THURSDAY, DECEMBER 26, 1889.

RECENT ORNITHOLOGICAL WORKS.

Notes on Sport and Ornithology. By His Imperial and Royal Highness the late Crown Prince Rudolph of Austria. Translated, with the Author's permission, by C. G. Danford. Pp. i.–viii., 1–648. (London: Gurney and Jackson, 1889.)

Matabele Land and the Victoria Falls. A Naturalist's Wanderings in the Interior of South Africa. From the Letters and Journals of the late Frank Oates, F.R.G.S. Edited by C. G. Oates, B.A. Second Edition. Pp. i.–xlix., 1–433. (London: Kegan Paul, Trench, and Co., 1889.)

Index Generum Avium. A List of the Genera and Subgenera of Birds. By F. H. Waterhouse, A.L.S. Pp. i.–v., 1–240. (London: R. H. Porter, 1889.)

The Birds of Oxfordshire. By O. V. Aplin. With a Map. Pp. i.–vii., 1–217. (Oxford: Clarendon Press, 1889.)

The Birds of Berwickshire; with Remarks on their Local Distribution, Migration, and Habits, and also on the Folk-lore, Proverbs, Popular Rhymes, and Sayings connected with them. By George Muirhead, F.R.S.E. Vol. I., pp. i.–xxvi., 1–334. (Edinburgh: David Douglas, 1889.)

The Birds in my Garden. By W. T. Greene, M.A., M.D. (London: Religious Tract Society, 1889.)

NO naturalist can peruse the pages of the handsome volume which contains the record of the sporting journeys of the late Crown Prince Rudolph, without sincere feelings of pity and regret. Here was a young man, whose scientific instincts were of the truest, and for whom, in every way, a splendid future might have been predicted, whose opportunities for the advancement of science were unlimited; and it is most sad that so promising a life should have been cut short by the decrees of fate. One-third of the volume before us is devoted to "Fifteen Days on the Danube," and the narrative affords a striking experience among the varied forms of bird-life which are to be met with on that famous river in April. This is a really valuable sketch of the ornithology of the district, and will be useful to everyone who is interested in the distribution of European birds. The same may be said of the chapters entitled "Sketches of Sport in Hungary" (pp. 391–98), "Miscellaneous Notes on Ornithology" (pp. 409–54), "Ornithological Sketches in Transylvania" (pp. 559–72), and the various "Ornithological Notes" from the neighbourhood of Vienna, &c. Throughout the work the great affection which the author entertained for the birds of prey is manifested, and the "Ornithological Sketches from Spain" (pp. 455–502), are entirely devoted to Raptorial birds, as are also many other chapters in the book. Prince Rudolph thoroughly believed in the races of Golden Eagle (*Aquila chrysaëtus*), which are admitted by A. E. Brehm and other Continental authors. The "Stein" Eagle is generally supposed to be a distinct bird from the true Golden Eagle, and we remember how the Crown Prince overhauled the series of specimens in the British Museum, and pointed out the differences between the supposed races; but when the discussion was over, we could only see that the "Stein" Eagles consisted mostly of immature birds, while the "Golden" Eagle was represented by the older birds in the collection, the alleged difference of habitat being due to the fact that the more lowland country frequented by the "Stein" Eagle was due to their being driven from the mountain eyries by the older birds. The discussion of many points by the Crown Prince on his visit to the British Museum was sufficient to show what a thoroughly sound ornithologist he was. Mr. Danford has done his work as a translator with evident care and a sympathetic knowledge of his subject. Over much of the ground traversed by the Prince the translator has also travelled, and he has evidently fully appreciated the enthusiasm of the author. In the "Ornithological Sketches from the East," wherein are detailed the results of the Crown Prince's journeys in Egypt and Nubia, and afterwards in Palestine, we notice several identifications which strike us as remarkable, and which we believe to be wrong. Was not *Falco feldeggii*, the Lanner Falcon, the species identified by the Prince as *F. barbarus? Acrocephalus turdoides* (p. 513). Surely this is *A. stentoreus? Certhilauda duponti*, "seen in considerable numbers, but only among the bushes and scattered pastures of the islands near the Barrage of the Nile." We should like some confirmation of such an eastward extension of this Algerian bird's range. Generally, however, the nomenclature is good, though slightly Brehmian in character, and Mr. Danford has detected some obvious errors, though the above statements appear to have escaped him.

The late Mr. Frank Oates was a young naturalist who travelled in South Africa in 1873, 1874, and 1875, and died from fever in February of the latter year after his return from the Zambesi. He was a fine specimen of the English traveller, devoted to the pursuit of natural history, and gifted with indomitable perseverance and pluck. His intention on going to South Africa was to penetrate into the interior beyond the Zambesi, and he seems to have regarded his Matabele journey as but a preliminary to more important explorations. The difficulties, however, of getting to the Victoria Falls were very great, and the traveller only succeeded in reaching this desired goal after four attempts and after excessive difficulties and delays. He seems to have won the friendship of Lobengula, and readily obtained the support of the latter for his expedition, but the inferior chiefs and the natives generally were very troublesome. The narrative shows that at the date of Frank Oates's expedition it was by no means easy to get to the Zambesi, especially when the traveller was bent upon collecting *en route*. He gave himself no rest in his pursuits; and the attack of fever which carried him off at the very time when one of his brothers was on the way to join him in the interior was doubtless accentuated and rendered fatal by his untiring devotion to work, which seems to have been one of his most pronounced characteristics. After the traveller's death, a friend, Mr. Gilchrist, went into the interior and brought down all Oates's effects and his natural history collections, and the story of the expedition was originally told by his brother, Charles Oates. The collections were worked out by different naturalists, and the whole results embodied in appendices which were, moreover, thoroughly well illustrated. Scarcely had the book appeared and met with a cordial appreciation from the public, when a fire at the publishers' destroyed the whole of the unsold copies; and now, after a lapse of some years, Frank Oates's brother and faithful biographer, Charles Oates, has brought out a second edition. Although the necessity of residing abroad has prevented the latter from finishing his labour of love before the present year, the work has lost nothing in consequence. The narrative must always remain of value as a simple record of a naturalist's journey, and the maps of the route are laid down with a fidelity and minuteness not to be exceeded if the traveller had been on a cycling tour instead of in the wilds of Matabele Land, while the lapse of time has enabled the authors of the various appendices to give additional information, to correct errors, and generally to bring their work up to date. Several species undetermined in the first edition have now been identified and described, new plates have been added, and the results as now given to the public by Mr. Charles Oates form a very material and valuable contribution to our knowledge of the natural history of Southern Africa, with the development of which the name of Frank Oates will be for ever connected. All the authors of the various appendices—the late Prof. Rolleston (to whose memoir Mr. Hatchett Jackson, of the Oxford Museum, has added some further information), Prof. Westwood, Mr. Distant, Mr. Olliff, and Mr. Rolfe—seem to have been actuated by a desire to work out the collections intrusted to them for description with the utmost care; and the present writer can only say that the writing of the ornithological portion of the volume was not only a pleasing task, but took the form of an absolute duty to do justice to the memory of the traveller, and to aid Mr. Charles Oates in his fraternal enthusiasm for his brother's fame. Would that every traveller in the Dark Continent attached as much importance to its natural history as did Frank Oates, and that the work of each one was edited by a loving friend, possessed of a desire to place on record the scientific results of the expedition, as has been done in the present work, so that volumes of travel, important as they are, might be rendered still more valuable by biological appendices such as are to be found in Oates's "Matabele Land."

Mr. F. H. Waterhouse, the well-known Librarian of the Zoological Society, has just issued a very useful book, which supplies a great want. The splendid library under his charge has given him the opportunity of personally verifying his references, and many inaccuracies which had been copied from one author to another are herein set right. He has applied himself so diligently to his task, that we believe that about 500 names, of which the origin was obscure, have been traced by the industrious author to their original source, and this fact alone should commend the work to the attention of every working ornithologist. It should be mentioned, however, that Mr. Waterhouse does not pretend to be a practical ornithologist, and he has been dependent to a great extent upon the *Zoological Record* for recent additions. As the volume for 1887 appeared only while the present work was going through the press, several new genera proposed in that year do not find a place in Mr. Waterhouse's book, and therefore the student who interleaves his copy must begin with the *Record* of 1887 if he wishes to have a complete "catalogue" of ornithological generic names.

Of the making of county lists of birds there is apparently no end, and "a good job too!" Little by little, enthusiastic observers are compiling ornithological lists for the different counties of the British Islands, and by these means alone can we hope to obtain a thoroughly accurate knowledge of the distribution of the birds of Great Britain. Mr. O. V. Aplin has long been known to us as an excellent observer, and we hope that the success of his first work, the results of several years of assiduous labour, will encourage him to still more ambitious efforts. The somewhat irregular shape of the county of Oxfordshire, and its generally narrow diameter, preclude the anticipation of a very varied avifauna; but the record of 242 species for the district is by no means bad, and some very interesting notes are given, the principal rarity being the Alpine Chough, of which the only British occurrence has taken place in Oxfordshire, and of which a good plate, by Mr. S. L. Moseley, is given. One of the most inviting features of Mr. Aplin's book is its conciseness. In the capital introduction he gives a very complete account of the configuration of the county and its natural features, all of which can be easily studied with the aid of the excellent map which accompanies the work.

A more ambitious volume is Mr. Muirhead's "Birds of Berwickshire," which is got up in a Bewickian style, as a book matured in such close proximity to Northumberland should be. Mr. Muirhead's book is a complete exemplification of that better style of county record which has been the order of the day during recent years, when a sober statement of facts of distribution and habits has taken the place of strenuous efforts to record rare, and often impossible, visitants. After an introduction which deals with the physical features of the county, aided by a very clear map, the author gives an account of the birds, from the Thrushes to the end of the Accipitres. The accounts of these birds not only contain ample, yet concise, information, but are interspersed with poetry, of a Scottish and local flavour, which successfully combats any notion of dulness, while the folk-lore of the district appears to have special attractions for the author. In some instances, notably that of the Rook, very full details of the breeding-haunts are given in tabular form. It is interesting to note how, on the border-lands, some species have increased in numbers, and have gradually extended their range towards Scotland. The illustrations of nests are drawn by Mrs. Muirhead, and very good they are; and the book is replete with woodcuts by Mr. John Blair, aided by some excellent reproductions of etchings by W. D. M'Kay, R.S.A., and other well-known artists. We trust that in the second volume Mr. Muirhead may be tempted to give us a few details respecting some of the places illustrated in the text, that his readers may share the evident pleasure with which he has illustrated some of the interesting localities of Berwickshire.

Dr. W. T. Greene's little work, "The Birds in my Garden," is an entertaining idyll of a London suburb. Many of the author's experiences agree with our own, and such a book as the present is just the one to encourage a love for the birds which are still to be seen in the vicinity of London, although, as the operations of the builder are extended in every direction year by year, their number gradually, but surely, diminishes. Where Dr. Greene writes from his own experience, he is always worth listening to, but he has a faith in Morris, which, as might be expected, often leads him awry. He quotes from the Bible about the "Sparrow" on the house-top (p. 13), but the bird alluded to is the Blue Rock Thrush (*Monticola cyanea*), for which cf. Canon Tristram's "Fauna and Flora of Palestine" (p. 31). The illustration on p. 23 is not that of the common Sparrow, but of the Tree-sparrow. At p. 46 he gives a tabular list of characters by which to distinguish the Missel-thrush from the Song-thrush, in which the former bird is said to have "no song to speak of." Evidently, Dr. Greene has never heard a "Storm-cock" in full swing. He does not love the Greenfinch, but this need not lead him to say that the species likewise "has no song." A cock Greenfinch, perched on the top of a tree in the nesting season, and singing to his mate sitting on the nest below, has a charming and varied song, like that of a very powerful Canary. The Whitethroat, of which Dr. Greene appears to know only one species, is placed in the sub-family *Motacillidæ*, and it will surprise many ornithologists to hear that the song of the Chiff-chaff is continued even till late in September (this information is derived from the Rev. F. O. Morris !). The Blackcap does *not* winter in Eastern Africa, and it can hardly be said that the Siskin "rarely nests in this country." We mention these points at the risk of appearing hypercritical, but we recognize in Dr. Greene an author who has the knack of writing good natural history books for the young, and it is therefore the more incumbent upon him to be scrupulously accurate. Let him discard Morris, and stick to Seebohm's "History of British Birds," or to the new edition of "Yarrell." Some pretty illustrations by Mr. Whymper form an additional attraction to his little book.

R. BOWDLER SHARPE.

DESCARTES.

History of Modern Philosophy. "Descartes and his School." By Prof. Kuno Fisher. Translated by J. P. Gordy, Ph.D., and edited by Noah Porter, D.D., LL.D. (London: T. Fisher Unwin, 1887.)

AMONG the many histories of modern philosophy few are so interesting and attractive as that by Prof. Kuno Fisher. The present volume consists of a translation of the third revised German edition, which includes the period of Descartes and his school; and the admirable way in which the author deals with so difficult a subject and his boldness in overcoming it are worthy of the highest praise.

The book is divided into three parts, the first of which is preceded by an introduction to the subject, showing the course of development of the Greek philosophy and that of the Middle Ages, with an account of the early history of Christianity and the Church, concluding with the periods of the Renaissance and the Reformation.

In Part I. we have an account of the early history of Descartes. He was born in the year 1596, a few days before the death of his mother, and was a weak and sickly child. Throughout his childhood he showed a strong desire for knowledge, and it was on this account that his father called him his "little philosopher."

Descartes was among the first pupils in the new school that was started at the Royal palace at La Flèche by Henry IV.; at the age of seventeen he was committed to the care and tutorage of Father Dinet. During his school life he was among the chosen pupils who, on June 10, 1610, solemnly received the heart of the king, which, by Henry's will, was to be buried in the church of La Flèche.

While going through a two years' course on philosophy, he became completely fascinated by mathematics, and was thereby incited to make a further study of it; and later on in life, seeing the true spirit of mathematics as a method of solving problems, he began by algebraical equations to solve geometrical problems, and thus to him is due the discovery of analytical geometry. On the completion of his school career, the state of his mind may be gathered from his own words—". . . I found myself involved in so many doubts and errors, that I derived no other result from my desire of learning than that I had more and more discovered my own ignorance."

The next few years of his life were spent in military service in Holland and Germany, after which, at the age of five-and-twenty, he travelled for nine years; to him his travels were studies in the great book of life, and during them he "did nothing but wander now here, now there, since I wished to be a spectator rather than an actor in the dramas of the world." The last period of his life consisted of the development and publication of his works, and the founding of a school of philosophy, concluding with his illness and death during his stay in Stockholm, to which place he was invited by Christina, then Queen of Sweden, who, being deeply interested in his works, found the difficulties in his system could better be explained by Descartes himself than by anyone else.

Although the philosophy of Descartes treats of the whole realm of Nature, we will here touch only upon those parts that are interesting to us from the scientific point of view. Not by any means the least important is his attempt to explain the origin of the world by purely mechanical laws. He bases his theory on the rest and motion of solid and liquid bodies, and the influence of the latter upon the former. Before entering upon this hypothesis, the mechanical principle of his explanation of Nature is first brought before us. He treats motion as a mode of extension, and explains it as the "translation of place (transport) of one part of matter or of one body from the vicinity of those bodies which directly touch it, and are considered at rest, into the vicinity of others."

The causes of motion are next dealt with, showing us that all changes are due to outward collision, and that since space is by no means empty, but is full of bodies moving in every direction, we may get a great number o collisions, the various possible results of which he then goes on to discuss. According to his principles, then, bodies are quite destitute of force, excepting that of resistance; changes in the material world are due to external collisions, and motion, therefore, is due to impacts. Comparing the views of Descartes with those of Galileo and Newton, we cannot do better than quot what the author says on this point:—"Gravity is regarded as . . . . an original property of a body belonging to it of itself. Descartes denies it. Therein consists the opposition between Galileo and Descartes; with gravity he was obliged to reject gravitation and the power of attraction. Therein consists the subsequent opposition of Newton and Descartes; he is, therefore, compelled to deny the so-called central forces, as well as every *actio in distans*."

The two essential pre-suppositions of his hypothesis are the "immeasurableness of the universe and the nullity of empty space. From the first it follows that the universe is not a spherical body, and does not consist in concentric spheres to which the stars are fastened; that there is, therefore, no celestial sphere beyond the farthest planet (Saturn), and that the sun does not lie in the same spherical superficies. From the second, it follows that the spaces of the heavens are filled with fluid matter, and that the heavenly bodies are surrounded by the latter, and subject to its influences."

Descartes supposes the earth to be completely surrounded by this fluid, and "acted upon uniformly in every direction, or carried along by its current, as a solid body in liquid matter. The planets follow also the same rule. Each is at rest in the heavens in which it is, and all the change of place which we observe in those bodies follows from the motion of the matter of the heavens which surrounds them on all sides."

