navigable for canoes through the deltaic swamps between Benin and Lagos, a distance of 160 miles.

THE *Proceedings* of the Royal Geographical Society for May contains a letter from Mr. Gilbert T. Carter, Governor of Lagos, describing a recent journey into the interior. From the summit of a hill near Ode Ondo he obtained a magnificent view to the south-east over a foreground of rocky forest-clad hills, backed by a fine range of mountains about twenty miles away, which have not previously been reported. The height of the most conspicuous summits is estimated to be from 5000 to 8000 feet above sea-level.

THE VARIATION OF TERRESTRIAL LATITUDES.

IN a letter addressed to M. R. Radau by M. Antoine d'Abbadie, which appears in the March number of the *Bulletin Astronomique*, the writer gives an interesting historical account of the work that has been done with regard to this question. As it contains also some suggestions for future work, the following *résumé* may be of service.

The author states that M. Fergola, the astronomer at Naples, may be looked upon as the one who first drew attention to this question. Of the earlier astronomers, Sir George Airy was led to the conclusion that the latitude was subject to a slight variation, and he published in 1854 and 1875 the greatest and least values for the co-latitude 38° 31′ 22″·16, and 38° 31′ 21″·35 respectively, obtained from observations of the pole. Many other results were obtained by him, which caused him to assign reasons for the fluctuations, but he deemed it wiser to publish the results at a time when the measurement by graduated circles was considered more concise.

One of the first causes to which these variations were attributed was refraction, and it was with the intention of settling this point that Airy undertook with his zenith telescope the measurements of the zenith distance of γ Draconis, as this star culminated near the zenith at Greenwich. M. Faye, towards the year 1846, found out the advantages of such an instrument as that used by Airy, and his installation was composed of three instruments, a zenith telescope, a mercury trough, and a nadir telescope, the last two of which provided a means of obtaining the true nadir point.

Porro, an Italian officer, adopted several of these improvements in his instrument: he added to his telescope a trough with a glass bottom, the plane surface of which was placed in a horizontal position, and reflected feebly the image of the central thread of the zenith telescope. By filling the trough with water, another image of the same wire was obtained, which remained visible during the transit of the star, and it was possible to take several measures of the distance between the star and image.

The next observer we find occupied in this research was Respighi, who, in the year 1872, published the nadir distances of several stars measured at Rome. The stars he observed were those which culminated so near the zenith that they could be seen in the telescope after reflection from mercury. From a series of seventy-seven observations, taken during five months of the year 1869, he observed the transits of two stars reflected at his nadir. During this interval he found a difference of 2″·07 between the greatest and least of his results.

In the method of Horrebow, the divided arc on his instrument gave a rough reading of the inclination of his telescope, while for greater precision he used the readings taken from a level fitted to the telescope.

M. d'Abbadie here condemns the use of levels altogether for really accurate work, and backs his opinion with facts which he has obtained from personal experience. He mentions that, as far back as 1837, he made a study of their accuracy, but the levels he used were not good ones. Later, after having purchased some from the best-known makers in Paris, Munich, London, and Hamburg, he repeated his experiments in a cellar in an old *château*, and he found that the results given were of a most unsatisfactory kind.

Admitting, then, that there was a variation in the latitude, it was not long before periods were established. Peters, in the year 1845, from observations at Pulkova, derived one of 303·9 days with a maximum on November 16, 1842. Mr. Nyrèn extended this to 305·6 days, with a maximum on December 13, 1867, while Mr. Downing, from ten years of observations made at Greenwich, deduced a period of 306·0 days, with a maximum on October 12, 1872. Leverrier, and Hough at Albany, also found variations that were confirmed at Abbadia.

M. d'Abbadie then refers to the variation of the true azimuth, which, as he says, did not escape the notice of Airy. In the year 1848 he estimated it as 4″ or 5″, while fifteen years later he extended it to 6″ or 7″. Of course, if the pole suffers any displacement, such as an increase in elevation, at its two elongations it will be displaced by the same amount, and the azimuths in these cases would be increased. The greatest displacement we have mentioned is 2″·07, but M. d'Abbadie says "that if, by hypothesis, the north pole of the earth be elevated by 7″ by approaching the actual zenith, the true azimuth will be diminished by those 7″ in a place situated at 6h. 0m. of west longitude, and increased by the same quantity at 6h. 0m. of east longitude." He then states how, if the pole was considered movable for places situated at opposite ends of a diameter of the earth, the values for the variation should be the same, but of opposite signs. To establish coincidences of this kind, it is suggested that observers in Asia and America should take their nadir readings at the same time as they are taken at Abbadia—that is, in the morning and evening at 6h. Paris mean time. The results Chandler obtained from his latitude observations indicated a minimum on September 1, 1884, and a maximum on May 1, 1885, with a difference of about 0″·7. By taking the 6 o'clock p.m. P.M.T. observations made at Abbadia, it was found that a maximum value was obtained on September 1, 1884, and a minimum on May 1, 1885, with a difference of 0″·74. Contemporary observations made at Berlin and Honolulu tended also to the same conclusion; but in spite of them M. d'Abbadie does not think it prudent to suppose a fluctuation of the earth's axis.

After referring to some sudden changes that this variation has undergone, he goes on to mention Darwin's, Wolf's, and Paschwitz's instruments that were constructed for the measurement of very small displacements. The last-named modified to a large extent Zöllner's horizontal balance, and added to it a mirror, obtaining in this way, by the employment of photography, a continuous series of curves.

Mr. Nobile, in his memoir of 1883, related that, in 1820, Brioschi believed in the small changes in the terrestrial latitudes, and admitted two possible variations, one secular and another periodic. He states, also, that Fergola, in 1871, supported this idea of Brioschi; and Peters, as well as Nyrèn and Gylden, confirmed this opinion. Euler and Legendre are also said to have concluded from theory such a variation, giving it a period of ten months.

Another memoir by M. Nobile, contains a discussion on the observations that were made with the object of determining the latitude of the Observatory at Capo di Monte, near Naples, and from these, together with some others, he deduced a tendency in the latitude to increase in the summer and decrease in the winter months.

It will be seen from the preceding summary that very little is definitely known as to the causes of this variation. From the observations just referred to, it seems that refraction would be the cause of such a variation, but as this is not borne out in other observations, new theories must be advanced. M. d'Abbadie, knowing the importance that is attached to the inquiries into the causes of these variations, before concluding his letter adds a few suggestions relative to a means of settling some of these points, and the following is the plan which he proposes should be adopted.

Three observers, A, B, and C, should be provided each with a good zenith telescope; and the same two stars, which it is proposed to use, should be observed by them. B and C should be as near as possible on the same parallel of latitude, so as to have identical refractions when measuring the declination on the meridian of the chosen stars. To insure greater accuracy in these declinations, he suggests that these stars should be observed at their elongations with a geodetical circle, the refraction in azimuth being zero, save in a few rare cases of lateral refraction. The three observers should "notify at once, in a continuous way, if possible, the varying movements of the nadir, and, in every case, these variations at the precise moment where A would observe on the meridian."