By supposing, again, that this flow of the matter, which surrounds the earth and planets, describes a current "spinning round like a vortex," with the sun in the centre and the earth and planets going round it; he obtains, without considering their weight and attraction, a method by means of which their various motions may be explained. He compares this "vortex" motion of the matter with eddies of water, "as waters when they are forced to a reflux form an eddy, and draw violently within their rotary motion, and carry along with them, light floating bodies, as, for example, straws; as then these bodies, seized by the eddy, turn about their own centre, and those nearer the centre of the eddy always complete their rotation earlier than the more distant ones; as, finally, this eddy always, to be sure, describes a circular figure, but almost never a perfect circle, but extends itself, now more in length and now in breadth, wherefore the parts at the periphery are not equally distant from the centre,—so one can easily see that the motion of the planets is of the same character, and that no other conditions are necessary to explain all their phenomena."

Thus Descartes agrees with Copernicus and Galileo with regard to the heliocentric motion of the earth and planets, although basing his hypothesis on different mechanical laws; he also teaches that the earth is a planet, and rotates on its axis daily, and revolves yearly in an elliptical orbit round the sun.

The author then tells us how Descartes, after the completion of his hypothesis, postponed its publication, on account of the fate of Galileo, and how he (Descartes) expressly stated at the end that "his hypothesis not only may be, but in certain respects is, false." Although he denied the movement of the earth, it was only in a sense that followed from his idea of motion which he applied to the heavenly bodies; for, with reference to the other bodies in the heavens, it does move, but is at rest in relation to the fluid matter around it, or, as the author says, "it moves exactly as a man who is asleep in a ship, while it takes him from Dover to Calais."

In conclusion, we must add that the work of both translator and editor has been honestly done, though, as the above quotation shows, the style of the translator is susceptible of improvement, and that this volume will form a valuable addition to the libraries of students of moral philosophy. To the readers of such a work as this, consisting as it does of so many historical facts, an index is imperative, and we hope in future editions to see one inserted. W. J. L.

A TEXT-BOOK OF ORGANIC CHEMISTRY.

A Text-book of Organic Chemistry. By A. Bernthsen, Ph.D., formerly Professor of Chemistry in the University of Heidelberg. Translated by George McGowan, Ph.D., Demonstrator in Chemistry, University College of North Wales, Bangor. (London: Blackie and Son, 1889.)

THIS work furnishes an excellent elementary account of the principles of organic chemistry. An introduction treating of the general theory of organic compounds, including the subjects of constitution, isomerism, physical properties, &c., is followed by the detailed description of the various classes of compounds and their relations to one another, the fatty compounds being first discussed, and then those belonging to the group of aromatic substances and to the pyridine group. The treatment of the various compounds in "series," all the hydrocarbons of the fatty series—paraffins, olefines and acetylenes—being, for example, fully described before any of their halogen derivatives or of the alcohols are discussed, cannot be commended from the point of view of the novice to the science, for whom the book is avowedly designed. This evil is, however, largely compensated for in the present work by the clear language invariably employed, and more especially by the frequent introduction of semi-diagrammatic tables showing the connection between various related series, such, for example, as the glycols, hydroxy-acids and dibasic acids.

The description of the aromatic compounds, prefaced by a short account of the benzene theory, is grouped about the typical hydrocarbons, benzene and its derivatives being first treated, then diphenyl with its derivatives, triphenyl-methane and its group, naphthalene, &c. Mere description of compounds is sternly and consistently avoided, its place being supplied, whenever possible, by tabulated statements, showing at a glance both the chemical and physical relations of a whole series of derivatives. These tables are a distinguishing feature of the book, and impart to it a clearness and conciseness which will render it welcome to every student.

Abundant references are provided to the original papers concerning subjects which fall without the elementary scope of the work, such as, among many others, the diazo-derivatives of the fatty series, the syntheses of glucosides, and the grouping of atoms in space, which last is treated in language which will perhaps be apt to mislead, and scarcely receives a degree of attention commensurate with its importance.

The translator has performed his work with great success, and he is to be congratulated on the almost complete absence of printers' errors, which so often mar the pages of works of this class. It is to be regretted that he has in some instances neglected to adopt the nomenclature employed by the Chemical Society, since uniformity of usage in this respect is greatly to be desired. An excellent index forms a fitting conclusion to the work, which is sure to take as high a place among the elementary text-books of organic chemistry in the English language as it has already done in the Fatherland.

OUR BOOK SHELF.

The Viking Age; the Early History, Manners, and Customs of the Ancestors of the English-speaking Nations. By Paul B. Du Chaillu. Two Vols. 1366 Illustrations, and Map. (London: Murray, 1889.)

THE author of this work has persuaded himself that the invaders who conquered and settled in Britain after the departure of the Romans were not, as we have been taught to believe, Low Dutch tribes, but Norsemen. It is unfortunate that he should have hampered himself in his researches by so arbitrary a theory. Of course, no one disputes that there is a strong Scandinavian element in England; the fact has always been perfectly well understood by historians, and has received from them due attention. But to say that the English people are wholly or mainly descended from Scandinavians is to advance a proposition opposed to all the most vital evidence we possess on the subject. The evidence of language alone would suffice to dispose of so crude a doctrine. Mr. Du Chaillu has not approached the consideration of the question in a scientific spirit, and has too lightly brushed aside the difficulties in his way.

He has tried to give an account of the ideas, customs, manners, and institutions of the ancient Scandinavians; and we need scarcely say that there are some lively and attractive passages in his chapters on these subjects. From his book, English anthropologists will learn that there is valuable material for them in the old northern laws and Icelandic Sagas. They will, however, be unable to make use of his translated extracts, because he does not attempt to estimate the date and weight of the documents used, late forged Sagas being treated precisely as authentic early poems or contemporary histories.

The work has, in fact, no scientific value. It will amuse "the general reader," but it is unsuitable for serious students. To the archæologist it may serve as a rough index to the chief finds made in the three Scandinavian countries; but even for this purpose he will need to refer to the original plates and cuts from which the illustrations in these volumes are more or less happily reproduced. This will be obvious to anyone who studies the originals in the papers of Montelius, the Proceedings of the Stockholm Congress, 1874, the splendid Copenhagen Museum Catalogues, or the "Aarbøger for Nordisk Old-kyndighed og Historie." F. Y. P.

A Glossary of Anatomical, Physiological, and Biological Terms. By T. Dunman. Second Edition. Edited, and supplemented with an Appendix, by W. H. Wyatt Wingrave, M.R.C.S. (London: Griffith, Farran, Okeden, and Welsh.)

IT is now eleven years since the first edition of this book appeared. The senior author outlived its publication by but a short period. The editor of the present edition has left its pages unaltered, and has taken upon himself to add thereto (in the form of an appendix) twenty-five pages, embracing some 400 physiological and morphological terms, to the paucity of which, in the original edition, he directs attention. Many of his supplementary words are superfluous, others are obsolete, and by no means a few are either insufficiently or inaccurately explained. The original edition was by no means free of like defects: in it we read, by way of example, that the "*Sepiostaire*" is "the only representative of an endoskeleton in the cuttle-fishes"; that the "*Septum lucidum*" is "the partition which separates from each other the lateral ventricles of the brain"; that by "*Schizocœle*" is meant "a term applied to the peri-visceral cavity of the Invertebrata, when formed by a splitting of the mesoblast of the embryo." The present editor, while preserving the above and many other similar misstatements, has, in turn, shown himself wanting in power of accurate definition of fundamentals. This is seen, for example, in his renderings of "*Endomysium*," "*Inhibition*" (defined as "checking or controlling influence, exercised by a nerve-centre over some subordinate organ or process"), "*Metabolism*," "*Meckelian bar*," and *Negative variation*" (which, we are told, embraces "changes in the natural nerve or muscle currents which occur during contraction"). The little volume has hitherto recommended itself to students chiefly by its compactness. There has always characterized it a want of expressiveness and of finish. A single instance will suffice: "*Glomerulus*" has all along stood, and still stands, as "the small ball of capillaries in the Malpighian capsules of the kidney." It is the first duty of an editor of a new edition to rectify original defects; and, until that shall have been done, he has no right to add supplementary matter. The volume, as it now stands, must be speedily revised, if the recommendation of experienced teachers is to be looked for; and it is upon the same that it can alone maintain its honoured position.

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.*]

Acquired Characters and Congenital Variation.

BEING one of those who do not believe that either the theory of Darwin or the theory of Lamarck gives any adequate or rational account of the "origin of species," I am always glad to see any controversy which pits the one of them against the other. It is by such controversy that the weak points of each are best exposed. But I now write in the interests of peace and conciliation. Prof. Ray Lankester seems to me to be much too belligerent. I see no necessary antagonism between "congenital variation" and the transmission of "acquired characters." If an acquired character affects the whole organism, and especially the reproductive elements, then its hereditary transmission would perfectly reconcile the two conceptions. And this is probably the universal fact. I have no doubt of the hereditary transmission of acquired characters. So far is it from being "unproved," it is consistent with all observation and all experience. It lies at the foundation of all organic development. But it implies the denial of "congenital" causes. It is very probable that every "acquired character" is necessarily correlated with some physical modifications in organic structure, and that it is only transmitted to progeny through, and by means of, this physical modification.

This being so, the question arises, Why is it that the idea of acquired characters becoming hereditary is so fiercely opposed by extreme Darwinians? Is it the mere jealousy of an exclusive worship—the mere dislike of the great name of Lamarck being mentioned, even in the same day, with the name of Darwin? It is partly this, no doubt. But it is something more. It is jealousy of any conception which tends to break down the empire of mere fortuity in the phenomena of variation. Darwin himself is not wholly responsible for this feeling. He expressly guarded himself against the interpretation which has been affixed to his language about "accidental" variation. He knew well enough that variations must be governed by some law. But as we are absolutely ignorant what that law is, he thought it allowable to make provisional use of the word accidental. But the "neo-Darwinians" (as Prof. Ray Lankester calls them) are not content with this dethronement of their idol, Fortuity. The supreme and everlasting rule of pure accident is their creed and worship. Hence comes Prof. Ray Lankester's simile of the kaleidoscope, by which he illustrates the genesis of "new characters" in organic life. There is, he indicates, no more connection between those "new characters" and their origin in the parent, than there is between the new patterns which tumble in a kaleidoscope and the tap upon the tube which shakes them out.

There is no argument so false as a false analogy. And this is a case in point. Every illustration or analogy must be false which confounds mere mechanical arrangement with organic structure. They are not only different, but they are different in kind. Neither mechanical aggregation, nor mechanical segregation, can possibly account for the building up of organic structures. To attempt to account for such structures by causes similar to those which determine the arrangement of tumbling bits of glass, is even more irrational than it would be to account for the structure of a great cathedral by explaining to us how its bricks or its stones were made. There is one grand peculiarity in all organic structures which all such illustrations are framed to conceal. That grand peculiarity is this—that they are all made for work, for the discharge of some function. They are where they are not merely because somehow they have been put there. But they are what they are, and where they are, because they have some given work to do. But more than this: they all pass through stages of development in which their work cannot as yet be done. In all these stages, that work lies before them in respect to time, and behind them in respect to adaptation. They are all of the nature of an "apparatus." This is the word which the profound but unconscious metaphysic of human speech has invented for them. It is the word chosen by natural selection, and, as such, it ought to secure the homage even of Prof. Ray Lankester himself. The idea, however, comes before the word—shapes it, and inspires it—just as the needs of function, and the organic necessities imposed by inorganic laws, have shaped and inspired the growth and development of every organic apparatus.

I am very glad to see that under the stress of controversy the Professor admits—and even hotly denies that it has ever been doubted—that natural selection cannot account for the pre-existence of the structures which are presented for its choice. And not only must selected organs exist before they can be chosen by natural selection, but they must have been already sufficiently developed to possess some functional activity. This was my contention thirty years ago, and to this day I have always found it either denied or evaded by the whole ultra-Darwinian school. I rejoice to see it now admitted as unquestionable. "Natural selection can account for the origin of nothing"—so says Mr. Cope. The Professor indignantly replies: "How can Mr. Cope presume to tell us this? Who has ignored it? when? and where?" So ends a long and a hard fight. The enemy not only lays down his arms, but denies he has ever carried them. ARGYLL.

Who Discovered the Teeth in Ornithorhynchus?

It is almost superfluous to add anything to Prof. Flower's reply (p. 151) to Dr. Hart Merriam. In justice, however, to Mr. Poulton, it ought, I think, to be stated that he fully refers to Home's paper in the Philosophical Transactions. In the *Quart. Journ. Micr. Sci.*, vol. xxix. p. 27 (a paper to which Dr. Hart Merriam alludes as though he had read it) Mr. Poulton, describing the horny plates of Ornithorhynchus, writes as follows: "Home (Phil. Trans., 1802, p. 71) correctly describes these horny plates as differing 'from common teeth very materially, having neither enamel nor bone, but being composed of a horny substance only embedded in the gum,'" &c. I observe too, with great interest, that in the same paper Home makes use of the expression (p. 70) "the teeth, *if they can be so called*." On p. 28 Mr. Poulton quotes in full the passage from Owen given by Prof. Flower. Perhaps Dr. Hart Merriam does not accept Owen's correction of Home's hypothesis. It is hardly necessary to point out that the teeth which Mr. Poulton describes (p. 15 *et seq.*) under the headings (1) tooth papilla; (2) dentine; (3) enamel; (4) inner epithelium of enamel organ; (5) stratum intermedium of Hannover; (6) middle membrane of enamel organ; and (7) outer membrane of enamel organ, *must* be very different from those which Home calls "cuticular," and further qualifies as in the sentence which I have quoted.

Comparison of Home's figures with Mr. Oldfield Thomas's (Proc. Roy. Soc., vol. xlvi. pl. 2) renders it highly probable that the true teeth of Home's younger specimen had only recently dropped out from the horny plates; the dimensions given by the two authors being almost identical. But Home's description is perfectly definite, and no hint whatever is made to true teeth situated upon the horny plates such as those described and figured by Mr. Oldfield Thomas. The length of the skull of Home's specimen, as given in his figure, is 71 millimetres, while that of Thomas's female specimen is 65 millimetres; the male is slightly larger. Probably, therefore, Home's specimen was considerably older than Thomas's, and had lost the true teeth for some little time.

The only conclusion at which I can arrive is that Dr. Hart Merriam did not read any of the three papers bearing on this subject with sufficient care and attention to enable him to fully understand the facts ascertained by their respective authors, if indeed he proceeded further than the introductory remarks prefacing Mr. Oldfield Thomas's communication to the Royal Society. OSWALD H. LATTER.

Anatomical Department, Museum, Oxford, December 20.

Galls.

In answer to Mr. Ainslie Hollis, I should like to observe that, in my opinion, the theory of natural selection is *not* "seriously assailed by investigations into the formation of galls by insects." On the contrary, in reply to what appeared to be a challenge from Mr. Mivart, I pointed out the manner in which natural selection might here be fairly supposed to have operated. But, while doing this, it appeared desirable to add that the case is a highly peculiar one. If galls were merely amorphous tumours, or even if they presented but as small an amount of specialization for the benefit of the larvæ as is presented by animal tissues for the benefit of their parasites, the case would not be so peculiar. But the degree of morphological specialization which the "pathological process" presents in the case of some galls—and this, of course, for the exclusive benefit of the contained parasites—is very remarkable. And although I doubt not that it is but a higher exhibition of the same principles as obtain in the case of animal tissues and their parasites, it is a case of much greater interest from the Darwinian point of view. For, if the explanation given in my last letter be accepted, the facts show how enormous must be the power of natural selection in building up adaptive structures, seeing that it can do this in so high a degree even when working, as it were, at the end of a long lever of the wrong kind—*i.e.* acting *indirectly* on the vegetable tissues through the benefits thereby conferred on their animal parasites. I am not aware that there is any other instance of "symbiosis" where so high a degree of adaptive specialization is presented by one of the "partners" for the exclusive benefit of the other. GEORGE J. ROMANES.

London, December 13.

MR. W. AINSLIE HOLLIS has involuntarily misrepresented me as saying that the theory of natural selection can be "seriously assailed" by investigations respecting galls. I said, indeed (NATURE, November 14, p. 41), that it would be "very interesting to learn how" natural selection could have caused them; but I was careful to add that doubtless an explanatory hypothesis was ready to hand. I do not myself believe they were so caused; but if they were not, they would none the less, like almost all biological phenomena, be explicable by an unlimited use of gratuitous hypotheses concerning physiological correlations and imaginary ancestors.

I confess I do not see that calling them "pathological" (an epithet I certainly would not deny them), and comparing them with inflammatory renal foci due to Bacilli, will explain them, unless it be affirmed that pathological conditions favourable to parasites are always due to the action of "natural selection" on the parasites themselves—an affirmation which appears to ask too much.

Herr Wetterhan's argument from *symbiosis* sins against natural selection itself. For that theory requires that, in the arduous and incessant struggle for life it supposes, any prejudicial growth should, in time, be eliminated unless carrying with it some preponderating advantage. The insect and the plant are not "partners," for the latter does not participate in the gain of the former. How, then, on symbiotic principles, can "natural selection" have been the means of producing a growth which, though important, if not necessary, to the animal symbiont, is more or less prejudicial to the symbiont vegetable organism?

There can, of course, be no doubt, as Mr. McLachlan says, that the various peculiarities of gall-structure "could be" explained "on purely physiological grounds if carefully studied;" but that "natural selection" will suffice to explain them, seems to me by no means equally free from uncertainty.

St. George Mivart.

Hurstcote, Chilworth, December 13.

The Permanence of Continents and Oceans.

I can find no flaw in the reasoning on the dynamical question of the permanence of continents and oceans, in Mr. Starkie Gardner's letter in Nature of December 5 (p. 103), by which he endeavours to show the universal "tendency for deep oceans to become deeper, and for mountain chains to grow into higher peaks." But when he says it is opposed to no known facts, I wish to ask how it is to be reconciled with the fact of the general distribution of marine deposits over the face of the earth, so that every part of what is now land appears to have once been ocean?

I fully concede that the change of ocean spaces into land spaces is an extremely slow process, taking, probably, millions of years, but it seems to me that it must have occurred, though I cannot suggest through what agency.

Belfast, December 14. Joseph John Murphy.

Does the Bulk of Ocean Water Increase?

Mr. Jukes-Browne (Nature, December 12, p. 130) admits that "if the area of the land were larger, and the depth of the oceans less," in early geological times, a further inference must be drawn—"that the bulk of the ocean water was less then than it is now."

So far we are in agreement; indeed, we could scarcely be otherwise, as the proposition admits of complete demonstration. When, however, Mr. Jukes-Browne proceeds to give his reasons for holding that the bulk of ocean water *was* less in early times than now, he enters upon a more controversial subject.

I am familiar with the arguments he urges partly on the authority of Mr. Fisher, and have to some extent discussed them in chapter xii. of the "Origin of Mountain Ranges." I desire, however, to point out a further objection that when stated will, I think, appear extremely obvious.

According to Dr. George Darwin and many other astronomers who follow him, our satellite, the moon, was once an integral portion of the earth, having been thrown off when the earth was in a molten condition. If this theory be correct, it is a fair assumption that the magma out of which the moon has consolidated was composed of matter similar to that of our earth. Even if their relations were never so intimate as this, I think most physicists and astronomers will admit a similarity of material constitution of the two spheres.

If then volcanic action on the earth is, as Mr. Jukes-Browne contends, accompanied by a separation of water initially contained in the magma, and its condensation on the surface in such quantities as to materially increase the bulk of ocean water, why has not the same effect followed volcanic action on the moon? Why, in fact, do we not see oceans on the surface of the moon instead of a dry and desert waste of volcanic rings, mountain protuberances, and arid plains? In face of this great fact it appears to me that ingenious arguments as to the amount of water contained in the fluidal cavities of granite, which most geologists think is explicable by percolation, have not much weight.

At all events, it seems a reasonable question to ask why oceans should be supplied with water from the perspiring pores of mother earth, while her offspring, the moon, is so dry as to have absorbed into herself all evidence of any aqueous envelope that may have formerly existed. T. Mellard Reade.

Park Corner, Blundellsands, December 14.

A Natural Evidence of High Thermal Conductivity in Flints.

A rather curious effect of the recent frost attracted my attention in the gravel foot-paths leading over Addington Hill, near Croydon, on the beautifully bright day of the 1st inst. The clear nights and frosty air of the closing week of last month had been productive of continued low temperatures in that locality, and the result observed was that the flint pebbles, which in neighbouring gravel-beds and here and there on the paths, are of the size of hens' eggs, and remarkably well rounded, had, in places, sunk in the frozen clunch or clay-earth of the foot-paths, and in the peaty ground or turf beside the paths, as it appeared, like filberts shrunk and resting at the bottoms of their shells; or else as if the pebbles' earthy moulds had, by expanding upwards, left such a large vacuity above each stone, that the tops of some of the large ones, instead of being level (as at first they must have been, by the appearance of the moulds) with the surface of the ground, were now, in a somewhat turfy place, about as much as half an inch below it. The physical enigma which hereupon offered itself for elucidation was, how the pebbles could remain at the much lower level, while such a considerable expansion upwards had been brought about by freezing in the moist earth immediately surrounding them; and this problem had certainly, in looking at the thickly-clustered cavities in the frozen ground, at first a very paradoxical appearance.

But if the question how the inclosing cavities of moist earth round flint pebbles which are nearly embedded in it, are distended upwards so curiously by a strong frost's predominance, has presented, it may be, to some of your readers who may have noticed in similar conditions a similar appearance, as it at first did to me, a subject for rather puzzled contemplation and conjectures, it will be worth pointing out, perhaps, that there is a well-ascertained thermal property of siliceous rocks and flint, of which it seems not improbable that this not unfrequently occurring action of a strong frost, in such conditions, may really be an interesting illustration.

Among a series of about a hundred different descriptions and varieties of commonly occurring rocks whose thermal conductivities were experimentally determined by a Committee of the British Association in the years 1874–78, it was found that such entirely siliceous ones as quartz, flint, and pure siliceous sandstone, &c., so much surpass all other ordinary rocks in their rates of transmitting both heat and temperature, that in flint pebbles these conducting powers are, for example, about four or five times as great as in damp sandy mould, or in wet clayey earth.

Instead of the layers of cold temperature, therefore, produced in wet pebbly ground by continued frosty winds and radiation, proceeding in plane levels downwards from one depth below the surface to another, large flints exposed in it must grow cold very quickly through their whole substance, and must freeze the wet earth under them almost as soon as the soil's surface-layer round them is beginning to be frozen. The effect of this freezing process's expansion, it seems evident, will hardly be so much to raise the pebbles and the earth's exposed surface upwards very differently from each other, by the frost's nearly equal action on them both, as, during the frost's continuance, to force up towards the surface a large superfluity of soft earth from between the bedded stones, carrying the cast or mould of the stone's upper sides, itself to some height above them. We would require, perhaps, as an aid to this interpretation of the process, to regard the congelation round the stones, as rooting them down, perhaps to lower-lying ones, so that the upward thrust of the extruded earth may not be able to dislodge them, but can be effective to raise up their frozen caps; but some such supposition as this does not appear to be a very impossible conjecture. By this recourse to the pre-eminent thermal conductivity of flints above that of moist turf and clay, in which they are embedded, it seems at least not impracticable to give a somewhat intelligible explanation of the frozen ground's abnormal elevation round them, lifting the moulded caps of earth-covering off their upper sides until their roadside clusters present the curious appearance of shrunken petrifactions of some nest of fossil yolks in half-empty egg-shells.

It is, indeed, true that when by long continuance of a frost the sodden earth may have become entirely penetrated and frozen by it to some considerable and tolerably even depth (we may suppose) below a layer of embedded flints, it should be noticed, to simplify the process's consideration, that the form which the frozen ground will then have acquired between and round the flints could be nowise affected in the end by any various shapes, plane or contorted by irregularly formed and differently conducting solid bodies in its course, wherewith the tract of reezing temperature after entering the ground approaches by stages of quick or slow rates, in different parts, towards the supposed nearly even depth at last, if we might only presuppose that, because of the endless material obstruction to its motion in any horizontal direction, no channels for the earth's lateral expansion in freezing should subsist; but that in all places and in all conditions where the freezing happens, the only line of escape of the earth's increase of volume should be vertically upwards towards a direction where no insuperable forces are, at least, opposed to it.

Were this assumption of upward reliefs only of all of the expansions a really true and valid one, every vertical fibre of the wet earth's mass would behave in freezing quite independently of every other one, and would take up its fully expanded length at last, no matter at what times and in what order congealing overtook its individual portions. A stone, in this supposition, just embedded in the ground, would have its lower half lifted at last in its socket, and the upper half of the socket lifted off the stone (whether its thermal conductivity is great or small), to the height, in either case, of a water-column's change of length by freezing, whose initial height is but half the vertically measured thickness of the round embedded stone—that is to say, about one-eleventh of an inch for a stone 2 inches in diameter, instead of nearly half an inch, which was about the depth of the settlement, in some of the large-sized flint stones, which was actually observed.

To return to the reality, however, from this artificial supposition, the actual course of the expansions, and the effects produced by the freezing dilatations must, no doubt, be very different. Supposing that the flint-stones, by their good thermal conductivities, soon become covered with a thickening coat of frozen earth, flow of the soft, unfrozen earth between them will really spring up and be maintained by direct outward expansions from the stones of the icy coats surrounding them. On account of the firm rigidity of the exposed earth-surface, to which the stones themselves must soon become fast fixed, the resultant flow of soft earth from between the stones, instead of finding an upward path the easiest, will rather choose a vertically downward one for its escape from its confinement, and lift the stones and icy covering together, rather than seek by an upward course to break through the latter. Yet this last effect may also perhaps occur to some extent, raising the frozen earth-caps in some measure off the stones' upper sides, and stretching them, it may be, a little upwards, so as to leave between them and the stones clear empty spaces. That this last effect must be only a secondary and inconspicuous one, however, seems to be pretty obvious from this passingly essayed, and as it now appears all too uselessly pursued and desultory *aperçu* of the frost's real mode and process of expansive action.

Regarding the peculiar structures, in fact, altogether from another point of view, and rejecting the imperfect explanation which any one of these presumed congelation processes might at first have been supposed to furnish, of the curiously sunken-lookiug assemblages of the wayside pebbles, an exactly opposite interpretation of their semi-interred condition seems, perhaps, indeed, to afford a more satisfactory and likely explanation of it, than the expansive effects of frost in the moist earth were ascertained and shown to have any capabilities and physical resources for. The warmth of the sun, or of wind and rain in some thawing daytime temperature of the generally frosty week, may in short be supposed (which the weather-table of the week, on the 26th and 27th ult. confirms) quite plainly and certainly enough, in consequence of the flints' good thermal conductivities, to have melted and shrunk again to its natural dimensions the hard frozen earth under them, without lowering the level equally of the badly conducting frozen earth surrounding them. Alternate days of thaw and nights of frost would, by progressive stages which can be easily traced out and understood, tend quite naturally to exaggerate this difference. Thus in another way, but complementary to and at returning times just fitly supplemented by that first supposed, the problem which the winter scene presented is, still more simply and clearly than before, seen to be solved quite truly and correctly by the relatively high thermal conductivity of the rounded flints as compared with that of the hard frozen earth in which they are enveloped.

This gradual subsidence, therefore, of flint stones during alternate frosts and thaws, into frozen earth, by consolidation and lateral expansion, followed by liquefaction and vertical contraction of the water in the earth beneath them, is, it would seem that we may reckon it accordingly, a phenomenon on land just analogous and similar to the familiar thermal process which small stones scattered on a smooth frozen glacier-field display in summer-time, by intercepting the heat of the sun's rays, and by sinking to the bottom of the deep water-holes which they thus scoop and delve out for themselves, wherever they happen to have found a lodgment in the naked ice.

A. S. HERSCHEL.

Observatory House, Slough, December 9.

Foreign Substances attached to Crabs.

AT the last meeting of the Linnean Society I exhibited a number of crabs and certain shells of the genus Phorus having various foreign substances attached to them, about which it is desirable that more should be known. Some of the crabs manage to fasten bits of sea-weed to the hairs on the carapace and legs; Polyzoa, Balani, Serpulæ, &c., in their earlier stages fasten themselves on others; a crab of the Indian Seas—*Camposcia retusa*—is sometimes completely covered on every part with sand, small shells, and bits of sea-weed—Corallina chiefly. These could only be attached by some adhesive matter, but whence derived? *Dromia vulgaris* is occasionally found with a sponge extending over the carapace and almost completely hiding the animal. The species of this genus have the two hinder pairs of legs much reduced, flattened, and lying close to the back, and this is assumed to be an adaptation for the purpose of retaining the sponge. Out of a number of specimens dredged in the Bay of Naples, I recollect only getting one with a sponge on it, and that very soon shrivelled up, leaving a leathery-looking substance attached to the base of the carapace, not held by the legs apparently.[1] Two crabs—*Æthusa mascarone* and *Dorippe lanata*—having similarly reduced hind-legs, but directed upwards, seem much better adapted for retaining a foreign substance, which, however, they are not known to do. In a Mauritian crab—*Dynomene hispida*—the hind pair only are reduced, but to such an extent as to be merely rudimentary and incapable of any use. *Paramithrax barbutus*—a New Zealand crab—has, like some others, hooked hairs, but in the specimen exhibited they appear to be free of any foreign substances, although many small fragments of an uncertain nature appear between them.

In Phorus a strong cement only could hold on those large and heavy substances—shells, stones, &c.—completely covering the shell, as in *P. agglutinans*. I have not seen any account of their *modus operandi*, but, as the animals have a long proboscis, it is possible that that may be the organ employed, but it is difficult to believe that it would be able to lift any large substance, or that it could reach the top of the shell. Another difficulty is that they must cast off, from time to time as they grow, the smaller substances, to replace them by larger ones. There is one Phorus, however—*P. calyculatus*—in which small shells imbed themselves at short intervals along the whorls, leaving the greater part of the shell uncovered; these little cup-shaped depressions are marked inside, as far as the mouth of the shell will permit them to be seen, by corresponding protuberances. This would seem to indicate a certain softening of the shell at one time or other.

I do not see where protection comes in, in any of these cases.

December 14. FRANCIS P. PASCOE.

A Marine Millipede.

IN the hopes of arousing the interest and the energies of British entomological collectors, "D. W. T.," in a short notice on p. 104 of the present volume of NATURE, draws attention to the recent discovery in Jersey, by Mr. Sinel, of that remarkable marine centipede *Geophilus* (*Schendyla*) *submarinus* (not *submaritimus* by the way), of Grube.

Those who observed this notice, and are interested in the fauna of Great Britain, may be glad to hear in addition that more than twenty years ago a number of specimens of this then undescribed species were taken by Mr. Laughrin at Polperro on the south coast of Cornwall. These specimens, which were presented to the British Museum in 1868, were found associated with *Linotænia maritima* (Leach)—also a marine centipede—

[1] Bell, in his "British Crustacea" (p. 371), states having received "numerous young specimens from Sicily, every one of which had the carapace entirely covered with a sponge, which had grown over it, concealing even the two hinder pairs of legs, which were closely placed against the back, and rendered immovable." No mention is made of a sponge on those that came from the Channel.

among the rocks on the sea-shore; but whether the place of their capture was above or below high-water mark, is not stated on the ticket with which the specimens are labelled.

Dr. Grube's specimens were taken at St. Malo.

December 17. R. I. POCOCK.

SUGGESTIONS FOR THE FORMATION AND ARRANGEMENT OF A MUSEUM OF NATURAL HISTORY IN CONNECTION WITH A PUBLIC SCHOOL.

HAVING lately been asked by Dr. Warre, Head Master of Eton, to give him some assistance in the fitting up, arrangement, and management of the museum about to be inaugurated at that College, I put down some notes, which he was pleased to think might be of use in pointing out the lines that should be followed with most advantage. As these notes are equally applicable to other school museums, I venture to publish them for the information of those who may be in position to profit by them, premising that they are mere outlines, which are susceptible of much elaboration in detail, and of some modifications according to special circumstances.

The subjects best adapted for such a museum are zoology, botany, mineralogy, and geology.

Everything in the museum should have some distinct object, coming under one or other of the above subjects, and under one or other of the series defined below, *and everything else should be rigorously excluded.* The curator's business will be quite as much to keep useless specimens out of the museum, as to acquire those that are useful.

The two series or categories under which the admissible specimens should come are the following:—(1) Specimens illustrating the teaching of the natural history subjects adopted in the school, arranged in the order in which the subjects are, or ought to be, taught. (2) Some special sets of specimens of a nature to attract boys to the study of such branches of natural history as readily lie in the path of their ordinary life, especially their school life, and to teach them some of the common objects they see around them.

The specimens of the first class should be all good of their kind, carefully prepared and displayed, and fully labelled. They should also be so arranged that they can be seen and studied without being removed from their position in the case or in any way disturbed or damaged. It would be best that they should never be taken out of the museum, but if it is necessary to remove them for the purpose of demonstration at lectures or classes, special provision should be made by which a whole tray or case can be moved together, with due precautions against disturbing the individual specimens. As a rule, the teachers should either bring the classes into the museum for demonstrations, or they should rely upon a different set of specimens kept in store in the class-rooms, and only brought out when required, and which may be handled and examined without fear of injury. Really good permanent preparations may be looked at, but not touched except by very skilled hands.

In zoology the collection should consist of illustrations of the principal modifications of animal forms, living and extinct, a few selected typical examples of each being given, showing the anatomy and development as well as the external form. The series now in the course of arrangement in the Central Hall of the Natural History branch of the British Museum, in the Cromwell Road, may, as far as it is complete, be taken as a guide, but for a school museum it will not be necessary to enter so fully into detail as in that series.

In botany there should be a general morphological collection, showing the main modifications of the different organs in the greater groups into which the vegetable kingdom is divided, and illustrating the terms used in describing these modifications. Such a collection may also be seen (although still far from complete) in the same institution.

For a teaching collection of minerals, an admirable model has for several years past been exhibited in the Mineralogical Gallery of the Natural History Museum, being, in fact, the various paragraphs of Mr. Fletcher's "Introduction to the Study of Minerals" cut up, and with the statements in each illustrated by a choice specimen.

The geological collection would best be limited mainly to a series illustrating the rocks and characteristic fossils of the British Isles, arranged stratigraphically. There would be no difficulty in making such a series on any scale, according to the space available, and if well selected and arranged, it would be extremely instructive and form a complete epitome of the whole subject. It should be placed in a continuous series along one side of the room, beginning with the oldest and ending with the most recent formations. It might be preceded by some general specimens illustrating the various kinds of rock structures, &c.