To further complete this plan, two other observers, at D and and E, might be added, the former situated at 6h. east, and the latter at 6h. west longitude, in the same relative positions as Paris is to Calcutta and Chicago. The position of E or D could be chosen in the austral hemisphere, in order to determine whether the variation of the nadir agrees with that which should be observed simultaneously in the opposite hemisphere. Still greater advantage would be gained if two other observers, situated at opposite points of the earth, were chosen to observe these phenomena at the same instant. By adopting this plan, a definite control would be had over the hypothesis that the fluctuation was due to the movement of the terrestrial axis, and if only this point could be settled, we should have advanced a considerable step in its solution.

We may mention here that quite recently Chandler has made the remarkable discovery that the earth's axis of rotation revolves round that of her maximum moment of inertia in a period of 427 days. This, as Prof. Newcomb says, seems at first to be quite contrary to the principles of dynamics, but, after having investigated the theory, he finds that it is in perfect harmony with the amount that the latitude varies, taking into account the elasticity of the earth itself and the mobility of the ocean. Radau's investigations were based on a 306-day period, but he showed that the observed discordances would have to be multiplied three times before they agreed with those obtained by theory.

W. J. L.

MAGNETIC VARIATIONS.[1]

IN this paper the author refers to the ordinary variations of the magnetic elements as observed at Greenwich; the annual progressive change; the diurnal variation—large in summer, small in winter, and also larger when sun-spots are numerous and smaller when sun-spots are few; the irregular magnetic disturbances and magnetic storms, and the accompanying earth currents; phenomena which are generally similar at other places.

He then invites attention more particularly to magnetic disturbances. Those at Greenwich may, after a calm period, arise gradually or commence with great suddenness. When sudden, the movement is simultaneous in all elements. The first indication may be a sharp, premonitory, simultaneous movement, followed after a time by general disturbance, or the movement may at once usher in the disturbance. These initial movements are not always great in magnitude, sometimes, indeed, small, but they have a very definite character, and frequently occur nearly instantaneously, as is shown in the character of the photographic traces.

It has been long known that magnetic disturbances occur at the same time over wide areas of the earth's surface, but the accidental comparison in past years of the times of commencement of one or two disturbances at Greenwich with the times at other places has led the author to suppose that the coincidence in time is much closer than had been before supposed, and the definite, and on occasions isolated, character of the initial movement induced him to undertake the collection and comparison of the times of such movements for a number of days at observatories geographically widely separated.

The times of such movements cannot be caught by eye observation without continuous watching of the magnets, so that the photographic registers have to be relied upon, which is better, excepting that the scale of time is necessarily contracted; but, though in individual measures there might be variations, it was conceived that (supposing no systematic error to exist) the mean of a number of comparisons should give a good result. Seventeen days, occurring in the years 1882 to 1889, were selected for comparison, the observatories being those of Toronto, Greenwich, Pawlowsk, Mauritius, Bombay, Batavia, Zi-ka-wei, and Melbourne, and, for a less number of days, Cape Horn (as obtained from the Mission Scientifique du Cap Horn, 1882–83). It was desired to have times for Pola, but it was found that photographic registers during great part of the period did not exist. The variation in time at each place from the mean of times for all places is given for each day. The mean deviation at the different places varies from +2·4 minutes to −2·9 minutes, the agreement between four of the places—Greenwich, Pawlowsk, Mauritius, and Bombay—being very much closer, the mean values of deviation for Greenwich, Pawlowsk, and Bombay differing, indeed, by only 0·1 minute, equivalent to 6 seconds.

The question arises, Are the differences real, or due (considering the contracted time scale) to accidental error? If the magnetic impulse is really simultaneous over the whole earth, it is a striking physical fact, and if not entirely so, the circumstance is no less interesting; but greater attention to accuracy of time scale, or a more extended scale, may be necessary before the point in question can be definitely settled.

A table is added, showing the character of the magnetic movement at the several observatories, from which it appears that at any one place the movements on different days were in most cases similar, though different at different places, indicating on these occasions the occurrence usually of one general type of disturbance.

Reference is made to the question of earth currents. A comparison for thirty-one days, between 1880 and 1891, of cases of sudden magnetic movement and earth current at Greenwich, shows the earth current to precede the magnetic movement by 0·14 minute, equivalent to 8 seconds. The question of the relation between magnetic movements and earth currents is discussed.

The desirability of being able temporarily to obtain, when occasion requires, a more extended time scale for all magnetical and meteorological phenomena is pointed out.

The general result is that in the definite magnetic movements preceding disturbance the magnets at any one place are simultaneously affected; also that in places widely different in geographical position the times are simultaneous, or nearly so, a small constant difference existing at some places which may be real or may be accidental, but the character of which it seems desirable to determine. It is shown also that at Greenwich definite magnetic movements are accompanied by earth current movements which are simultaneous, but that neither magnetic irregularities nor ordinary magnetic variations seem to admit of explanation on the supposition of being produced by the direct action of earth currents.

[1] Abstract of paper "On the Simultaneity of Magnetic Variations at different places on occasions of Magnetic Disturbance, and on the relation between Magnetic and Earth Current Phenomena," by William Ellis, F.R.A.S., Superintendent of the Magnetical and Meteorological Department, Royal Observatory, Greenwich. Communicated to the Royal Society, on May 5, 1892, by W. H. M. Christie, F.R.S., Astronomer-Royal.

SCIENTIFIC SERIALS.