Mineral and fossil specimens are generally to be procured as wanted from the dealers, and as they require little or no preparation, collections illustrating these subjects can be quickly made, if money is available for the purpose. This is not, however, the case with zoological and botanical specimens, most of which require labour, skill, and knowledge to be expended upon their preparation before they can be preserved in such a manner as to make them available for permanent instruction.

We will next proceed to consider what objects may be included under the second head, many of which need not be constantly exhibited, but may be preserved in drawers for special study. These may be—

(1) A well-named collection of the commoner British insects, especially those of the neighbourhood in which the school is situated, with their larvæ, which should (if means will allow) be mounted on models of the plants upon which they feed. All should have their localities and the date of capture carefully recorded. These are best kept in a cabinet, with glass-topped drawers, with a stop behind, so as to allow them to be pulled out for inspection, but not entirely removed. Such a collection, formed of specimens prepared and presented by Lord Walsingham, can now be seen in the British Room of the Natural History Museum.

(2) A similar collection of British shells, especially the land and freshwater shells of the neighbourhood.

(3) If space and means allow, a collection of British birds, especially the best-known and more interesting species. Rare and occasional visitors, reckoned in the books as British, which are the most expensive and difficult to procure, are the least important for such a collection. Variations in plumage in young and old, and at different seasons, should be shown in some common species. Every specimen must be good and well mounted, or it is not worth placing in the museum.

(4) The principal British mammals of smaller size, especially the bats, shrews, and mice.

(5) The British reptiles, Amphibia, and commoner fishes, so shown that their distinctive characters may be recognized.

(6) A collection, as complete as may be, of British plants, or at all events of the plants of the neighbourhood. By far the best way of preserving and exhibiting such a collection is in glazed frames, movably hinged upon an upright stand, as may be seen in the Botanical Gallery of the Natural History Museum. A collection arranged in this manner should find a place in every local museum of natural history.

(7) A collection of the fossils found in the quarries of the neighbourhood, should there be any.

Every collection or series should be kept perfectly distinct from and independent of the others, and its nature and object clearly indicated by a conspicuous label.

The exhibited specimens should be arranged in upright wall-cases or in table-cases on the floor of the room. For the latter a high slope is preferable, and in all the exhibition space should not extend too high or too low for comfortable inspection. Between three to six or seven feet from the floor should be the limits for the exhibition of small objects. The three feet nearest the floor may be inclosed with wooden doors forming cupboards or fitted with drawers. Glass in this situation is liable to be broken by the feet or knees.

The museum should have a permanent curator—a man of general scientific attainments, and who is specially acquainted with, and devoted to, museum work, and who might also be one of the teachers, if too much of his time is not so occupied. But, as he is not likely to have special knowledge of more than one branch of natural history, the teachers of the other branches represented in the museum would probably each give advice and assistance with regard to his own department. It is also probable that some of the boys may be sufficiently interested in the work to render valuable aid in collecting and preparing specimens.

If ethnographical, archæological, historical, or art collections be also part of the general museum scheme, they should be kept quite distinct from the natural history collections, preferably in another room.

Above all things, let the following words of Agassiz be remembered: "The value of a museum does not consist so much in the number as in the order and arrangement of the specimens contained in it."

W. H. FLOWER.

THE FISHERY INDUSTRIES OF THE UNITED STATES.[1]

THE volumes which form the subject of the present article are the continuation of a complete monograph of the fisheries and fishing industries of the United States, of which the first and second sections have already been published under the titles of "A Natural History of Useful Aquatic Animals," and "A Geographical Review of the Fisheries of the United States."

The direction of the immense investigation necessary for the preparation of this work has been in the hands of Mr. G. Brown Goode, who, as early as 1877, had drawn up a scheme for an exhaustive exploration of the coast of the United States in connection with the fishing industry. The enterprise was undertaken jointly by the United States Fish Commission and the Census Bureau, and the expenses of investigation, compilation, office and field work, and publication, have been shared by these two departments.

A work of this magnitude was quite beyond the powers of an individual, and we find accordingly that a number of authors, whose names are given at the back of the title-page, have been associated with Mr. Brown Goode in his undertaking. Among them are many names well known to science from their contributions to the natural history of the United States. Chief among these are Messrs. Marshall MacDonald, J. A. Ryder, and other members of the United States Fish Commission.

An English reader will invariably use his knowledge of British fisheries as a standard for comparison with those of a foreign country, and, in doing so, will find many difficulties, owing, not only to the difference in the species of fish which are found on the two sides of the Atlantic, but to the fact that many of our common names, such as pollack and hake, are applied to different fish in America, and that the Americans often use an altogether peculiar zoological nomenclature, which may throw even an experienced zoologist into confusion. Many American fishes of great commercial importance are unknown in Great Britain, such as the tautog (*Tautoga onitis*), the squeteague (*Cynoscion regale*), the blue-fish (*Pomatomus saltator*), the menhaden (*Brevoortia tyrannus*), and the shad (*Clupea sapidissima*). The most favourite edible crab of North America (*Callinectes hastatus*), the blue crab, is a perfectly distinct species from our common *Cancer pagurus*, and the American lobster (*Homarus americanus*) and oyster (*Ostræa virginica*) are different from our own. The European sole is unknown in American waters, as are our turbot and brill; the halibut, which has only recently become important in British fisheries, is of great importance in America, and their "plaice" (*Paralichthys dentatus*) differs entirely from the fish known to us by that name. These and many other differences in the species of marketable fish are important, as they serve in part to explain the different methods pursued by American fishermen; why, for instance, beam-trawling is unknown in their waters.

Of the third section of the monograph, which forms a half of the first of the four volumes under consideration, Mr. Brown Goode himself says:—"It is the first report of the kind ever written. It describes the locations, the characteristics, and the productiveness of the numerous grounds resorted to by the fishermen of the United States, extending from Greenland to Mexico, from Lower California to Alaska, and including the fishing grounds of the great lakes." For the Atlantic seaboard this work is carried out on a scale of completeness never before attempted. Not only does the text abound with information relative to the different fishing grounds and banks, their history, productiveness, the character of their bottom, and the weather prevailing there at different seasons, but the whole of this is graphically represented in a series of admirable charts which form in themselves a complete fisherman's guide to the whole coast from Greenland to Mexico. In addition to this, the migrations of different species of fish from locality to locality are alluded to, and the characters of the invertebrate fauna are, in some instances, adduced in explanation of these migrations. It is impossible to criticize this part of the work: to do so one must have a thorough knowledge of all the principal fishing-grounds of America; but, granted that the information and observations on which the charts and text are founded are correct, the method of displaying this information is unimpeachable.

Not the least valuable part of Section III. is the appendix containing the temperature observations from 1881 to 1885 inclusive. A word as to the manner of making these observations will not be out of place. The Census Bureau was, of course, unable to undertake this kind of work, and the Fish Commissioners, whose steamers were constantly engaged in expeditions to various localities, found that they could not keep a sufficiently continuous record of the temperatures observed at different points along the coast. Application was accordingly made to the United States Lighthouse Board and Signal Service, and these departments instructed their *employés* to make the required observations as part of their regular duties, and without extra compensation. The editor acknowledges the thoroughness with which these men performed the gratuitous services demanded of them, and the result is a large number of charts of temperature curves for each observing station, and charts showing the isothermal lines connecting the stations in different years.

The Pacific fisheries are dealt with in a much less complete manner, and are referred to as being undeveloped. The Alaskan fisheries are more fully dealt

[1] "The Fisheries and Fishery Industries of the United States." By George Brown Goode, Assistant Secretary of the Smithsonian Institute, and a staff of Associates. Section III. The Fishing-Grounds of North America, with 49 Charts, edited by Richard Rathbun. Section IV. The Fishermen of the United States, by George Brown Goode and Joseph W. Collins. Section V. History and Methods of the Fisheries; in Two Volumes, with an Atlas of 255 Plates. (Washington: Government Printing Office, 1887.)

with, and have a special interest as forming the chief, if not the only means of subsistence of the native population. The methods of fishing adopted there are of the most primitive character, and very few civilized fishermen are employed in the industry. Fish, however, is exceedingly abundant, and its value is shown by the price of salmon (*Onchorhynchus*) in the Yukon River. Dried salmon is called *ukali*, and the best quality *chowichee ukali*. One *chowichee ukali* is accounted a sufficient day's food for six men or dogs, and can be purchased for one leaf of tobacco, or five to eight musket-balls.

The fourth section of the monograph relates to the United States fishermen themselves. In 1880 there were 101,684 *bonâ fide* professional fishermen in the United States, those men only being reckoned as fishermen who make more than half their income by fishing. At the same time there were in Great Britain and Ireland between 90,000 and 100,000 fishermen who would come under this definition. It appears that whalers and sealers are reckoned among the American fishermen, and as they are certainly not reckoned in the English computation, the number of men engaged in fishing, properly so called, would be about equal in the two countries. Of the United States fishermen, the majority, including the negroes of the Southern States, and the Alaskans, are native-born American citzens, while from 10 to 12 per cent. are foreigners. The majority of the latter are natives of British provinces; the remainder are made up of Portuguese from the Azores, Scandinavians, Irish, and Englishmen, Italians, Indians, and, on the Pacific coast, Chinese. The chapters devoted to the fishermen of the different States are very interesting. The description of the Maine fishermen might be taken from any English fishing port. They are hardy, self-reliant, and honest, but are ill educated, inveterate grumblers, and entirely in the hands of the middleman. They will work hard when fishing, but are reluctant to undertake any other work, even for good pay. They marry early, and have large families, whilst their profits are low, the average annual return to each fisherman being $175 (about £36).

Oyster-dredging seems to have a peculiarly demoralizing effect in the United States, the white oystermen of Maryland being reckoned as the lowest of their class. The New England fishermen are the best educated, the most enterprising, and the most successful in the United States. Unlike the majority of European fishermen, they do not form a class apart, and have no peculiar traits or characteristics marking them off from their fellow-countrymen. They are good men of business, and many of them have left the fishing trade altogether, and been highly successful in other branches of business. Their fishing-craft, nearly all schooner-rigged, are the finest and largest in the world, and their life on board is far more civilized and comfortable than anything met with in Europe. Their earnings are far higher than those of the Maine fishermen. A Gloucester man will commonly make $1000 (more than £200) in a year, whilst skippers who are partly owners have on rare occasions made as much as $10,000 to $15,000 in a single year (from £2000 to £3000). Men living under such conditions are naturally of a high standard of intelligence, and the U.S. Fish Commission have profited largely from the co-operation of the New England fishermen. They have from the first recognized the value of a scientific inquiry in fishing matters; have in many instances devoted themselves heartily to assisting the labours of the Commissioners; have kept regular records of their journeys, including observations on tides, temperatures, weather, and sea-bottoms; have collected the fauna of the different fishing-grounds, and otherwise have been instrumental in helping scientific observation. They have one and all been ready to profit by the information gained by the Commission, and have readily tried and adopted novel methods of fishing, such as gill-nets for cod-fishery, and purse-seines for catching mackerel.

It is obvious, from a perusal of this volume, that the American fishermen are far more careful of their fish than Englishmen; they do not thump them down on the deck and stamp about on them, as is too commonly done on a British smack; they carefully clean them on board, and store them in proper receptacles, and, where fish is cured, it is commonly done on board when the fish is perfectly fresh. The reputation of the Gloucester, Mass., fishermen is curiously illustrated by a petition sent to the Lord-Lieutenant of Ireland this year. It was reported that several American schooners were coming to fish for mackerel off the coast of Ireland, and the fishermen, who do not fear the competition of English and French boats, were in great alarm lest the Americans with their purse-seines and large boats should utterly sweep the seas of fish.

Section IV. closes with a description of the dangers to which American fishermen are exposed, and an account of the management of fishing-craft. The whole is most interesting reading.

Section V. comprises two thick volumes of text and one of plates. The subjects it deals with range from whale-fishing to sponge-gathering, from baiting hooks to preparing sardines. Each branch of the fishing industry is minutely described in the text; the history of the fishery is given; old and new methods are compared; the boats, crews, fishing-gear, methods of packing and curing on board are carefully explained, and the descriptions are supplemented by a profuse number of illustrations.

It will be unnecessary to follow the various branches of fishing in detail, but a few remarks on special forms of fishing will be of interest. As has been said above, the Americans have no beam-trawl fishery: the flat-fish which are so highly prized in Europe are either absent from the American shores, or are held in low estimation, and we find no special mention of flat-fish fisheries in this section, with the exception of the extensive fishery for halibut. There appears to be a prejudice against flat-fish in many parts of America, and there is certainly a prejudice against the use of the beam-trawl. If the latter were introduced, and the several flat-fishes which are abundant in some parts of the United States waters were thrown freely into the market, an important branch of fishery would no doubt be established. Halibut are caught in deep water by means of long lines, known in America as "trawls," just as they are by the Grimsby boats working in the neighbourhood of the Faroe Islands. The method of setting several long lines round the schooner by means of smaller boats called "dories," is well worth noticing, but the great risk to life entailed by the use of the "dories" is an objection to introducing this mode of fishing into British waters.

The cod-fishery of the United States is very large, and is carried on to a large extent on the Great Bank of Newfoundland, as well as on the Labrador and St. Lawrence coasts. There appears to be a fine cod-fishery off Alaska, but it has only been partially worked by a small fleet hailing from San Francisco. The cod-fishery was formerly, and still is to a large extent, carried on by hand lines and long lines, or "trawls," but in 1880 the U.S. Fish Commission succeeded in introducing gill-nets, long since used by the Norwegians, among the fishermen of Gloucester. The obvious advantages of the cod gill-nets are that they save the fishermen the trouble and expense of obtaining bait, which is often as difficult to procure as it is in England, and thus increase their profit; they are easily set and worked, they catch more than the long lines working on the same ground, and as the size of the mesh is adapted only for cod of a certain size, the small fish or "trash" pass through and escape. This is a good example of the practical usefulness of the U.S. Fish Commission.

The accounts of the menhaden and mackerel fishing show that the Americans are as prone to complain of particular modes of fishing as English fishermen: the purse-seine is as obnoxious to some of them as the beam-trawl is in England, and the use of steam is at least equally unpopular. Steam is used chiefly in the menhaden fishery, and this, in combination with the purse-seine, a net practically unknown in England, has, it is alleged, utterly destroyed the menhaden fishing in certain districts. This led to petitions to Congress for the protection of the menhaden fishery, and in 1882 and 1883 the matter was inquired into, and protective legislation recommended. The evidence of actual decrease in the fishery does not appear in the Report on the fishery, but as the Commissioner of Fisheries was a member of the Committee which drew up the Report recommending legislative interference, it is to be presumed that he was satisfied that the fact of a diminution of the menhaden, due to over-fishing, was established.

Mackerel-fishing is conducted entirely by sailing-boats, most of them schooners of sixty tons register and upwards, and in these days it is carried on almost entirely by means of the purse-seine. In England, the summer fishing for mackerel is carried on by means of hand lines, and small boats may be seen "railing" or "whiffing" amongst the schools of mackerel. This method was formerly followed in America, but is now, to all intents and purposes, a thing of the past, the figures of small boats "jigging" and "drailing," as it is called in America, being given only in illustration of an obsolete industry.

The purse-seine first came into general use in 1850, but its greatest development dates only from 1870, and since the latter date there has been great opposition to its use, on the score of its destructiveness. The statistics of the mackerel-fishery do not, however, warrant this opposition. Mackerel-fishing has always been uncertain, and, as early as 1660, prohibitory laws of various kinds were passed to prevent, as it was supposed, the destruction of this industry. In 1838, twelve years before the introduction of purse-seines, the catch of mackerel was very small, and then the blame was laid on "the barbarous method of taking mackerel called gigging." The largest take of mackerel in a single year was in 1831, when 449,950 barrels of pickled mackerel were officially inspected; the second largest catch was in 1881, when 391,657 barrels were inspected. The worst catch was in 1877, when 127,898 barrels were inspected. A glance at the official tables shows that the fluctuations in the mackerel-fishery are quite independent of the usual method of fishing. The use of purse-seines might advantageously be tried in England, though it was found a failure by American schooners fishing off the Norwegian coasts, because, as it was alleged, the mackerel moved there in smaller schools than on the opposite side of the Atlantic.

In the second volume, on history and methods, English readers will find especial interest in the account of the great fur-seal industry of Alaska, which is regulated, as is well known, by a wise law prohibiting the destruction of more than a fixed number of seals every year.

No one who reads these volumes can fail to be struck with the practical national benefit of the United States Fish Commission. The production of this great work is only a small part of their active usefulness, but if it be judged by its utility alone, it is an exceedingly important part. When finished, this monograph of the fishing industry of the United States will form a complete text-book of American fisheries in all their branches, and will serve not only to interest the American public in a great national industry, but as a reliable guide to all those who are engaged in the fishing trade itself. In many cases it will be eminently serviceable as a book of reference to the practical fisherman, informing him of the localities and characteristics of fishing-grounds with which he is unacquainted, of the kinds and abundance of fish that he may expect there at different seasons, and of the best methods of prosecuting fisheries to which he is unaccustomed. Capitalists and manufacturers will learn from it how they may most profitably embark in a new industry, and the consumer will know from it how to judge of the quality of the article he consumes, and where to obtain it to the best advantage. It is impossible to refrain from drawing a comparison between this enlightened support given to an industry which from its very nature is incapable of being benefited by private effort, and the comparatively small support given by the English Government to our own fisheries, which, when the whale and seal fisheries are discounted, are at least of equal value with those of the United States. There are, indeed, signs that it is being generally recognized that the *laissez faire* policy as applied to national fisheries is a mistake. It is to be hoped that, when our Government takes another step forward, the example of the United States may not be lost sight of, and that, in addition to a central office with its necessary clerks and official administrators, a staff of skilled scientific investigators and practical men may be appointed, such as will be able to produce as exhaustive a work as that under review.