American Journal of Science, May.—Radiation of atmospheric air, by C. C. Hutchins. A stream of hot air was arranged so that it could be made to pass in front of one of the faces of a thermopile at a distance of 3 cm., and cause a deflection of a galvanometer needle, or the air could be discharged high above the thermopile, leaving it unaffected except by radiation from a large Leslie cube containing water at the temperature of the laboratory. There was no sort of agreement between measures made on eight different days to determine the absolute radiating power of a column of air 1 centimetre thick at a temperature near 100° C.; but in an ordinary room and under average conditions the value came out $= 0·000001133 + 0·0000000711\ (t - t')$, where $t - t'$ is the difference in temperature between the air and the cube. Tyndall's result, that the radiation increases with the amount of moisture in the air, was confirmed, but no exact law of connection between the two was found. This is probably due to the presence of accidental impurities in the air employed. The increase of radiation proves to be proportional to the increase of temperature. There was a small increase of radiating power when sheets of air more than 1 centimetre thick were used; with sheets less than this thickness, no difference of radiation could be detected.—Atmospheric radiation of heat and its importance in meteorology, by Cleveland Abbe. In this interesting and exhaustive paper Prof. Abbe brings together practically all the conclusions that have been arrived at on atmospheric movements and their relation to radiation from the air. In his words, "A comprehensive study of fluid motions shows that air and water alike may be forced to ascend without being warmer and lighter, or to descend without being colder and denser, than the surrounding fluid. The currents and whirls behind any obstacle in streams of air or water are almost wholly independent of differences of density, and are caused by differences of pressure as modified by simple kinetic laws." These motions, which the air is forced to take for purely kinetic reasons, are specially discussed in detail, but it is impossible to enumerate, in an abstract, the many cases considered.—Experiments upon the constitution of certain micas and chlorites, by F. W. Clarke and E. A. Schneider. The minerals analyzed are waluewite, v. of xanthophyllite, clinochlore, leuchtenbergite, diallage, serpentine, and mica from Miask, Ural.—On the qualitative separation and detection of strontium and calcium by the action of amyl alcohol on the nitrates, by P. E. Browning.—The age and origin of the Lafayette formation, by Eugene W. Hilgard.—On the influence of swamp waters in the formation of the phosphate nodules of South Carolina, by Dr. Charles L. Reese. From the experiments it appears probable that both carbonic acid and the humus substances in fresh-water swamps play an important part both in the accumulation and the concentration of calcium phosphate, and thus in the formation of phosphate nodules, these being considered to be phosphatised marls.—Plattnerite, and its occurrence near Mullars, Idaho, by William S. Yeates; with crystallographic notes by Edward F. Ayres.—On the occurrence of Upper Silurian strata near Penobscot Bay, Maine, by William W. Dodge and Charles E. Beecher.—Zinc-bearing spring waters from Missouri, by W. F. Hillerbrand. The chief constituent salt in the spring in question is zinc sulphate. It forms about 56 per cent. of the total dissolved solids.—A meteorite from Central Pennsylvania, by Prof. W. G. Owens. A chemical analysis of the meteorite gave Fe 91·36, Ni 7·56, Co 0·70, P 0·09, S 0·06, Si trace = 99·77.—On two meteoric irons, by G. F. Kunz and E. Weinschenk. One of the masses examined came from Indian Valley Township, Floyd County, Virginia; the other from Sierra de la Ternera, Province of Atacama, Chili.—The molecular masses of dextrine and gum arabic as determined by their osmotic pressures, by C. E. Linebarger. The molecular mass of gum arabic is found to be about 2500, of dextrine 1134, and of colloid tungstic acid 1750. In each of these three cases the colloid molecule is seven times the simple molecule.

American Journal of Mathematics, vol. xiv., No. 2. (Baltimore, Johns Hopkins Press, April 1892.)—The number before us opens with a paper entitled "Some Theorems relating to Groups of Circles and Spheres," by Prof. W. Woolsey Johnson (pp. 97–114). The title at once calls to mind Mr. Lachlan's memoir "On Systems of Circles and Spheres" (Phil. Trans., vol. 177). The author thus puts the connection between the papers: "(1) If there be 5 circles or 6 spheres in each group, the product or determinant of powers is equal to zero; and (2) if there be 4 circles or spheres in each group, the power determinant is the product of two determinants each of which depends upon one of the groups." Mr. Lachlan's results are derived principally from the first of the above theorems, whereas it is Prof. Johnson's object "to point out some other results derivable from the second theorem, and particularly to evaluate the power determinants for groups of smaller numbers of circles and spheres." The two memoirs are an interesting application of a "Theorem in the Geometry of Position" (the multiplication of two determinants) due to Cayley (*Camb. Math. Journ.*, vol. ii., 1841).—The next paper, by C. H. Chapman, is an "Application of Quaternions to Projective Geometry" (pp. 115–40).—Then follows an adaptation of G. W. Hill's method (*American Journal of Mathematics*, vol. i.) "so as to include that class of inequalities which depends also on the ratio of the solar and lunar distances, and, in particular, the principal part of the parallactic inequality," by E. W. Brown. The title of the paper is "On the part of the Parallactic Inequalities in the Moon's Motion, which is a Function of the Mean Motions of the Sun and Moon" (pp. 141–60).—The two remaining papers were read before the New York Mathematical Society, viz. "On the Curves which are self-reciprocal in a Linear Nulsystem, and their Configurations in Space," by C. P. Steinmetz (pp. 161–86); and "A Classification of Logarithmic Systems," by Irving Stringham (pp. 187–94).—This last is an attempt to use the logarithmic spiral, defined as a geometrical locus, as the means for defining the logarithm and demonstrating its properties.

Bulletin of the New York Mathematical Society, vol. i. Nos. 6, 7 (New York: March, April, 1892).—The first of these numbers opens with a discussion of the mechanical axioms, or laws of motion, as presented by Newton. The author, Prof. W. Woolsey Johnson, examines at some length (pp. 129–39) the views put forward in Thomson and Tait, "Natural Philosophy"; Tait, "Mechanics" ("Encyc. Brit."); and Williamson and Tarleton, "Dynamics." The article is a careful piece of reasoning, founded upon the principle that "it is desirable to include among the axioms of mechanics the smallest basis of postulated principles upon which it is possible to construct the science by rigid mathematical reasoning." Then follow short notices of an 8-figure logarithm table, published "par ordre du Ministre de la Guerre, Paris, 1891," and of "An Introduction to Spherical and Practical Astronomy, by Dascom Greene (Boston, 1891)." The usual "Notes" and list of new publications close this number and also No. 7. This last-named number opens with a review of "The Laws of Motion, an Elementary Treatise on Dynamics, by W. H. Laverty." The writer's object in this, and similar articles that are to follow, is "by reviewing somewhat at length a few of the better recent works on elementary mechanics to 'fix the ideas' and arrive at some conclusions, at least, as to what is the best modern usage in treating the subject" (pp. 145–50). The next contribution, by Dr. C. H. Chapman, entitled "Weierstrass and Dedekind on General Complex Numbers" (pp. 150–56), is one of those that makes this *Bulletin* so interesting and valuable to the student. The last article is a translation (pp. 156–68) by Prof. Ziwet of an *éloge* by M. Duhem on "Emile Mathieu: His Life and Works."

Memoirs of the St. Petersburg Society of Naturalists, vol. xxi. (Section of Botany).—Besides the proceedings, the volume contains the first part of an excellent monograph, by M. Aggéenko, on the flora of Crimea, being a description of the botanical geography of the peninsula. The orography and hydrography of Crimea, and its various soils, are shortly described, as also its climate. The periodical phenomena of blooming and fruit-bearing are next dealt with. The following chapter is devoted to the analysis of previous exploration, and the remainder of the work is given to the description of the character of vegetation in the Steppes of Crimea, on the northern slope of the highlands, the flat summits of the Yaila highlands, and especially the southern slope. The influence of man and of the fauna on vegetation is briefly treated, and a new species, *Alyssum rotundatum*, as well as a new variety of Orchids (*Ophrys aranifera*, Hudson, var. *taurica*) are described and figured on plates. A very interesting geo-botanical map of Crimea is given.—A paper on the pigments of Fungi, by A. Nadson, must be rather considered as a preliminary communication, containing many valuable data on the pink, yellow, red, and orange pigments of some fifteen species.—On the crystals in the leaves of the *Anonaceæ* and *Violarieæ*, by Prof. Borodin.

Vol. xxii. (Section of Zoology and Physiology).—Ornithological observations in the middle course of the Amu-daria in the Tcharjui-kelif region, by A. Yaschenko. A list of 161 species of birds and their distribution in various regions (cultivated, mixed, deserts, and mountains) is given, each of the regions being described separately as to its most characteristic birds.—On the hybrids between *Butydes flava* and *Butydes campestris*, by N. Zaroudnoi. — On the embryonal development of *Phyllodromia* (*Blatta*) *Germanica*, by N. Kholodkovsky, being a very elaborate and valuable contribution to comparative embryology. It is the fruit of a four years' laborious research, and is accompanied by five large well-drawn plates.

Bulletin de l'Académie des Sciences de St. Pétersbourg, Nouvelle Série, t. ii., No. 3.—The ephemeris and the approximate elements of the comet of Encke for the year 1891, by O. Backlund (in German). The ephemeris is calculated from July 2 to November 1, 1891, after having taken into account the perturbing influences of Venus, the Earth, Mars, and Jupiter in 1884–88, and Jupiter alone from March 7, 1888, to May 31, 1891.—Additions to the Flora of the Caucasus: i. Two new varieties of *Rhamnus*, by N. Kuznetsoff (in German, with two plates).—On the radiants of the Andromedides, by Th. Bredikhine (in French), with a plate. The meteoric current of November 27, 1872, and 1885 is studied, the former on the ground of the observations of the Brera Observatory at Milan. The positions of the radiants are given on a map, upon which the orbit of the comet of Biela (for 1859) is also traced. The positions of the radiants being taken into account, the author compares the probable elements of the meteoric current with the orbit of the Biela comet. Taking further into account the meteoric currents observed on December 7 and 8 in 1798, 1830, 1838, and 1848, the author concludes that those currents must have belonged to the orbit of the same comet before the severe perturbations it suffered through the influence of Jupiter in 1794.—Observations of 51 double stars, followed by a research into systematic errors, by F. Renz, of Pulkova (in German). The observations and the catalogue based upon them are given.—On some old and new catalogues of stars, by J. Seyboth (in German). Before the printing of Romberg's catalogue a comparison of its data with those of previous catalogues was felt to be necessary. A series of comparative measurements has been undertaken for that purpose, and their results are given in the introduction to Romberg's catalogue. Further comparison is now made with the catalogues of Struve, Argelander, Pulkova (3542 stars), Becker, and Gould, and reduction tables are given.—A new Bacterium, *Nevskia ramosa*, by A. Famintzin (in German), with a plate. This strange organism, so widely different from all known Bacteria, but not unlike to Metchnikoff's *Pasteuria ramosa*, consists of a jelly-like ramified growth, the Bacteria cells appearing upon the ends of the branches. It forms colonies similar to those formed by some Algæ and Infusoria (*Urococcus*, *Gomphonema*, *Epistylis*).—On the libration of Hyperion, by H. Struve (in French). The last years' observations of this satellite of Saturn, which have been made with the aid of the great Pulkova refractor, having disclosed considerable discrepancies from the ephemerides calculated by Mr. Marth, the Pulkova astronomer tried to explain them—and succeeded to a great extent—by a libration which has a short period of 641 days, and an amplitude of 9° in the average longitude.—Revision of the Hymenopteres of the Zoological Museum of the Academy, by A. Semenoff: i. Genus *Cleptes* (in Latin). The following new species are described: *Cleptes flammifer*, *obsoletus*, *Buyssonis*, and *Mocsarii*; ii. Genus *Abia* (new species): *A. symballophthalma*.—New Gentianæ from Asia, by N. Kuznetsoff. The following new species, some of which had already been recog nized as new by Maximowicz, are described: *Gentiana Maximowiczi, leucomelæna, purpurata, siphonantha, Regeli, glomerata,* and *G. Kuroo,* var. *brevidens.* They are from Central Asia, North China, and Mongolia.—Report of the International Meteorological and Polar Conferences, and the International Committee of Weights and Measures, by H. Wild. No. 4: Remarks on Mr. Kock's work, "Comicorum Atticorum fragmenta" (in German).

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 5.—"Transmission of Sunlight through the Earth's Atmosphere. Part II. Scattering at Different Altitudes." By Captain W. de W. Abney, C.B., D.C.L., F.R.S.

In this paper the results of observations made by exposing platinotype paper are recorded, and it is shown that the total intensity of light as thus registered is the same as if observations had been made on a ray of λ 4240 alone. The observations were made at altitudes varying from sea-level to 12,000 feet in different countries, at different times of the year, and during four to five years. The instrument in which the exposures were made is described, as also the method of deriving the intensity of light from the developed prints. The results of these observations agree closely with those obtained by the measures of the spectrum which was described in Part I. of this subject. The value of k in the formula (1) $I' = \epsilon^{-k\lambda^{-4}x}$ (from which can be calculated the loss of intensity of a ray of any particular wave-length) was found to be 0·00146 at sea-level. It was also found that k apparently varied as h^2, h being the barometric pressure. A table is attached, showing the value of the transmitted light in the formula (2) $I' = Ia_x$, where a is a constant and x the air thickness in terms of the vertical thickness, μ being the formula $I' = I\epsilon^{-\mu x}$, from which (1) and (2) are both shown to be derived.

Bar in inches.	μ.	a.	Bar in inches.	μ.	a.
30	0·154	0·856	24	0·098	0·908
29	0·144	0·866	23	0·090	0·915
28	0·134	0·875	22	0·083	0·922
27	0·124	0·884	21	0·075	0·928
26	0·115	0·891	20	0·068	0·934
25	0·107	0·899	19	0·062	0·940