NOTES.

ON Friday evening last, Sir Lyon Playfair, having distributed the prizes and certificates gained by the students of the City of London College, delivered an interesting address, taking as his chief subject the need for vital improvements in English methods of education. There had been, he said, a marked change going on over the world in regard to work. Machinery had been taking the place of muscular labour. Less human labour was employed, but it was much better paid than formerly. The workman must adapt himself by trained intelligence to these changes, otherwise he would go to swell the ranks of unskilled labour. Foreign countries had been quicker awake to the changes that were going on than we had been. We were proposing technical education, while France, Germany, Belgium, and Switzerland had been adapting themselves to the altered state of things by improved schools, secondary schools, commercial, building, and other special schools, which they had been promoting for many years. Germans and Frenchmen were taking places in English counting-houses, because the youth of London had not been educated in those languages which were necessary to commerce. We were now beginning to awake to the necessity of doing what was being done in other countries. Until comparatively lately we had nothing but classical schools. The learned classes had been entirely separated from the people; but the people's knowledge of trade improved science, and science improved trade. The learned classes were ignorant of this. This was not the way that the magnificent science and literature of Greece and Rome arose. Their great philosophers were busy in commerce, and were acquiring experience and knowledge among the masses of their own countrymen. This, he was rejoiced to see, was what we were now trying to bring about in this country.

THE formation of two new Microscopical Societies has recently been announced. One of these is the Scottish Microscopical Society, meeting in Edinburgh, with the following office-bearers: President, Prof. Sir W. Turner; Vice-Presidents, Prof. Hamilton and Mr. Ad. Schulze; Secretaries, Dr. A. Edington and Mr. Geo. Brook. This Society has already held two successful meetings. The other Society is the Italian Microscopical Society, intended to bring together microscopists from the whole of Italy. The subjects for research, specially mentioned in the prospectus, are animal and vegetable histology, petrology, bacteriology, and the structure of the microscope and its appliances.

AT Leyden there is a fine ethnographical collection, which is especially valuable so far as it relates to the Dutch East Indian territories. At present this collection is seen to great disadvantage, but there is some prospect that it may soon be transferred to better quarters. A Parliamentary Committee has recommended that proposals should be submitted to Parliament for the erection of a suitable building.

THE Public Free Libraries Committee of Manchester, in their annual report, just issued, state that the success which has so long attended the working of the public free libraries in that city still continues in all departments. During the last twelve months the number of readers and borrowers at the various libraries and reading rooms (*i.e.*, the number of visits they made) reached an aggregate of nearly four millions and a half (4,442,499), being over 70,000 in excess of the previous year. The number of books used for home reading and for perusal in the reading rooms was 1,649,741. In the preceding year the number was 1,606,874, the increase being 42,867. The daily average of volumes used in all the libraries was 4700. Of the volumes issued to readers at the libraries, 336,058 were read in the reference library, 507,964 in the reading rooms attached to the branches, and 64,770 in the Bradford, Harpurhey, and Hyde Road reading rooms. The number of volumes lent out for home reading was 740,949. Out of these only sixteen are missing. There are now 197,947 volumes in the libraries. The committee express regret that the limited resources at their disposal prevent the extension of branch libraries and public reading rooms, but they trust that the Council will, before long, enable them to take the necessary measures for giving effect to the resolution of the Council passed unanimously on December 21, 1887, with regard to obtaining parliamentary powers for the removal of the present restriction of the rate (a 1*d*. in the £) to be expended for library purposes.

THE following scientific lectures will probably be delivered at the Friday evening meetings of the Royal Institution before Easter, 1890:—January 24, Prof. Dewar, F.R.S., scientific work of Joule; January 31, Sir Frederick Abel, F.R.S., smokeless explosives; February 14, Prof. J. A. Fleming, problems in the physics of an electric lamp; February 21, Shelford Bidwell, F.R.S., magnetic phenomena; February 28, Prof. C. Hubert H. Parry, evolution in music; March 7, Francis Gotch, Esq., electrical relations of the brain and spinal cord; March 14, Prof. T. E. Thorpe, F.R.S., the glow of phosphorus; March 21, Prof. G. F. Fitzgerald, F.R.S., electromagnetic radiation. On Friday, March 28, a lecture will be given by Lord Rayleigh, F.R.S.

ON December 8, at 6.30 a.m., a severe shock of earthquake was felt in Upper and Central Italy, Dalmatia, the Herzegovina, and Bosnia. At Serajewo three shocks were felt, the direction being from south-east to north-west. They lasted for five seconds each.

THE inhabitants of the town of Reggio d'Emilia, in Upper Italy, are very much alarmed by the activity of the volcano, the Queccia de Salsa, which is situated about eight kilometres from the town. During the last two or three weeks it has thrown up lava, stones, and ashes.

IN the *Comptes rendus* of the French Academy of Sciences for December 9, M. Angot has published an interesting paper on the observations of temperature at the top of the Eiffel Tower. The mean monthly maxima and minima for July to November inclusive are compared with those recorded at the Parc Saint-Maur. According to the usual decrease of temperature with height, the tower observations should be about 2°·9 lower than at the ground station, but the difference is much greater in summer during the day, and much less in winter during the night. In calm and clear nights especially, the temperature has been found to be nearly 11° higher at the summit than at the base. At the time of a change of atmospheric conditions, the change is manifested some hours, or even days, at the higher station. A striking instance of this occurred in November. After a period of high pressure, with calms and easterly breezes, the wind on the surface became strong, and shifted to south-south-west, and temperature rose. But the change had manifested itself on the tower on the evening of the 21st, and during the whole period from the evening of the 21st to the morning of the 24th, the temperature at the tower was higher than at the base, at some times even exceeding 18°. Observations made by a "swinging" thermometer at 11h. a.m. on the 22nd showed that the inferior limit of the warm current was approximately between 500 and 600 feet above the ground.

THE Third Report of the Meteorological Institute of Roumania for the year 1888 shows that much progress is being made, with very scanty means, thanks to the willingness of the observers and to the voluntary assistance rendered in the preparation of the observations for publication. The Institute has been established only four years, and at the beginning of 1889 it numbered 21 stations of various classes, in addition to 42 rainfall stations. The observations are regularly published in the *Annales* of the Institute, a quarto volume of about 600 pages, about half of the volume being devoted to discussions, in French and Roumanian.

FOR a year past Mr. R. W. Schufeldt has been working at a memoir on the morphology and life-history of *Heloderma suspectum*, the well-known poisonous lizard of the south-western part of the United States. This memoir is now nearly ready for publication. Biologists have hitherto denied *Heloderma* even the rudiment of a zygomatic arch, and Dr. Günther, of the British Museum, has said in his article "Reptiles," in the ninth edition of the "Encyclopædia Britannica" (p. 451), that "the skull of *Heloderma* is very remarkable in that it has no zygomatic arch whatever." We learn from Mr. Schufeldt that his recent dissections of this lizard go to prove that such statements must be qualified. Upon examining skulls of both old and young individuals of *H. suspectum*, he has found at least a very substantial vestige of the arch in question. It consists of a freely articulated, conical ossicle, standing on the top of the quadrate, being moulded to the outer side of the posterior end of the squamosal, with which it also freely articulates. It is seen to be present upon both sides. That this is the osseous rudiment of the hinder end of the zygomatic arch in this reptile, there cannot, Mr. Schufeldt thinks, be the shadow of a doubt.

AT a recent meeting of the American Ornithologists' Union, Mr. Jonathan Dwight, Jun., read a paper on birds that have struck the statue of Liberty, Bedloe's Island, New York Harbour. He said, that, on account of its lighter colour, more birds strike the pedestal of the statue than the statue itself. The statue was erected too late in 1886 for the migratory birds. It was first struck on May 19, 1887, then late in August, when the lights were said to be put out by birds. The first date at which birds struck the statue in 1889 was August 5, when fourteen were killed. A few others were killed during the month, and a considerable number in September and October. October 24 was the last date at which birds were killed. The whole number killed this year was 690, which was considerably less than in 1888 or 1887. He found that every cold wave in the early fall was followed by migratory birds flying against the statue. Of the dead birds picked up this year, 60 per cent. belonged to one species, the Maryland yellow-throats. The remaining 40 per cent. included a great variety.

AT the meeting of the Scientific Committee of the Royal Horticultural Society on December 10, Mr. Morris read a letter addressed to the Director, Royal Gardens, Kew, by Mr. R. W.

Blunfield:—"I see in the August number of the *Kew Bulletin*, an interesting account of the *Icerya purchasi*, and its depredations in South Africa, California, &c. During the past four years our gardens at Alexandria have been invaded by a coccus, which threatens now to destroy all our trees, and is causing the greatest alarm here. . . . It first appeared about four years ago, when I noticed it in quantities on the under side of the leaves of a banyan tree, but it has since spread with extraordinary rapidity, and one of our most beautiful gardens, full of tropical trees and shrubs, has been almost destroyed. A breeze sends the cottony bugs down in showers in all directions. It seems to attack almost any plant, but the leaves of the *Ficus rubiginosa*, and one or two other kinds of fig, seem too tough for it, and it will not touch them. It seems almost hopeless here for a few horticulturists to try to eradicate this formidable pest, while their indifferent neighbours are harbouring hotbeds of it, and there will have to be some strong measures taken by law to put it down." The insect in question had been referred to Mr. Douglas, and was said to be an undescribed species of Dactylopius. Spraying with kerosene emulsion was recommended, but no remedy was likely to be effectual that was not carried out universally.

THE new number of the Journal of the Royal Horticultural Society contains a full and interesting report of the proceedings of the National Rose Conference held at the gardens of the Society at Chiswick on July 2 and 3. In the same number there are the following papers: on irises, by Prof. Michael Foster; the strawberry, by Mr. A. F. Barron; strawberries for market, by Mr. G. Bunyard; the origin of the florist's carnation, by Mr. S. Hibberd; peaches and nectarines, by Mr. T. F. Rivers; on conifers, by Mr. W. Coleman; on pears, by Mr. W. Wildsmith.

A GERMAN biography of the late Dr. E. G. F. Grisanowski, by Elpis Melena, has just been published (Hanover: Schmorl und von Seefeld). The book ought to be interesting to anti-vivisectionists, as Dr. Grisanowski was an enthusiastic advocate of their ideas, and much attention is given to the subject by his biographer.

THE United States Department of Agriculture has issued the first and second of a series of illustrated papers on the North American fauna. They are by Dr. C. Hart Merriam. The first is a revision of the North American pocket mice, and includes descriptions of twelve new species and three new sub-species. The second paper contains descriptions of fourteen new species and one new genus of North American mammals.

THE sixth edition of Mr. H. Bauerman's "Treatise on the Metallurgy of Iron" (London: Crosby Lockwood and Son) has been published. Mr. Bauerman explains that, as the progress in iron and steel manufacture during the seven years that have elapsed since the last issue of the volume has been mainly in the direction of perfecting the appliances and working details of the great processes introduced between 1858 and 1878, it has not been necessary to make any very great alteration in the principal part of the text. The additions required to bring the information up to date have been placed mostly as supplemental notes at the end. The statistical details have been revised and brought up to the latest dates for which returns are available.

IN a recent paper on zoogeography, in *Humboldt*, Dr. Lampert states that a good many wolves are still captured in the east and west provinces of Germany, *e.g.* about fifty annually in Lorraine. In France, 701 wolves were destroyed in 1887; in Norway, only 15. It is estimated that in Russia the yearly loss in domestic animals through wolves is over £2,000,000, and the loss of game from the same cause, over £7,000,000. The German mole swarms, apparently, in the neighbourhood of Aschersleben, where 97,519 individuals were taken last year, and rewards amounting to £97 were paid. In great part of Germany, however (Upper and Lower Bavaria, East and West Prussia), it is not met with. Mecklenburg and Pomerania are its northern limits, at present. The beaver is nearly extinct in Germany, but a new settlement of thirty individuals was recently discovered at Regenwehrsberg, not far from Schönebeck, on the Elbe. A recent catalogue of diurnal birds of prey in Switzerland (by Drs. Studer and Fatio) gives thirty-two species. The disappearance of the golden vulture is here noteworthy. Early in this century it was met with in all parts of the Alpine chain; whereas now, only a very few individuals survive on the inaccessible heights of the Central Alps.

AN interesting inquiry into prehistoric textiles has been recently made by Herr Buschan (*Arch. für Anthrop.*) He examined tissues with regard to the raw material used, to their distribution in prehistoric Germany, to their mode of production, and to their alteration by lying in the ground. With certain chemical reagents he was able to distinguish the various fibres, though much altered. The oldest tissues of Germany (as we now know it) come from the peat-finds of the northern bronze period. On the other hand, some articles of bone found in caves of Bavarian Franks, and evidently instruments for weaving or netting (bodkins, knitting needles, &c.), show that already in the Neolithic period textiles were made. The art of felting probably preceded that of weaving. Herr Buschan sums up his results as follows: (1) in the prehistoric times of Germany, wool (mostly sheep's) and flax were made into webs, but no hemp; (2) the use of wool preceded that of flax; (3) the wool used was always dark; (4) most of the stuffs were of the nature of huckaback (none smooth); (5) the textiles have, on the whole, changed but little in course of time. The author has some interesting observations on the oldest kinds of loom. The pile-builders on the Pfaffiker, Niederwyl, and Boden Lakes, were busy weavers; and they knew how to work flax fibres not only into coarse lace, fish nets, or mats, but into such finer articles as fringes, coverlets, embroidery, and hair-nets.

IN a recent Consular Report from British North Borneo, an account is given of the explorations for gold which were made in the territories of the British North Borneo Company last year. The main obstacle had always been the difficulty of ascending the river, which is full of shallows and rapids, and of forwarding supplies of provisions, as the country is totally uninhabited, and does not afford supplies of any kind whatever. Striking into the forest at a point in Darvel Bay, which was judged to be nearest to the desired district, Mr. Skertchly crossed three sharp ridges of mountains, and at length struck the higher Segama, at a place some 250 miles inland from its mouth. The track is only 31 miles long, but great difficulty was experienced in bringing up provisions, as, owing to the rocky and mountainous nature of the ground, animals could not be used for transport, and everything had to be carried, at considerable expense, on men's backs. Payable gold was found soon after the Segama was reached, and the higher the river was ascended the more there was, but it was patchy and uncertain, and, so far, no reefs are reported, the gold being almost entirely in the river-bed. It is now certain, says the Consul, that payable gold exists, but whether the extent of country it is found in is large or small has yet to be ascertained, while the expense of conveying provisions to the gold-fields will require gold to be abundant to make it worth while working, unless an easier path is found. Mr. Skertchley was five months and a half in the forest without coming out once, and it was mainly owing to his foresight in arranging details, and his perseverance in carrying on the expedition, that success was due.

THE Annual Report of the Conservator of Forests at Singapore refers at great length to the difficulty of dealing with a grass called *lalang* (*Imperata cylindrica*, Cyr.), which is not only useless, but very injurious, both by reason of its inflammability, and because it prevents any cultivation of the land covered by it, except with a great deal of labour and expense. Wherever the land is burnt or having been under cultivation is suffered to run to waste, it is soon covered with *lalang*, whatever may have been the previous vegetation, except where the soil is sandy, or wet, or shaded by trees. The treatment of the soil by chemicals, such as salt, sulphate of iron, &c., apart from the heavy expense connected with it, is liable to have a very injurious effect, even for many years, on the plants with which the ground is afterwards afforested. The introduction of some more actively growing plant to combat and destroy the *lalang*, has been proposed, but this would be to destroy one noxious weed by another still more noxious. When trees are tall enough to throw a shade upon the ground, the *lalang* quickly disappears, nor can it penetrate even into forest glades if but a few trees bar its progress. It is suggested, therefore, that shade trees and bushes should be gradually planted.

OUR ASTRONOMICAL COLUMN.

Objects for the Spectroscope.

Sidereal Time at Greenwich at 10 p.m., December 26 = 4h. 22m. 20s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) G. C. 839	—	—	4 15 32	+19 7
(2) 47 Eridani	5	Reddish-yellow.	4 28 54	− 8 25
(3) ε Tauri	4	Whitish-yellow.	4 22 12	+18 56
(4) μ Eridani	4	White.	4 40 0	− 3 27
(5) R Leporis	Var.	Red.	4 54 36	−14 56
(6) U Geminorum ...	Var.	Variable.	7 48 34	+22 17
(7) Neptune, Dec. 26..	—	Greenish.	4 2 21	+18 59
,, Jan. 2 ...	—	—	4 1 44	+18 57

Remarks.

(1) This is described in the General Catalogue as an exceedingly interesting object, but very faint and small; according to Hind it is variable. I have not been able to find any record of its spectrum. Continuous observations over a considerable period, even with small dispersion, may throw light upon the nature of the changes which take place.