Linnean Society, April 21.—Prof. Stewart, President, in the chair.—An example of an Australian bird (*Gymnorhina*), which had lately been shot near Tor Abbey, Devonshire, after being observed all the winter, and which had doubtless escaped from confinement, was exhibited on behalf of Mr. W. Else, Curator of the Torquay Museum.—On behalf of Mr. Charles Head, of Scarborough, two specimens of the Whiskered Bat (*Vespertilio mystacinus*) taken in that neighbourhood were exhibited.—Mr. W. B. Hemsley, F.R.S., read a paper entitled "Observations on a Botanical Collection made by Mr. A. E. Pratt in Western China, with descriptions of some new Chinese plants from various collections." Mr. Pratt travelled in 1889–90 in Western China, close on the borders of Eastern Tibet, and though chiefly in search of zoological specimens, he fortunately secured the services of a native who had been trained to dry plants by Dr. Henry, the result being that he was enabled to bring home a very interesting botanical collection. The plants were obtained chiefly at elevations of 9000 to 13,500 feet, in the neighbourhood of Tat-sien-lu, a frontier town situated in about 30° N. lat. and 102° 15' E. long.; and although Mr. Hemsley reported that he had not finished working out the collection, he estimated that it contained about 500 species, of which perhaps 150 species were new to science. The paper was criticized by Mr. C. B. Clarke, who remarked that the mountain ranges of Western China seemed to abound in showy herbaceous plants, rivalling in this respect the richest districts of the Himalayan region, of which, in fact, it is a continuation.—Mr. H. M. Bernard then gave an abstract of a paper on the relation of the Acaridæ to the Arachnida, in which he argued that the former were fixed larval forms of the latter; though he found a difficulty in dealing with the segmentation, this being so profoundly modified and in some cases lost. The paper was criticized by Mr. A. D. Michael, Mr. Breeze, and Prof. G. B. Howes, all of whom, while testifying to the ingenuity of Mr. Bernard's reasoning, considered that there was hardly as yet sufficient evidence to justify the acceptance of his conclusions.

May 5.—Prof. Stewart, President, in the chair.—On behalf of Mr. Holt, Prof. G. B. Howes exhibited and made remarks on a very interesting collection of the metamorphosing larvæ of flat-fish.—Mr. Curtis showed a photograph of sections of the Silver and Douglas firs, illustrating the relative rate of growth in trees of the same age growing in the same soil and under similar conditions in all respects, the diameter of the one (*A. Douglasii*) being nearly double that of the other. —Mr. George Murray exhibited spirit specimens of *Ascothamnion intricatum*, an organism described as a siphoneous Alga, but ascertained to be identical with an animal—namely, *Zoobotryon pellucidum*, Ehrenberg. He also exhibited two specimens of a palm (*Thrinax Morrisii*, Wright), peculiar to Anguilla in the Leeward Islands, and made some remarks as to the results of the recent cryptogamic collections made by Mr. W. R. Elliott for the West India Committee.—Mr. Holmes exhibited and made some observations on an abnormal development of the calyx in a primrose.—The President exhibited and explained a collection of Lepidoptera containing several examples of mimicry between protected forms.—On behalf of Dr. J. Müller, Mr. Thiselton Dyer communicated a paper entitled "Lichenes Epiphylli Spruceani."—Mr. W. F. Kirby gave an abstract of a paper on the family *Saturnidæ*, with descriptions of new species in the British Museum.—In the absence of the author, Mr. W. Percy Sladen read a paper by the Rev. Hilderic Friend, entitled "Observations on British Earthworms."—The President announced that the anniversary meeting of the Society would be held on May 24, at 3 p.m.

Royal Microscopical Society, April 20.—The President, Dr. R. Braithwaite, in the chair.—Mr. A. W. Bennett called attention to some slides received from Prof. D. P. Penhallow, of Montreal, who sent them to illustrate an improved method of labelling. Instead of writing upon the usual paper label, he writes directly upon the glass, and covers the writing afterwards with a thin coating of Canada balsam, which makes it permanent. —Prof. F. Jeffrey Bell said that, the Council having concluded the negotiations with their landlords, the rooms of the Society would now be open for the use of the Fellows every Wednesday evening from 6 to 10 p.m., from November till June. This order would take effect at once.—Mr. F. Chapman's paper onthe Foraminifera of the Gault of Folkestone was read.—Surgeon P. W. Bassett-Smith's paper on the deep-sea deposits of the Eastern Archipelago was read by Prof. Bell. H.M.S. *Penguin*, to which Surgeon Bassett-Smith was attached, made a passage during the latter part of 1891 from Port Darwin, North-west Australia, through the Arafora, Banda, Celebes, Sulu, and China seas to Hong Kong. A continuous and close line of soundings was taken through the whole passage, the deepest water being 2880 fathoms in the Banda Sea. In almost every instance specimens of the bottom were obtained. They consisted mostly of "green muds," with a few "blue" and "brown muds" in the deeper parts. The definition of "green mud" is a very wide one; broadly it may be divided into that in which calcareous organisms, chiefly Globigerina, predominate, and that in which the tests of Radiolarians have taken their place; this latter condition was almost always present in "brown muds." The inorganic materials were either fine quartz sand in the deeper and more distant positions, or, as the coast was approached, argillaceous matter together with sponge spicules and small shells. In places the material was typically volcanic, as in the upper part of the Banda Sea, among the Moluccas, and on the coast of Luzon. Only two specimens of pure Globigerina ooze were obtained, both being in the Molucca passage, one in 1885 fathoms and the other in 197 fathoms. It would seem that in the deeper parts of the seas the bottoms consist of Radiolarian muds, and the shallower parts of Globigerina muds, the line being roughly drawn at 1500 fathoms. In almost every case over 2000 fathoms the siliceous organisms were undoubtedly most abundant.—A note was read from Dr. E. Giltay on the use of the camera lucida in drawing Bacteria, in which he recommended the illumination of the drawing by a powerful lamp, and the testing of the drawing by a slight change in the position of the paper, so as to compare side by side the drawing made and the camera lucida outline. Dr. Giltay stated he had succeeded in drawing objects magnified 2500 times. Mr. A. D. Michael thought the method of comparison would be likely to produce distortion.—Prof. Bell said a note had been received from Mr. J. C. Wright on some rotifers which he had found attached to a newt. The accompanying drawings did not render it sufficiently clear that what he had found were really rotifers, and he suggested they were Vorticellæ. —A note from Mr. W. M. Osmond was also read, descriptive of a new cheap photomicrographic stand. Dr. W. H. Dallinger thought that though it might be useful for low-power work, he doubted if it would be of value for high or even moderate powers. He should be afraid that there would be too much vibration. Mr. C. L. Curties said he should be sorry to use it for anything beyond a half-inch objective.