(2) A star of Group II., in which Dunér records the bands 2–8. Bands 2 and 3 are the strongest, indicating that the star is well advanced in condensation towards Group III. As in similar stars, dark metallic lines and lines of hydrogen should receive special attention, as the stages at which these make their appearance have not yet been determined.

(3) Vogel classes this with stars of the solar type, and the usual differential observations are suggested. (For criteria, see p. 20.)

(4) According to Konkoly, this is a star of Group IV. The usual observations of the relative intensities of the hydrogen and metallic lines are required, so that the star may be placed in line with others on the temperature curve.

(5) This is a variable star of Group VI., but the range of variation is small (6·5–8·5). The origin of variability in stars of this group has not yet been satisfactorily explained, and there is no record of the spectroscopic changes which accompany the changes in magnitude. Further observations are therefore necessary, and it is suggested that variations in the intensities of the carbon flutings should be particularly noted. The star was at minimum on October 23.

(6) This variable reached its maximum on December 21, and, as the period is only 86 days, observations may be made from maximum to minimum, providing that sufficient optical power is employed. The magnitude ranges from about 9 at maximum to 14 at minimum. The colour is stated to vary from white at maximum to reddish at minimum. The spectrum has been described as continuous (probably near maximum), but the colour-changes indicate that considerable variations in the spectrum may also be expected.

(7) The spectrum of Neptune was first observed by Secchi, in 1869. He noted that there were three broad dark bands, which were nebulous at the edges, and that there was a remarkable absence of red light. Vogel gave a more detailed account of the spectrum in 1872 (*Bothkamp Beobachtungen*, 1872, p. 71). The bands then recorded were as follows:—

Wave-lengths.			Remarks.
597	...	...	End of spectrum.
565·7	...	...	End of a wide dark band.
556	...	...	Very feeble band.
540	...	...	Middle of the darkest band.
518	...	...	Faint band.
513	...	...	,,
507	...	...	,,
485·8	...	...	Middle of a dark band.
477	...	...	Middle of a wide dark band.

The whole spectrum is very similar to that of Uranus. The proximity of the edges of some of the dark bands to the bright flutings of carbon and manganese led Prof. Lockyer to suggest that in Uranus and Neptune we might have to deal with the radiation of those substances, the dark bands being produced by contrast. Acting on this suggestion, I made observations of Uranus with a 10-inch equatorial, and afterwards, in conjunction with Mr. Taylor, with Mr. Common's 5-foot reflector. Direct comparisons certainly showed coincidences of the flutings of carbon with luminous parts of the spectrum. No solar lines were visible, but Dr. Huggins has recently photographed the spectrum, and found nothing but solar lines. In a recent observation of Neptune, I thought the bright flutings were more evident than in Uranus, but I have not had an opportunity of making comparisons. Further observations with reference to the existence of bright flutings are suggested. A. Fowler.

Variable Star in Cluster G.C. 3636.—Prof. Pickering writes (*Astr. Nachr.*, 2941) that photographs are being taken at Wilson's Peak, Southern California, with a telescope of 13 inches aperture. Four photographs, with exposures of about one hour each, were taken of the above cluster, whose position for 1900 is R.A. 13h. 37m. 35s., Decl. + 28° 52′·9. A star about twenty seconds south of the centre of the cluster was found to be much brighter on May 21 and June 8, 1889, than on May 31 and June 17, 1889. Two maxima seem to be indicated by the photographs separated by an interval, during which the star becomes comparatively faint. Visual observations made at Cambridge Observatory since June appear to confirm this variability.

Changes in Lunar Craters.—A few observations made by Prof. Thury (*Astr. Nachr.*, 2940), of craters in the terraced ring of Plinius, indicate some striking changes. On November 1, Plinius presented the same aspect as that described in 1882 by MM. Elger, Gaudibert, and H. Klein. Two craters, cutting one another, appear in the middle of the ring, and it is thought that one of these was not visible in the middle of September. The central opening seems to have been enlarged, for on November 1 its diameter was estimated as at least one-third of the total crater, whereas in September the diameter of the opening was rather less than one-fourth of the total diameter.

The interpretation put by Prof. Thury upon these appearances is that in the centre of Plinius there are two small craters, the aspect of which is modified by the different amounts of snow and ice about them. Emissions of heated gas and vapour would affect considerably the state of the lunar surface, for if, in the beginning of an eruption, water-vapour were predominant, it would be immediately condensed around the crater, forming a circular field of snow, so that the apparent enlargement of the opening may be due to the melting of the snow surrounding it by the hot gases emitted.

SIR HENRY ROSCOE ON TECHNICAL EDUCATION.

LAST week we referred to an address delivered by Sir Henry Roscoe at Goldsmiths' Hall on Tuesday, December 17, after the distribution of the prizes and certificates to the students of the City and Guilds of London Institute. He spoke as follows:—

In his admirable address delivered last year on a similar occasion to the present, Sir Lyon Playfair pointed out that one of the important objects for which the City Guilds were originally founded was to develop and restore arts and sciences, and act as teachers to pupils. In the ancient charters the word "Universities" is used for the modern designation of Guild. University simply means a teaching corporation, whether for professional or trade purposes. In both cases the teacher is termed a "master," and the pupil an "apprentice" from *apprendre*, to] learn. The function of teaching by the Guilds was gradually lost. The master became the capitalist, the pupil the workman. The capitalist does not consider it part of his duty—quite the contrary—to teach the workman his craft, and thus the latter, though handy in one branch, never becomes a craftsman; intelligence is wanting, and the industry suffers when placed in competition with that for which the craftsman has been intelligently trained.

But now the Guilds have recovered their long lost ground, and by a natural process of evolution they are now engaged separately and collectively in nobly carrying out the work for which to a great extent they were originally constituted.

This new departure, or rather this recurrence to the ancient type, we know as technical education, and we define it as the instruction in those arts and sciences which underlie the practice of the industry or trade, this instruction being given in the technical school.

No attempt is there made to teach the trade or industry itself; this is done, and can only be done, in the factory or workshop. The school teaches how to make the best article; the workshop, how to make that article cheapest. The school ignores economical production, whilst this is the all-important factor in the workshop.

In my remarks this evening I propose to consider how the Guilds are now carrying on their work, and to point out the relation which that work bears to the general question of technical education in the country, which is now acknowledged on all hands to be one vitally affecting our industrial supremacy amongst the nations.

This acknowledgment has now received a national recognition in the passing of the Technical Instruction Act of last session of Parliament, and this has materially changed the whole aspect of affairs. *Now* technical instruction, which has hitherto been sporadic may become systematic, for private effort has received national authorization, and sooner or later a complete scheme for technical instruction must be forthcoming.

The commencement of such a scheme has indeed already been made by the efforts of the City Guilds. Your Institute, with its various branches, is the nucleus of such a system, the importance of which will perhaps only be recognized when the history of this great educational movement comes to be written.

Starting from small beginnings, this work has already attained dimensions which exceed the most sanguine expectations of its founders.

The extension of your technological examinations has been so rapid that now no fewer than 12,000 students are receiving instruction in 500 registered classes in 113 towns in the Kingdom, whilst 6000 students passed the examinations last year.

Of the value of these examinations as stimulating a knowledge of the *rationale* of practical processes there can be no doubt. The age of empiricism is past, rule-of-thumb is dead, and a new rule, that of scientific training or organized common-sense, has taken its place.

These examinations serve to spread that scientific training amongst the masses of our population, and though they do not accomplish *all*, they accomplish much, and the classes if not all first-rate are still vastly better than none at all, and it is satisfactory to note that the employers of skilled labour are beginning to find out that the men thus trained are of greater value than those who have not had such training.

To quote one example of this among many, a pupil of the Manchester Textile School gained at the last examination the silver medal in honours. He was simply a "cotton operative," but since that time he has obtained the post of manager of 1170 looms under a large manufacturing firm, and the determining factor in his success over a great number of competitors was his possession of the silver medal first-class certificate in honours of this Institute.

But, after all, the attendance on these classes is only the beginning. A more thorough training is needed; for this the Institute has founded the admirable model "Intermediate" Technical School in Finsbury, where the course is a real preparation for entering the workshop, and thus the pupils begin industrial life under more favourable conditions than otherwise would have been the case.

It is much to be hoped that the Institute may not only be able to continue grants to this most useful school, but may see its way to plant other similar schools in various parts of the metropolis, which after all is the greatest industrial centre in the Kingdom.

But the Institute does not stand alone in carrying on this great work of raising up the true craftsman, and thus helping to keep down that danger to our overcrowded centres of population—the great army of unskilled labour. The Guilds are separately taking up the question, and if we may deplore the withdrawal of some from the general scheme, we may well commend their efforts in other directions. Witness the foundation by the Company in whose hall we are now assembled of a great technical and recreative institute at New Cross, which bids fair to become a centre of light and leading in a district dark and backward.

Again, look at what the Drapers' Company have done, and are doing, at the East End to place the People's Palace on a sound financial basis; or at the still greater work, if such things can be compared, which the Clothworkers' Company has done in Yorkshire and other districts to place upon sure scientific foundations the clothworker's craft.

Amongst these efforts to raise the industrial capabilities of our population we must not forget the scheme of the Charity Commissioners for the application of the property of the City of London charities. This arose out of an Act passed six years ago at the instance of my friend Mr. Bryce, which directed that the general funds of these charities should be applied to the benefit of the poorer part of the population.

No less a sum than £50,000 per annum is thus applicable, and the scheme lately put forward by the Commissioners for the appropriation of this sum is, on the whole, an admirable one, which may, if wisely worked, end in the creation of what may be termed a popular technical University for London. The value of such an organization as is thus proposed will be appreciated by those who have some knowledge of how these things are managed on the Continent, and in how chaotic a state is the whole of London education beyond the rank of the primary school.

All these efforts are truly "signs of the times;" they point to the recognition by the better endowed that not merely is it their duty, but their self-interest, to see that those who have the power know how to use it wisely, for it is on this that our national stability and progress depend.

But it is not enough simply to educate the craftsman; his employer needs it equally, if not more, and this task is, perhaps, a more difficult one, for as the Royal Commissioners on Technical Education report, "Englishmen have yet to learn that an extended and systematic education, up to and including original research, is a necessary preliminary to the fullest development of industry," and this necessity your Council have fully acknowledged, for, at the inauguration of your Central Institution, Lord Selborne said:—"It is, however, in the appreciation of, and in the facilities for higher technical instruction, that we in this country are most deficient, and it is to supply this want that the Central Institution has been established, . . . in which new and increased facilities will be afforded for the prosecution of original research, having for its object the more thorough training of the students and the elucidation of the theory of industrial processes."

I do not think that one could more emphatically or more clearly define the character of the work needed for the highest instruction of the future leaders of industry, than Lord Selborne has done in these words.

Now, the question arises, Is the Central Institution accomplishing the ends thus clearly marked out? It must be admitted that the supply of students has hardly been equal to the expectations formed by its friends at the outset. But if the work done is of a high class, and if those who come within its walls are there fitted for discharging the higher duties which modern industry requires, we may be satisfied, for the fact is that the demand for high-class technical instruction has yet to be created. Other difficulties beset this particular kind of teaching. One is that, as in many new institutions, the students enter ill-prepared, and thus the instruction is forced into elementary lines, and the time which can be given to higher work materially shortened.

A second, is that of hitting off the happy mean between the teaching of theory and that of practice, and in order that this essential may be accomplished, it is necessary that the teachers giving this higher technical instruction should be men who are well known and respected in their several professions, and not mere schoolmasters. In other words, that they shall know the practice as well as the theory of the subjects they profess. Such men, as far as I am able to judge, your Council has found in the present able staff of professors.

Then again, in measuring the success of such a College, it must be remembered that it is intended for the *élite* of the industrial world, and that, as individual attention must be paid to each student in the laboratories and drawing-offices, the highest technical instruction of crowds is impossible.

Little seems hitherto to have been done in the way of training technical teachers, and for the obvious reason that the demand for such is very limited, whilst that for competent men to enter a more practical career is great.

But whether the College is training teachers, or those who are to carry out the lessons of such teachers into practice, does not matter. The object is to train men who can improve our present industries, and raise up new ones; and this may be accomplished by either or by both methods. Neither the one nor the other can, however, succeed unless the student of technology has a firm grasp of the scientific principles upon which his industry is based.

It is useless, and worse, to attempt to teach the applications to pupils to whom the science itself is an unknown quantity.

Hence arises the question, How and where can the preliminary science training be best given? and the answer to this raises many difficult and some delicate matters.

First, however, let me disabuse your minds of a notion which may become general, and, if so, harmful—namely, the new Metropolitan Polytechnic Institutions, as they are called, can overtake this highest and most important kind of education. Do not let us fancy that the establishment of these no doubt very valuable institutions is the ultimatum to be aimed at in technical education, or imagine that they can attempt to do what is done in Germany, France, or Switzerland by institutions bearing the same name. I look upon it as a misfortune that, by mere chance, the name of the old Institution in Regent Street, known to fame as the home of the diving-bell and of Prof. Pepper's Ghost, should have been retained for institutions which neither resemble it nor the high schools which form so marked a feature in the Continental educational system. These latter are in our country rather represented by the scientific departments of our Universities, and by those of the metropolitan and local University Colleges, by the Royal Normal School of Science, and by your own Central Institute. We cannot too clearly understand that whatever success attends the foundation of these Metropolitan Polytechnics—and no one more cordially wishes them success than I do—the work of the centres of the highest education still remains; indeed, the greater the popularity of the lower institutions, the greater the need and scope for the higher ones.

The rapid growth in London of this idea of the importance of handicraft and recreative education is most remarkable, and for this stimulus we are almost wholly indebted to Mr. Quintin Hogg.

The effect of this movement upon your Institute has been severely felt, for it is clear that, whereas seven or eight years ago the enthusiasm of the City Companies was strongly in favour of the higher technical education in the Continental sense, it is now all for this newer and more popular, I will not say less useful, form of handicraft and recreative instruction.

It is a fact which may as well be clearly stated, that the Central College cannot do all it might do for want of a few thousands, and that the scheme of technological examinations is crippled by the loss of the support of those who at first nobly contributed towards these objects.

The Drapers prefer to support more popular institutions at the East End, and the Goldsmiths do likewise in regard to their own institution at New Cross, so that there is no doubt that the interest formerly felt in the general and collective work of the Institute is distinctly on the wane.

Well, ladies and gentlemen, a consideration of these patent facts leads one to the question, How are these things to go on? Are we never to have "law and order"—about which we have heard enough in other matters—introduced into affairs educational?

And in what I am about to say, let me premise that I merely express my own individual opinion as an independent observer, anxious only for the success of the good cause which we all have at heart. Then may I say that I am dead against a cut-and-dried system of Governmental education such as we see in other countries. I am all for stimulating and developing local effort to local requirements, and it is because I am fully aware of the dangers of centralization, and desire to promote adaptability to local needs, that I gave my hearty support to the Government Technical Instruction Bill as amended in the House of Commons, in which the power of the locality to work out its own educational salvation is fully safe-guarded.

But holding these views I see clearly that there are things which can only be satisfactorily accomplished by a central authority.

That our primary education can only be properly conducted on a national basis has been admitted for more than a quarter of a century; so it will be with the higher or secondary education, whether technical, commercial, or professional—we *must* have a system. As I have said, the foundation of your Institute was the beginning of such a system for technical instruction; but has it not already outstripped the bounds of your control? Can it be satisfactorily worked in the future on its present lines?

Let us look at the matter from an independent point of view. We have now three Government Departments charged with educational work—the Education Department for Elementary Instruction, the Science and Art Department, and the Charity Commissioners. One of the most important steps which could be taken to bring these under effective control is the appointment of a Minister of Education, of Cabinet rank, who would be in close touch with every part of our now discordant educational system. But that is not the immediate question before us.

This refers more especially to the desirability of consolidating the Science and Art Department. As you know, this controls and stimulates, in what I think we may allow to be a satisfactory manner, the teaching of elementary science and of art throughout the country. Would it not conduce to the benefit of the country, if the Guilds' technological examinations were to be undertaken by the Department, and thus placed on a national basis? Several of the subjects now included in the Directory of the Department, on which grants are made, are of a distinctly technical character, and therefore no objection can be raised that the other subjects now under the Guilds Institute cannot equally well be placed under the Department.

The benefits which would thus accrue are great and palpable, the two systems of examinations in pure and in applied science would then work side by side without friction or overlapping, and the extension of the technical examinations would be easy and certain.

If this were accomplished, I for one would strongly urge the removal of the system of payment on individual results—a method in all cases to be deprecated, but one which is especially unsuited for testing the value of technical instruction. This can be much more certainly effected by ascertaining the efficiency of the whole class, of the teacher, and of his appliances, by inspection or otherwise.

If once we get rid of this system of payment on individual results in one set of subjects, we may look forward to its ultimate extinction in the others, and no subject seems so suitable for making a beginning as that of technical instruction.

I would therefore suggest that the best means of securing the permanency and the extension of the very useful technological examinations which your Council—and all honour to them for it—have started, is to request the Government to take them over, thereby rendering the Science and Art Department more efficient, and enabling that Department to make the improvements and alterations in the system which it undoubtedly requires.