Geological Society, April 27.—Prof. J. W. Judd, F.R.S., Vice-President, in the chair.—The Chairman announced that the Organizing Committee of the International Geological Congress have arranged to convene the sixth meeting of the Congress at Zürich, about the commencement of September 1894. Any communications should for the present be addressed to Prof. E. Renevier, University, Lausanne.—Prof. W. C. Williamson, F.R.S., exhibited the following specimens: slab of Carboniferous Limestone from Bolland, illustrating the passage of a foraminiferal ooze into crystalline calcite; *Asteropecten Orion*, Forbes, from the Kellaways rock, near Pickering, Yorkshire; and made the following remarks:—The specimen before me is a slab of Carboniferous Limestone from the Bolland district of West Yorkshire. In its centre is a magnificent section of a large Nautilus—beautiful as a fossil, but still more important because of what it teaches. Its large terminal chamber is filled with foraminiferal ooze, the component objects of which are almost as perfect as when the organisms were living. The surrounding limestone is chiefly in an amorphous state; but it contains innumerable evidences that it also consists of foraminiferal ooze, largely reduced to the amorphous state by the agency of carbonic acid, now known to be so abundant in the depths of the ocean. The action of this acid upon the minute calcareous shells necessarily converted the water into a solution of carbonate of lime. In this state it percolated by osmosis through the shell of the Nautilus, penetrating its closed chambers, which it gradually filled with calcareous spar. The specimen is thus an epitome, within its limited area, of what has taken place on a gigantic scale in the deep sea. We have here first the organic mass, next its conversion into amorphous limestone, and lastly the production of the crystalline state of the same, so frequently seen filling the interiors of fossils. The second object is the original type-specimen of Forbes's *Asteropecten Orion*, from a sandstone bed of the Kellaways rock in the neighbourhood of Pickering, in Yorkshire. This starfish had lived upon and became buried in a sandy matrix which contained no lime. When the rock was split open, the space originally occupied by the starfish was hollow; the sand contained no soluble material, like that which filled the chambers of the Nautilus. But in the lowest beds of the Coralline Oolite at Filey Brigg, on the Yorkshire coast, we long ago found another species of starfish closely allied to the Pickering species. This was embedded in calcareous stone, which had once in all probability been foraminiferal ooze, and the processes which filled the chambers of the Nautilus also filled the cavity left by the decay of the starfish with crystalline carbonate of lime. These specimens, studied collectively, illustrate two of the most important and common of the processes by which the mineralization of fossil remains has been effected.—The following communications were read:—Notes on the geology of the Northern Etbai or Eastern Desert of Egypt, with an account of the emerald mines, by Ernest A. Floyer. The principal feature in the district is a long ridge of igneous upthrust running north north-west and south-south-east, in which porphyry rises into lofty peaks, whilst the lower parts are formed of granites and sedimentary rocks. To the west of the watershed, sedimentary rocks occur dipping slightly to the west. The following succession of rocks in descending order is given by the author: limestone, sandstone, clay, "cataract"-rock (corresponding to the *Stock-granit* of Walther), and compact hard granite. The sedimentary rocks are frequently metamorphosed, and the author states that every stage of metamorphism is shown, from sandstone to compact green granite. The blue clay shows various kinds of metamorphism, and forms the pistachio-breccia containing topazes, and the mica-schist, mica-slate, and talcose blue clay of the mass of Zabbara containing emeralds. The author discusses certain theoretical questions, and considers that the erosion of the valleys does not indicate the existence of a greater rainfall than the present one. He concludes by giving an account of the emerald mines. The reading of this paper was followed by a discussion, in which Prof. Hull, Prof. Le Neve Foster, Mr. Rudler, Mr. J. W. Gregory, and Dr. Blanford took part.—The rise and fall of Lake Tanganyika, by Alex. Carson (communicated by R. Kidston). In this paper attention is called to certain recorded discrepancies concerning the discharge of Tanganyika by the Lukuja. It is suggested that the rise of the lake is due to the blocking-up of the river by vegetation, assisted by silting during the first rains, whilst the fall is produced by the destruction of the barrier formed in this manner.

Zoological Society, May 3.—Prof. W. H. Flower, F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of April, 1892, and called attention to a finely-marked Owl (*Pseudoscops grammicus*) from Jamaica, presented by the Jamaica Institute, being the first example of this Owl that has reached the Society.—Mr. Sclater exhibited and made remarks on a fine specimen of the egg of *Æpyornis*, the extinct giant bird of Madagascar, obtained from Southern Madagascar, and brought to this country by Mr. Pickersgill, H.B.M. Vice-Consul at Antananarivo.—Mr. Oldfield Thomas read a paper on the probable identity of certain specimens formerly in the Lidth de Jeude collection, and now in the British Museum, with those figured by Albert Seba in his "Thesaurus" of 1734.—Mr. F. E. Beddard read some notes on various species of aquatic Oligochætous Worms that he had lately had an opportunity of examining. Amongst these was a new form allied to *Acanthodrilus* from the saline waters of the Pilcomayo, discovered by Mr. Graham Kerr during the Pilcomayo expedition.—Dr. Hans Gadow read a paper on the systematic position of *Notoryctes typhlops*, the newly-discovered Mammal of Central Australia, and came to the conclusion that this anomalous form should stand as a distinct family of Polyprotodont Marsupials, allied to the Dasyuridæ and the Peramelidæ.—A communication was read from Captain H. G. C. Swayne, R.E., containing field-notes on the Antelopes of Northern Somali-land. —Mr. W. Schaus read the second portion of his descriptions of new species of Lepidoptera Heterocera from Brazil, Mexico, and Peru.—Mr. W. L. Sclater read some notes on certain specimens of Frogs in the Indian Museum, Calcutta, and gave descriptions of several new species based upon some of these specimens.

Entomological Society, May 11.— Frederick DuCane Godman, F.R.S., President, in the chair.—The President announced the death, on May 4, of Dr. C. A. Dohrn, of Stettin, one of the ten Honorary Fellows of the Society. Mr. Stainton, F.R.S., expressed regret at the death of Dr. Dohrn, whom he had known for a great number of years, and commented upon his work and personal qualities.—Dr. D. Sharp, F.R.S., exhibited drawings of the eggs of a species of Hemiptera, in illustration of a paper read by him before the Society; and also a specimen of a mosquito from the Amazon district, with the body, legs, and palpi furnished with scales as in Micro-Lepidoptera.—The Rev. Canon Fowler, on behalf of Mrs. Venables, of Lincoln, exhibited cocoons of a species of *Bombyx* from Chota Nagpur, India; also the larvæ-cases of a species of Psychidæ, *Cholia crameri*, from Poona, India; and a curious case, apparently of another species of Psychidæ, from the island of Likoma, Lake Nyassa.—Mr. F. W. Frohawk, on behalf of the Hon. Walter Rothschild, exhibited a specimen of *Pseudacræa miraculosa* mimicking *Danais chrysippus*; also a specimen of the mimic of the latter —*Diadema misippus*—and read notes on the subject.—Mr. C. G. Barrett exhibited, and commented on, a long series of specimens of *Melitæa aurinia* (*artemis*) from Hampshire, Pembrokeshire, Cumberland, and other parts of the United Kingdom; also a long and varied series of *Coremia fluctuata*.—Mr. H. Goss exhibited, for Mr. W. Borrer, Jun., of Hurstpierpoint, a photograph of a portion of a nest of *Vespa vulgaris* which had been built with the object of concealing the entrance thereto and protecting the whole nest from observation. He also read notes on the subject, which had been communicated to him by Mr. Borrer.