May I go one step further in these suggestions, and ask if this should be done, is it not a necessary corollary that the Central Institute should likewise become a Government Normal School for Applied Science? There is much to be said in favour of such a proposal.

The very situation, close to the Royal Normal School of Science, seems to forecast its ultimate destiny. Under separate management, no consistent or well-arranged scheme of common work is possible; brought under one direction, the essential alliance between pure and applied science, as regards teaching, becomes easy of attainment.

Students would pass and re-pass from the one school to the other, obtaining at the one the knowledge of the scientific principles, and, at the other, that of their applications.

Of the national advantages of such a fusion there can, I think, be little doubt. England would then be in possession of an institution which might, for completeness and efficiency, both as regards the *personnel* and the appliances, soon be made second to none on the Continent, and worthy of the greatest industrial nation in the world.

Your Institute would thus set itself free to extend its influence in other directions, and could then concentrate its efforts on what is perhaps, after all, its most legitimate and most useful function—that of providing intermediate technical schools on the pattern of the Finsbury School, of which many are required in the metropolis.

The exact terms on which the Government would be prepared to take over this part of your work is a subject on which, of course, I cannot pretend to enter, but a satisfactory basis can, I do not doubt, easily be found.

Your Council would then feel that the great work which they have begun has been handed over in its full vigour to the nation, and that with the nation lies the responsibility of extending and perfecting the system which they have had the honour and the gratification of inaugurating.

If, in the foregoing remarks, I have raised a somewhat burning question about which I know there is a difference of opinion, my apology must be the importance of the subject, and the anxiety which we all feel that the technical education of our country shall be placed on a firm and enduring national basis.

A FIRST FORESHADOWING OF THE PERIODIC LAW.

IT is well known that the Newlands-Mendeleeff classification of the elements was preceded by the discoveries of certain numerical relations between the atomic weights of allied elements, due to Döbereiner, Dumas, and others; but what has been almost entirely ignored is the immense advance made by M. A. E. Béguyer de Chancourtois,[1] a French geologist of note, Professor at the École des Mines, who was the first to publish *a list of all the known elements in the order of their atomic weights.*

M. de Chancourtois embodied his results in two memoirs presented to the French Academy of Sciences in April 1862 and March 1863. These memoirs have never been printed *in extenso*,[2] but extracts from them, and additional notes relating to the subject, were published in the *Comptes rendus* for 1862 (liv. pp. 757, 840, and 967; lv. p. 600), 1863 (lvi. pp. 253 and 479), and 1866 (vol. lxiii. p. 24). The first note bears the date of April 7, 1862, so that there can be no doubt as to de Chancourtois's claim to priority in this important matter.[3]

I have in my possession a thin quarto pamphlet, by de Chancourtois, entitled "Vis Tellurique: Classement naturel des corps simples ou radicaux, obtenu au moyen d'un système de classification hélicoïdal et numérique" (Paris, Mallet-Bachelier,[4] 1863), which contains nearly all the extracts from the *Comptes rendus*, together with some additional matter. It contains, also, what is absolutely essential to the comprehension of de Chancourtois's ideas, the graphic representation of his system, which is not to be found in the *Comptes rendus.*

I propose to give here a translation of the first communication to the Academy, followed by certain explanatory comments and brief extracts from the other papers:—

"Geological studies in the field of research opened up by M. Elie de Beaumont in his note on volcanic and metalliferous intrusions (*émanations*) have led me, for the completion of a lithological memoir on which I am now engaged, to a natural classification of the simple bodies and radicles by a table in the form of a helix, founded on the use of numbers which I call *characteristic numbers* or *numerical characteristics.*

"My numbers, which are immediately deduced from the measure of the equivalents or other physical or chemical capacities of the different bodies, are, in the main, the proportional numbers given by the treatises on chemistry, these being reduced to half in the case of hydrogen, nitrogen, fluorine, chlorine, bromine, iodine, phosphorus, arsenic, lithium, potassium, sodium, and silver; in other words, I either divide the equivalents of these bodies by two in the system in which oxygen is taken as 100, or multiply by two the equivalents of the other bodies in the system in which hydrogen is taken as unity.

"On a cylinder with a circular base, I trace a helix which cuts the generating lines at an angle of 45°. I take the length of one turn of the helix as my unit of length, and starting from a fixed origin, I mark off on the helix lengths corresponding to the different *characteristic numbers* of the system in which the number for oxygen is taken as unity. The extremities of the lines thus marked off determine points on the cylinder which I call indifferently *characteristic points* or *geometrical characters*, and which I distinguish by the ordinary symbols for the different bodies. The same points will evidently be obtained if we take as the unit of length the $\frac{1}{16}$ of a turn of the helix, and mark off on the curve lengths corresponding to the numbers of the system in which hydrogen is represented by unity.

"The series of points thus determined constitutes the graphic representation of my classification, which may easily be traced on a plane surface by supposing the surface of the cylinder developed; by its aid I am enabled to enounce the fundamental theorem of my system: *The relations between the properties of different bodies are manifested by simple geometrical relations between the positions of their characteristic points.*

"For instance, oxygen, sulphur, selenium, tellurium, bismuth,[1] fall approximately on the same generating line, while magnesium, calcium, iron, strontium, uranium, and barium, fall on the opposite generating line. On either side of the first of these lines we find hydrogen and zinc on the one hand, bromine and iodine, copper and lead on the other; parallel to the second line we find lithium, sodium, potassium, manganese, &c.

"Simple relations of position on a cylindrical surface would be obviously defined by means of helices, of which the generating lines are only a particular case; hence, as a complement to the first theorem, we may add the following: *Each helix drawn through two characteristic points and passing through several other points or only near them, brings out relations of a certain kind between their properties; likenesses and differences being manifested by a certain numerical order in their succession, for example, immediate sequence or alternation at various periods.*

"In order to attain a greater degree of accuracy, it is necessary to discuss the results of different measurements with respect to the same body.

"One question is all-important in this discussion; it is to know if the divergencies which occur may have causes other than the error of experiment. I reply to this question in the affirmative.

"I think that here, as in all determinations of constants which we wish to compare, they must be reduced to the same conditions. This idea seems to me the indispensable complement to the notion of an absolute characteristic number. Once the existence of this absolute number or *numerical characteristic* guaranteed by the possibility of connecting it afresh with observed facts, certain limits of variation being allowed [*literally*, varying within certain limits], we promptly arrive at Prout's law, which presents itself as furnishing a means for reducing experimental observations to a comparable state by a series of trials, without this state being even a completely defined one, but, on the contrary, in order to be able to define it. The combination of this principle with the rules for alignment allow me to give the most striking form to my invention. I am thus led to formulate the table of integral numbers, which, as I must not omit to mention, exhibits under certain aspects the *résumé* of the work of M. Dumas on this subject.

"In the construction of this table I have had recourse to the determinations of specific heats, not only as a means of control, but also to find new numbers unattainable by the methods of chemical investigation. By adopting as the constant product of specific heat by atomic weight, the number which corresponds both to sulphur and to lead, I have deduced from the series of results given by M. Regnault, purely *thermic* quotients or numbers, which take their places on my alignments in the most felicitous way. I will only quote two examples: firstly, the number 44, obtained from the specific heat of the diamond, which finds its place on the generating line of the characteristic, 12, of carbon, by the side of the characteristic, 43, which corresponds to one of the equivalents generally accepted for silicon; and another

[1] Wurtz ("The Atomic Theory," p. 170) and Berthelot ("Les Origines de l'Alchimie," p. 302) give a bare mention of de Chancourtois's name. Mendeleeff, in his Faraday Lecture (Journ. Chem. Soc., October 1889), couples his name with those of Newlands and Strecker, and shows greater appreciation of his work.

[2] M. Friedel, the eminent Professor of Organic Chemistry at the Sorbonne, has kindly procured for me the information that the original manuscripts of these memoirs are preserved in the archives of the Institut; I hope to be able to examine them at some future period.

[3] Mr. Newlands' first paper, chiefly devoted to showing that the numerical differences between the atomic weights of allied elements are approximately multiples of 8 was published on February 7, 1863 (*Chemical News*, vol. vii. p. 70); his second paper, in which he arranges the elements in the order of their atomic weights, was published on July 30, 1864 (*Chemical News*, vol. x. p. 39). See J. A. R. Newlands "On the Discovery of the Periodic Law," &c. (Spon, 1884).

[4] Now Gauthier-Villars.

[1] This is probably a misprint, as bismuth does *not* fall on the same generating line in the table.

characteristic, 36, of silicon deduced from an equivalent proposed by M. Regnault, and which is very remarkable, from its coincidence with the characteristic of ammonium.

"By the discussion, which has shown me the advisability of accepting various results hitherto looked on as scarcely reconcilable, I have been led to conceive the possibility of reproducing the *series of natural numbers* in the series formed by the numerical characteristics of the real or supposed simple bodies supplemented by the characteristics of the compound radicles formed from gazolytic[1] elements, such as cyanogen, the ammoniums, &c., and doubtless also by the compound radicles formed from metallic elements, of which the alloys offer us an example. In this natural series, the bodies which are really simple, or at least irreducible by the ordinary means at our disposal, would be represented by the *prime numbers*. It will be at once seen that there are in my table at least twelve bodies, which, like sodium (23), have characteristics which are prime numbers. This is what led me to perceive this law, which, I believe, is destined, when established, to form one of the bases for the discovery of the law of molecular attraction. The predominance of the law of divisibility by 4 in the series of my table, a predominance which is also to be found in the elements of the theory of numbers, has confirmed me in the idea—an idea in itself really simple—that there is a perfect agreement between bodies, the elements of the material order, and numbers, the elements of the abstract order of things (*éléments de la variété matérielle, de la variété abstraite*). This goal once caught sight of, it will seem natural that I should have recourse to the theory of numbers to help me attain it. It will seem not less natural that I should also have recourse to higher geometry; for the series of relations it offers cannot fail to afford resources which may enable one to establish connections between the different numerical characteristics.

"My helicoidal system in this way leads me on towards abstract views of an extremely general nature; and on the other hand it should, it seems to me, find an application in the natural[2] sciences, as a method of classification throughout their whole domain, from the series of simple bodies which forms the prototype, to the opposite extreme of our natural divisions; in it will be found, I believe, the means of bringing into connection simultaneously, and by all their characters, the different terms of those parallel series, orders, families, genera, species, and races, in each natural kingdom, of which men of science have in vain tried to show the affiliation. In geology, as is evident, the application is implicit.

"Whatever may be the import of these considerations, and to return to the principal object of the present memoir, I think that the efficacy of the helicoidal system will be admitted as a means towards hastening the advent of the time when chemical phenomena shall be amenable to mathematical investigations.

"My table, by the distribution of bodies in simple or coupled series, by its indication of the existence of conjugate groups, &c., traces a plan for diverse categories of syntheses and analyses already executed or to be executed; it draws up very definite programmes for the execution of several researches which are exciting attention. Will not my series, for instance, essentially chromatic as they are, be a guide in researches on the spectrum? Will not the relations of the different rays of the spectrum prove to be derived directly from the law of numerical characteristics, or *vice versâ?* This idea, which occurred to me before we were taught the identification of the lines in the spectrum, and the admirable applications of this discovery, seems to me now even more than probable. Finally, looking upon it only as a concise representation of known facts, and reducing it to the points which offer no matter for discussion, the geometrical table of numerical characteristics affords a rapid method for teaching a large number of notions in physics, chemistry, mineralogy, and geology. I hope, therefore, that my natural classification of the simple bodies and radicles being capable of rendering manifold services, will need, like every object in habitual use, a name of easy application; hence, on account of its graphic representation and its origin, I give it the significant name of *telluric helix*."

It will be well to point out immediately that M. de Chancourtois's system assigns to the *numerical characteristics* of the elements a general formula of the form $(n + 16n')$, where n' is necessarily an integer;[3] and his table thus brings out the fact

[1] Metalloid.

[2] The term includes physical science.

[3] n is always represented in the author's table as integral, but he expressly states that he looks on this as by no means necessary. "The construction of the telluric helix rests on the use of proportional numbers derived from experiment. It would remain valid with fractional numbers, and often the helicoidal alignments would be even more easily applicable to these than to integers" (*Comptes rendus*, vol. liv. p. 842).

that the differences between the atomic weights of allied bodies approximate in many cases to multiples of 16.[1]

Thus we get the parallel series of which our author speaks—

Li ... Na ... K ... Mn

$$7 \;\ldots\; 7 + 16 = 23 \;\ldots\; 7 + 2 \,.\, 16 = 39 \;\ldots\; 7 + 3 \,.\, 16 = 55.$$

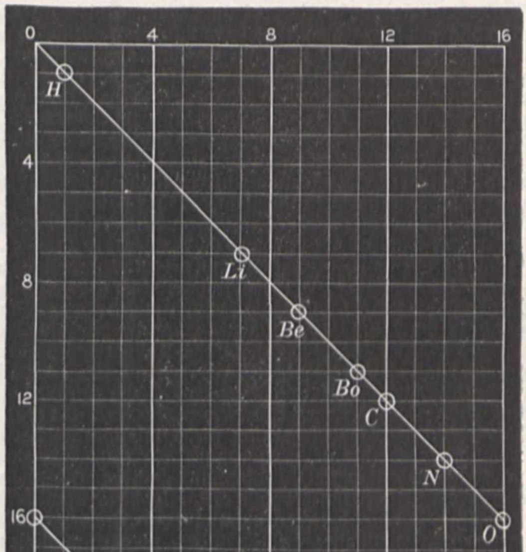
Rb

$$7 + 5 \,.\, 16 = 87.$$[2]

O ... S ... Se ... Te

$$16 \ldots 16 + 16 = 32 \ldots 16 + 4 \,.\, 16 = 80 \ldots 16 + 7 \,.\, 16 = 128.$$[3]

As we glance at the first two turns of de Chancourtois's helix, we ask ourselves if the discovery of Newlands and Mendeleeff does not lie before us.



But the discovery of the "octaves" or "periods" cannot be ascribed to our author, although it seems almost impossible that chemists should not have perceived their existence on looking at his table.

[1] This fact, now familiar, has again been noticed by your correspondent, Mr. A. M. Stapley, in the issue of November 21, 1889.

[2] The atomic weight of rubidium should be 85. We may notice that the author gives as probable also $Cs = 135 = 7 + 8 \,.\, 16$, which is thus placed on the same generating line.

[3] Certainly too high a value; according to Brauner, the exact atomic weight of tellurium remains to be determined.

Three important points, however, do exist in common between de Chancourtois's system and that of Mendeleeff:—

Firstly, all the known elements are arranged in the order of their combining weights.

Secondly, the combining weights chosen as best suited to bring out clearly the numerical relations existing between them are those adopted by Cannizzaro in 1858, a striking fact when we recollect that de Chancourtois wrote only in 1862, at a date long before these numbers had gained anything like general acceptance.

Lastly, an attempt is made to show that simple numerical relations exist, not only between the combining weights, but between all the measurable properties (*toutes les capacités physiques et chimiques*) of allied elements.

The reasons for the neglect of de Chancourtois's researches and the oblivion into which they have fallen are not far to seek. His style was heavy and at times obscure, and, moreover, his ideas were presented in a way most unattractive to chemists.

A geologist by profession, de Chancourtois had been powerfully impressed by the facts of isomorphism in the case of the feldspars and pyroxenes, which form such important constituents of the volcanic rocks he was studying; and he was thus led to seek for a system of classification which should bring out some simple relationship between the elements they contained.

To quote from his paper (*Comptes rendus*, vol. liv. p. 969): "The parallelism of the groups of manganese (7 + 3 . 16) and iron (8 + 3 . 16), of potassium (7 + 2 . 16) and calcium (8 + 2 . 16), of sodium (7 + 16) and magnesium (8 + 16), is the origin of my system"; and again, suggesting the expediency of adopting 55 (= 7 + 3 . 16) as a *characteristic* for aluminium, which would bring the element on the sodium and potassium generating line, "this would render perfect the parallelism between the elements of the feldspars and the pyroxenes, the starting-point of my system" (*Comptes rendus*, lvi. p. 1479).

Thus the correct idea of seeking for a relationship between the combining weights of isomorphous elements was marred by a somewhat imperfect comprehension of the facts of isomorphism. No chemist would certainly have tried to show any close relationship between aluminium on the one hand and the group of the alkalies on the other, notwithstanding their union in the feldspars and pyroxenes; and a suggestion of this kind served to cast discredit on de Chancourtois's really important views.

Notwithstanding his frequently eccentric ideas, de Chancourtois had the merit, so rare in an inventor of this stamp, of not considering his system as final. We cannot do better than let him speak for himself; and quote the conclusion of his last paper on the subject (*Comptes rendus*, lvi. p. 481):—"In presence of the rapid increase in the list of elements which engage the attention of chemists and physicists, it has become urgent to unite in one synthesis all the notions of chemical and physical capacities, of which the exposition would otherwise become an impossible task.

"It is, therefore, perhaps not unnecessary to recall the ideas of Pythagoras, or what I may better term the *Biblical truth* which dominates all the sciences, and of which I propose to make practical use by the following concrete example,[1] the first general conclusion of my essay:—

"THE PROPERTIES OF BODIES ARE THE PROPERTIES OF NUMBERS.