—The Hon. Walter Rothschild communicated a paper entitled "Notes on a collection of Lepidoptera made by Mr. William Doherty in Southern Celebes during August and September, 1891." He also sent for examination the types of the new species described therein.—Dr. Sharp read a paper entitled "On the eggs of an Hemipterous Insect of the family *Reduviidæ*. Mr. McLachlan, F.R.S., Mr. Poulton, F.R.S., and Mr. Hampson made some remarks on the subject.

Mathematical Society, May 12.—Prof. Greenhill, F.R.S., President, in the chair.—The following communications were made:—A Newtonian fragment on centripetal forces, by Mr. W. W. Rouse Ball. The demonstrations given by Newton in his "Principia" are geometrical, though there is little doubt that in establishing the truth of some of his results he used fluxions (cf. the "Commercium Epistolium," Rigaud's "Essay on the first publication of the 'Principia,'" and Brewster's "Life of Newton"). To his contemporaries the language and methods of geometry were familiar, while to most of them the calculus was unknown; hence it was natural and reasonable that the proofs should be presented in a geometrical form. It is probable that the fluxional analysis by which a result was obtained was generally thrown aside as soon as a synthetic geometrical proof had been found; apparently the only proposition in the book of which Newton's fluxional demonstration has been published is his determination of the form of the solid of least resistance, of which the result alone was given in Book ii., Scholium to Prop. 35 (first edition). Among the numerous sheets of rough work and calculations which are preserved in the Portsmouth collection is a fragment on the law of centripetal force under which any orbit, and particularly a parabola of any order, can be described. The theorem to which the analysis leads is so inconvenient of application as to be practically useless, and probably for that reason was not inserted in the "Principia." Such interest as it possesses lies rather in its illustrating the way in which Newton arrived at the law given (in the paper) for the description of any parabola under a central force. The date of the fragment is put "about the year 1694," when we know that Newton was engaged in revising the first edition of the "Principia."—On an operator that produces all the covariants and invariants of any system of quantics, by Dr. W. E. Story.—Applications of a theory of permutations in circular procession to the theory of numbers, by Major MacMahon, F.R.S.

OXFORD.

University Junior Scientific Club, March 18.—Mr. J. A. Gardner, Magdalen College, President, in the chair.—A paper was read by Mr. J. E. Marsh, Balliol College, on variations in the rotatory power of turpentine oil. This was chiefly given up to the consideration of the probable explanation of the phenomenon. The experiments were described at length in the Journal of the Chemical Society some months back.—Mr. T. H. Butler, of Corpus Christi College, read a paper on poisons, chiefly in relation to their physiological action.—Mr. H. Balfour, of Trinity College, exhibited a whaling cross-bow from Greenland.—Mr. F. Britten, of Christ Church, exhibited a specimen of incrustation.

March 30.—Mr. J. A. Gardner, President, in the chair.—Mr. E. B. Poulton, F.R.S., read a paper on a further investigation of the degenerate scales of Lepidoptera with transparent wings, which was illustrated by the magic lantern.—Mr. O. V. Darbishire, Balliol College, read a note on karyokinesis, illustrated by microscopical preparations.—A note was read by Mr. R. S. Hughes, Jesus College, on the action of dried hydrogen sulphide on magnesia.

DUBLIN.

Royal Dublin Society, April 20.—Sir Robert Ball, F.R.S., in the chair.—The following communications were made:—On a new mercury-glycerine barometer, by Dr. J. Joly. This barometer has the full range of the glycerine barometer. The total length of the tube is, however, only 250 cms. about. This result is attained by weighting the glycerine in the tube by a column of mercury 67 cms. in length. By means of a float in the mercury which pulls a disk, loosely fitting the tube, against the base of the column, this is kept from breaking, and falling down through the glycerine. In a uniform tube this column remains of invariable length and moves up and down with the glycerine. The balance of the atmospheric pressure is equilibrated by glycerine drawn from a bath of glycerine. Owing to the short length of tubing traversed by the viscous liquid, the instrument is probably more prompt than the full length glycerine barometer. On the other hand, there appears to be a very slow ascent of the glycerine past the mercury, which will probably necessitate the resetting of the instrument at intervals.—Mr. J. R. Wigham read a paper explanatory of the new "giant" lighthouse lens, the largest ever made, which he exhibited to the meeting. It was constructed for him by Messrs. Barbier and Co., of Paris. Its focal distance is 2 metres, and its axial intensity equal to 800,000 candles. The beam which this lens, in triform, in conjunction with Mr. Wigham's new "intensity" burner, is capable of transmitting to the mariner, has more than five times the power of that of Tory Island, the largest lighthouse light in the world, and is much more efficacious in penetrating fog than the most powerful electric light.—Dr. G. Johnstone Stoney, F.R.S., read a paper on the cause of the absence of hydrogen from the earth's atmosphere, and of water and air from the moon. In this communication reference is made to the conditions that determine the height of an atmosphere upon any celestial body. These had been announced by the author in a paper "On the Physical Constitution of the Sun and Stars," printed in the Proceedings of the Royal Society for 1868; and in the present paper it is pointed out that the same method of investigation shows that under certain circumstances some of the constituents of an atmosphere may, molecule by molecule, wander off into space. This event occurs with more readiness—(1) the lower the mass of the molecules of the gas; (2) the feebler the attraction downwards at the boundary of the atmosphere; (3) the higher the temperature at the boundary of the atmosphere. By investigating the conditions that prevail on the earth and moon, it is shown that free hydrogen could not remain a constituent of the earth's atmosphere; and that no free oxygen, nitrogen, or the vapour of water, could remain on the moon. Hence, even if there were no oxygen present, the earth's atmosphere could not retain free hydrogen; and on the moon there is now neither atmosphere, such as we know it, nor water, nor ice. It follows from the investigation that space must be peopled with vast numbers of wandering gaseous molecules, especially of the lighter gases, and that these tend ultimately to settle down upon such of the more massive bodies of the universe as are sufficiently dense to exercise a powerful attraction at their surface. Finally, the investigation indicates conditions which must be fulfilled by any "nebular hypothesis" in order that it may be admissible.—A list of Irish Rotifers, with descriptions of twenty-five new species, by Miss Glascott, was communicated by Prof. A. C. Haddon.

PARIS.

Academy of Sciences, May 9.—M. d'Abbadie in the chair.—Photographs of solar prominences taken by M. Deslandres at Paris Observatory, by M. Mouchez. This is a brief statement of the work that is being done at Paris on the dimensions and velocities of solar prominences. By the methods employed the radial velocity can be determined within about a kilometre per second. Some of the photographs obtained were presented by M. l'Amiral Mouchez to the Academy. It is proposed to make a continuous record of the movements of the solar atmosphere as soon as the necessary funds are obtained.—On the propagation of Hertz oscillations, by M. H. Poincaré.—On residual life and the products of the action of separate tissues of living beings, by MM. A. Gautier and L. Landi. After a healthy animal has been killed, a considerable interval elapses before the death of the tissues. This action after the death of the body as a whole is termed "*la vie residuelle*" by the authors. They have investigated the changes that go on by analyzing flesh freshly killed and otherwise, and comparing the results.—On entire functions of the form $e^{G(x)}$, by M. Hadamard.—A theorem on harmonic functions, by M. G. D. d'Arone.—On the determination of the moment of the torsion couple of a unifilar suspension, by M. C. Limb.—Action of potassium cyanide on ammoniacal copper chloride, by M. E. Fleurent. By heating together in sealed tubes potassium cyanide, cupric chloride, and ammonium chloride, the author has succeeded in forming the compounds, (1) $2Cu_2Cy_2 . AmCy . 2NH_3 . 3H_2O$, forming long blue needles, very unstable; (2) $2CuCy_2 . Cu_2Cy_2 . 2NH_3 . 3H_2O$, green rectangular plates, quite stable in the air.—Sodium trimethylcarbinol:

thermal value of the replacement of H by Na in a tertiary alcohol, by M. de Forcrand.

$C_4H_{10}O$ sol. + Na sol. = H gas + C_4H_9ONa sol. . . . +27·89 cal.

For secondary and primary alcohols the values are respectively +29·75 and +32·00 cal.—Establishment of the fundamental formulæ for the calculation of maximum moments of inertia (of molecules), by M. G. Hinrichs.—The constitution of the hydrocarbon derived from perseïte, by M. L. Maquenne.—The chemical properties and analysis of acetyl fluoride, by M. Maurice Meslans. (See Notes.)—The acid antimonite of pyrocatechol, by M. H. Causse.—Action of organic acids on acetylenic hydrocarbons, by MM. A. Béhal and A. Desgrez.—On the stranding of a whale mentioned in the 113th Olympiad, by M. G. Pouchet.—On the physiological constitution of the tubercles of potatoes in relation to the development of shoots, by M. A. Prunet.—On the old glaciers of the Cordilleras of Chili, by M. A. G. Noguès.—On the genus *Megapleuron*, by M. Léon Vaillant.—On a Dicotyledon found in the Upper Cretaceous on the environs of Sainte-Menehould (Marne), by M. P. Fliche.

AMSTERDAM.

Royal Academy of Sciences, April 29.—Prof. van de Sande Bakhuyzen in the chair.—Mr. Behrens dealt with the microscopic structure of alloys. Crystallization is a common phenomenon in metals. The least crystalline are pure Al, Cu, Ni, when cast without overheating. Rapid cooling has no other effect than to make the crystals of smaller size. Pure Ag does show always crystallization, if properly etched. In alloys crystallization is more easy and perfect than in unalloyed metals. When 1 gr. of Cu, alloyed with 2 mgr. Ag, is melted and slowly cooled, it will be found chequered by minute threads of an alloy rich in silver. All types of structure found in crystalline rocks can be reproduced in alloys. The most common is rectangular wickerwork, less common are isolated clusters of crystals (alloys with few crystals of high melting-point, as in Zn + 10 per cent. Pt, Cu + 10 per cent. Co). Mechanical stress does not destroy the crystalline structure. A fibrous or lamellar structure is set up, corresponding with planes of sliding or shearing in inter-crystalline matter, and under heavy stresses partly due to flattening and stretching of crystals. By annealing, alloys of Cu with Ni can be made to crystallize even as soft iron, thereby becoming even brittle.—Mr. Schoute treated of movement in space of *n* dimensions.—Mr. Bakhuis Roozeboom treated of the hydrates of iron perchloride.—Mr. Kapteyn made a communication on the distribution of the stars in space. He has compared the spectral type of stars of different proper motion. For this latter element the list given by Mr. Stumpe in the *Astr. Nachr.*, Nos. 2999–3000, was used; the spectral types were taken from Mr. Pickering's "Draper Catalogue." 476 stars not fainter than 7·0m. were found common to the two catalogues. Together with these, 115 other well-determined stars were used, taken from Bradley's catalogue, whose proper motion according to Auwers's reduction is less than 0·003s. in R.A., and less than 0″·03 in Decl. This material, arranged according to the amount of the proper motion, leads to the following conclusion:—The region of the universe nearest to our planetary system contains nearly exclusively stars of the second type (Pickering's Cl. E–L); with growing distances the number of stars of the first type (Pickering's Cl. A–D), relatively to the number of those of the second type, increases gradually and approximately in inverse ratio with the proper motion (*i.e.* very probably in direct ratio with the distance) in such a way that equality of number is reached at a distance corresponding to a proper motion of 0″·08 or thereabout. At distances still greater, the stars of the first type begin to preponderate, and they are more than twice as numerous as those of the second type at the mean distance of those of Bradley's stars, whose proper motion is insensible. From the differences between visual and photographic magnitudes Mr. Kapteyn shows that analogous results will most probably be found for the southern hemisphere as soon as a catalogue of southern star spectra is published. The investigation further indicates, though far less clearly, for the centre of symmetry of the system, a situation at a certain distance from the sun in the direction of 23 hours of R.A. Lastly, it is demonstrated that, even for distances corresponding to proper motion of 0″·16 to 0″·30, no accumulation of stars towards the plane of the Milky Way is shown; that for distances considerably greater this accumulation cannot be considerable, and that the Milky Way must be attributed therefore to stars at enormous distances.—Mr. Franchimont communicated an experiment used by him in his College during several years to show that the presence of hydriodic acid is necessary for the formation of iodine starch.

GOTTINGEN.

Royal Society of Sciences.—The following papers of scientific interest have appeared in the *Nachrichten* since November 11, 1891:—

November 11, 1891.—E. Riecke and W. Voigt, the piezoelectric constants of quartz and tourmaline.

November 25.—Franz Meyer, on a persistence-theorem for algebraic equations. Starting from the theorem that, for a cubic equation, the sum of the number of real roots for the cubic and its Hessian together is always three, the author finds for any equation of odd order a series of forms such that the sum of the real roots of the equation and these forms together is always the same.—Otto Bürger, preliminary communication on the *Nemertina* of the Gulf of Naples.—Otto Wallach, on certain new hydrocarbons with a ring of carbon-atoms.

December 23.—Alfonso Sella, contribution to our knowledge of the specific heats of minerals.—Frobenius, on potential functions whose Hessian is zero.—Schönflies, remark on Hilbert's theory of algebraic forms.—Alberto Tonelli, remark on the solution of quadratic congruences.—P. Drude and W. Nernst, on fluorescence-effects of stationary light-waves.

January 27, 1892.—Heinrich Burkhardt, the reduction of the twenty-seven lines of a cubic surface to the transformation problem of the hyper-elliptic functions for $p = 2$.—David Hilbert, on the theory of algebraic invariants.—Clemens Hartlaub, on the *Anthomedusæ*.

March 9.—J. Disse, changes in the renal epithelium during secretion.—Kroeker, the dependence of the specific heat of boracite upon the temperature.

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