"It is easily perceived, that a helicoidal system of some kind or another, which is necessarily a graphic table of divisibility, offers the most convenient means for rendering manifest the relations between the two orders of ideas. It is evident, also, that the particular system which I have adopted brings into relief the relations of the most important and usual of the properties of matter, because the case of divisibility by 4, which is the basis of my plan, is the first which presents itself in arithmetical speculation after the case of divisibility by 2, to which there corresponds directly, as one perceives by a first glance at my table, the existence of the natural couples of elements, with consecutive odd and even characteristics.

"I hope, therefore, that the *telluric helix* will offer, until it is replaced by some more perfect invention, a practical framework, a convenient scale, on which to set down and compare all measurements of capacities, whatever the point of view which may be taken, whatever elasticity or variation, whatever interpretation may be given to the *numerical characteristics*, by which these capacities must always be represented.

[1] The French is *vulgarisation*, literally *popularization*.

"The development in a plane of the cylinder ruled into squares, with the circumference at the base divided into 16 equal parts, seems to me, in a word, to be a *stave* on which men of science, after the fashion of musicians, will note down the results of their experimental or speculative studies, either to co-ordinate their work, or to give a summary of it in the most concise and clear form to their colleagues and the public."

Lothar Meyer has noted down his classification in the form of a helix,[1] and Dr. Johnstone Stoney, F.R.S., has shown that the numerical values of the atomic weights may be expressed geometrically as functions of a series of integral numbers by points all lying approximately on a logarithmic spiral.

But no simple mathematical formula has so far been discovered to express the relationships of the atomic weights accurately—*i.e.* within the limits of experimental error, and de Chancourtois's predictions still remain but incompletely fulfilled.

I need not comment further on the remarkable breadth and originality of our author's views, taken as a whole. Strange to say, it was only a year or two before his death that he heard, through a colleague, of the immense development they had undergone; nor did he ever set up any claims to priority. But when we speak of the greatest generalization of modern chemistry, and recall the names of Newlands and Mendeleeff, it is only just that we should no longer forget their distinguished precursor, de Chancourtois.

P. J. HARTOG.

[1] "Die modernen Theorien der Chemie," iv. Auflage, p. 137; English translation, p. 118.

SCIENTIFIC SERIALS.

American Journal of Science, December.—The temperature of the moon, by S. P. Langley, with the assistance of F. W. Bery. With this memoir the authors complete the researches begun at the Allegheny Observatory in 1883 and continued during the next four years. The main outcome is that the mean temperature of the sunlit lunar surface is much lower than has been supposed, most probably not being greatly above 0° C.—The Lower Cretaceous of the South-West, and its relation to the underlying and overlying formations, by Charles A. White. The chalk formations constituting the so-called "Texas Section" are here referred to two natural divisions, which may be designated the Upper and Lower Cretaceous respectively, although not necessarily the exact equivalents of the corresponding European strata. Their fossil contents show that each represents an unbroken portion of Cretaceous time, while the palæontological contrast between the two indicates that there is a time hiatus between them. But this hiatus is no greater than exhibited in others of the mountain uplifts in the same region, and not so great as it is in some cases.—On the hinge of Pelecypods and its development, with an attempt toward a better subdivision of the group, by William H. Dall. Three fundamental types of hinges are described, and on these is based a new classification comprising the three orders of Anomalodesmacea with five sub-orders, Prionodesmacea with eight sub-orders, and Teleodesmacea with eleven or more sub-orders.—The magnetism of nickel and tungsten alloys, by John Trowbridge and Samuel Sheldon. The question is here discussed whether nickel and tungsten alloys magnetized to saturation increase in specific magnetism as different kinds of steel alloyed in small proportions with tungsten or wolfram are known to do. The tabulated results show that tungsten greatly increases the magnetic moment of nickel, if the alloy be forged and rolled, but has small influence if simply cast; nor do changes in the amount of tungsten appear to cause corresponding changes in the magnetic properties of the alloy.—Note on the measurement of the internal resistance of batteries, by B. O. Peirce and R. W. Willson. The authors' researches show that the value of the resistance of a cell obtained by the use of alternate currents is always smaller than that obtained by other methods, but the application of the method of alternate currents "fatigues" all but the so-called constant cells. In most cases there is a tendency in the internal resistance to *decrease* as the strength of the current which the cell is delivering increases.—Papers were contributed by Robert T. Hill and R. A. F. Penrose, Jun., on the relation of the uppermost Cretaceous beds of the Eastern and Southern United States, and on the Tertiary Cretaceous parting of Arkansas and Texas; by W. E. Hidden and

J. B. Mackintosh, on sundry yttria and thoria minerals from Llano County, Texas; and by O. C. Marsh, on the skull of the gigantic Ceratopsidæ.

THE *American Meteorological Journal* for November contains the first part of an article on "Theories of Storms, based on Redfield's Laws," by M. H. Faye, member of the French Institute. In support of his "whirlpool" theory, he urges that meteorologists have constructed a theory of storms on the basis of a single fact, viz. that storms which burst over a region cause a fall of the barometer there, and he points out that starting with the idea of an ascending column, exercising an aspiration below, a thing is invariably produced which neither turns nor progresses. Mr. A. L. Rotch contributes the first part of an article on "Meteorology at the Paris Exposition," dealing with the instruments exhibited in the French Section. Among the most interesting are (1) the actinometers exhibited by the Montsouris Observatory; (2) the Richard actinometer, which has bright and black bulbs *in vacuo*, connected with two thermometers, by which curves are traced giving at each instant the radiation from the sky, both at night and day; (3) the Richard anemographs, which have, instead of the usual Robinson cups, a fan wheel formed of six blades inclined at 45°, and fastened to a very light axis, one revolution of the wheel corresponding to one metre of wind. Parrigou-Lagrange's anemometer (NATURE, vol. xxxvii. p. 18), giving the vertical component of the wind, was also exhibited. M. Baudin showed some very fine standard thermometers, and Mr. Rotch describes various other instruments, such as hygrometers, aneroids, &c. Dr. F. Waldo continues his discussion of the "Distribution of Average Wind-velocities in the United States." The present article deals with the comparison of average wind-velocities with other elements, *e.g.* with barometric minima. Lieutenant Finley contributes State tornado charts for Arkansas, North Carolina, and Dakota.

THE numbers of the *Journal of Botany* for November and December are chiefly occupied with articles of special interest to students of British botany. Mr. Thiselton Dyer gives a very interesting biography of the late Mr. John Ball, F.R.S., first President of the Alpine Club, Under-Secretary of State for the Colonies under Lord Palmerston, an ardent explorer in all the four quarters of the globe, and a botanist of wide and varied knowledge. In the December number is a remarkable article on the disappearance of British plants, mainly through the depredations of collectors.

Rendiconti del Reale Istituto Lombardo, November 1.—Physical researches on the lakes of North Italy, by Prof. F. A. Forel. During a visit to this lacustrine region, last autumn, the author studied the waters of Lakes Maggiore, Como, Piano, and Lugano, with a view to determining their temperature, colour, and transparency, as compared with the analogous properties of Lakes Lucerne and Geneva. The results, which are here tabulated, show that the temperature is generally higher, and the colour deeper in the Italian than in the Swiss lakes, while the transparency is about the same, except in the shallow Lake Piano, where the temperature is lower and the transparency less than in any of these basins.—Meteorological observations made at the Brera Observatory during the month of September. These observations include records of temperature, barometric pressure, atmospheric moisture, rainfall, direction of the winds, and cloudiness.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 12.—"The Relation of Physiological Action to Atomic Weight." By Miss E. J. Johnston, University College, Dundee, and Thos. Carnelley, Professor of Chemistry in the University of Aberdeen. Communicated by Sir Henry Roscoe, F.R.S.

A. *As deduced from the Character of the Elements occurring naturally in Living Organisms.*—It is shown (*a*) that life is associated with a low atomic weight, so that elements with an atomic weight of 40 and under are required by the living organism, whereas those of an atomic weight greater than 40 are more or less inimical to life (compare Sestini, *Gazz. Chim. Ital.*, vol. 15, p. 107). (*b*) That the eight elements which enter most largely into the composition of the earth's crust, and which, therefore, are the most easily accessible to the living organism, are all included, with the exception of aluminium, in the fourteen elements which are required by the living organism.

A consideration of the exceptions (viz. Li, Be, B, Al, and Fe) to the first rule and of all the known facts bearing on the question leads to the conclusion that, "*The degree of necessity of an element to the living organism is a function of, first, its atomic weight, and, second, its accessibility to the organism.*" An element may be inaccessible to living organisms either because it is rare (*e.g.* Li and Be); or because, though moderately common, it has a very limited distribution (*e.g.* B); or because, though plentiful and widely distributed, it does not occur in nature in a form in which it can be assimilated (*e.g.* Al, on account of the insolubility of its native compounds).

That elements which are necessary to life must be readily accessible is self-evident, but that living organisms should require elements with low atomic weights, while elements with high atomic weights are inimical to life, is not so evident. This, however, may be due, in part at least, to the fact that the elements with low atomic weights are on the whole the most common elements (as shown by Gladstone, *Phil. Mag.* [5], vol. 4, p. 379; compare also Mendeljeff, *Zeit. f. Chem.* vol. 5, 1869, p. 405), and therefore the most accessible, so that *from the first the elements utilized in vital processes have been those which have been the most accessible, and therefore those with the lowest atomic weights.*

B. *As deduced from the Toxic Action of Compounds administered artificially.*—In view of the somewhat discordant results obtained by previous observers as to the relation between atomic weight and physiological action, the authors have reinvestigated the subject as carefully as possible. Their experiments have been made partly with fish (sticklebacks) and partly with aërial micro-organisms, the salt being administered by solution in the medium (water or Koch's jelly) in which the organism lived. the following conclusions are drawn from the results of about 800 experiments which the authors have made during the two years they have worked on this subject:—

1. *With corresponding compounds of elements belonging to the same sub-group, the toxic action*[1] *alters regularly* (i.e. *increases or diminishes*) *with the atomic weight.*

2. *In almost all cases this alteration takes place in such a way that the toxic power increases with the atomic weight.* (This is analogous to increase in toxic action in homologous series of carbon compounds.)

3. *Elements belonging to odd series* (Mendeljeff's classification) *are much more toxic than the corresponding elements of even series.*

4. *Other things being the same, the greater the ease of reducibility of an element from a state of combination to the free state the greater its toxic action.* (Applicable to compounds of odd as compared with those of elements of even series, and also to compounds of the elements of odd series belonging to the same group when compared with one another.)

5. *Other things being the same and the compounds comparable, the greater the heat of formation of a compound from its elements the smaller is its toxic power*; or, in other words, the greater the stability of a compound the smaller its toxic power. (Applicable to elements belonging to odd series; data for those belonging to even series are wanting or are too incomplete.)

There is a close connection between rules 3, 4, and 5.

6. *Lithium forms a very marked exception to all the above rules*, for notwithstanding its very low atomic weight, its difficult reducibility to the free state, the fact that it belongs to an even series, and the great stability of its compounds, as indicated by their relatively great heat of formation, its toxic power is, nevertheless comparatively very great. This exceptional character of lithium, however, is not limited to its physiological action only, but applies likewise to many of its purely chemical and physical properties. So much so, indeed, is this the case that its exceptional physiological character might have been foreseen.

7. *The toxic action of a series of comparable salts runs parallel with the solubility in such a way that as the solubility increases the toxic action either increases likewise or else diminishes.*

8. *When the quantity of salt present in Koch's jelly is less than the minimum dose required to prevent the development of micro-organisms, the number of colonies which develops increases as the amount of salt diminishes, but as a rule much more rapidly.*

[1] As represented in terms of either the minimum toxic weight of metal or of the minimum molecular toxic dose. The minimum molecular toxic dose = minimum toxic weight of salt ÷ molecular weight of the salt.

9. When Koch's jelly has been previously neutralized with sodium carbonate the minimum quantity of metallic salt required to prevent the development of aërial micro-organisms is scarcely altered in the case of KCl, NaCl, $MgCl_2$, and $HgCl_2$, but is slightly greater in that of $CaCl_2$, and much less in the case of KBr, KI, NaBr, NaI, $ZnCl_2$, and $CdCl_2$, than when the jelly has not been neutralized.

10. *Mercuric iodide,* notwithstanding its comparative insolubility, *has an exceptionally high antiseptic power*, which is 1½ times as great as that of mercuric chloride per weight of salt, or 2½ times as great per weight of metal, or 3 times as great per minimum molecular toxic dose.

Geological Society, November 20.—Mr. W. T. Blanford, F.R.S., President, in the chair.—The Secretary announced that a series of specimens from the line and the neighbourhood of the Main Reef, east and west of Johannesburg, Witwatersrand Gold Fields, had been presented to the Museum by Dr. H. Exton, and a letter from that gentleman in explanation of them was read. In this Dr. Exton stated that all but one of the mines represented were on the main reef of the district, which has a general direction east and west, its dip varying generally from 45° to 80°. South of the main reef, and parallel to it at a distance of 15–20 feet, is a narrow reef known to the miners as the "south leader," and generally much richer than the main reef. The gold-bearing deposits consist of conglomerates, specimens of which, and of a purplish-red rock which forms a jagged ridge at some distance north of and parallel to the so-called reef, were contained in the collection. The President considered the occurrence of the gold in large quantities in such a conglomerate was a remarkable and interesting case. The rock was an ancient-looking one, and the country appeared to have undergone much disturbance. Dr. Hinde remarked that in Nova Scotia beds of conglomerate of supposed Carboniferous age were formerly worked for gold, but the yield had not been very great.—The following communications were read :—On the occurrence of the striped hyæna in the Tertiary of the Val d'Arno, by R. Lydekker.—The catastrophe of Kantzorik, Armenia, by Mons. F. M. Corpi ; communicated by W. H. Hudleston, F.R.S. Secretary. The village is 60 km. from Erzeroum, and 1600 metres above sea-level. Subterranean noises and the failure of the springs had given warning, and on August 2 last part of the "eastern mountain" burst open, when the village, with 136 of its inhabitants, was buried in a muddy mass. The author described the district as formed of Triassic, Jurassic, and Cretaceous strata, subsequently broken up and torn by granitic, trachytic, and basaltic rocks, which overlie the Secondary rocks, according to the nature of the dislocation. The flow was found to have a length from east to west of 7–8 km., with a width ranging from 100 to 300 metres, and the contents were estimated at 50,000,000 cubic metres. It appeared as a mass of blue-grey marly mud, which, after the escape of the gases, solidified at the top ; the inequalities projected to the extent of 10 metres. The site of the village was marked by an elevation of the muddy mass, some of the *débris* of the houses having been carried forward. The lower part of the flow was still in a state of motion, and carried forward balls of marly matter. It was difficult to approach the source of this flow on account of the crevasses in the side of the mountain. An enormous breach served as the orifice for the issue of the mud, which emitted, it was said, a strong odour. The violent projection of this marly liquid and "incandescent" (?) mass had carried away a considerable portion of the flanks of the mountain, whose *débris* might be recognized on the surface of the flow by the difference of colour. Great falls were still taking place, throwing up a fine powder which rose into the air like bands of smoke. There were also fissures and depressions of the ground at other localities in the neighbourhood. The President, in commenting on the remarkable nature of the phenomenon, said it was not a volcano eruption, but more of the nature of a mud-flow produced by a big landslip—possibly connected with the stoppage of the springs. Still it was on a very large scale, though clearly the effect of water and not of fire. Dr. Evans agreed with the President. It was difficult to reconcile the alleged incandescence with the other phenomena. Infiltration of water probably had something to do with the outburst. It was not even a mud volcano. The falling in of the mountain, he thought, might have been due to soft beds covered by harder material having oozed out. It would be interesting to know if there had been an increased rainfall prior to the occurrence. There was nothing of a truly volcanic nature mentioned in the paper. He should like to have further information about the incandescence. Mr. Dallas (the translator of the paper) said that the "redness" was reported by the people to the author. Rev. Edwin Hill thought that the mud-balls could in no way be explained by igneous agency. The photographs gave no indication of the presence of steam. As a landslip the amount was very great, and possibly the phenomenon might be something similar to the overflow of peat-bogs. Mr. Hudleston recalled the statement of the author regarding the geological constitution of the district, where masses of Secondary rocks are folded within igneous ones, probably of Tertiary age. It was likely, therefore, that some of the softer Secondary marls, pressed in more than one direction by harder rocks and soaked by water, might at last have given way. The immediate cause of the catastrophe could scarcely be indicated without a knowledge of the district. Such events occurred from time to time elsewhere. The Russian topographers, if his memory served him right, had described the bursting of a mountain-side wlth fatal results, in one of the valleys near Lake Issyk Kul. The smoke-like powder, resulting from the continued falls of rock, had often given rise to the notion of volcanic action. There could be no better instance of this than the case of Mount St. Elias, the highest mountain in North America. In geography-books this mountain has almost invariably been described as a volcano, and a portion has actually been designated as the crater. This illusion had been occasioned by the dust of rock-falls resembling smoke. We might well pardon the author for speculating on the probability of a return to volcanic activity in a region which bears so many traces of it as this part of Armenia.—On a new genus of Siliceous sponges from the Lower Calcareous Grit of Yorkshire, by Dr. G. J. Hinde.

December 4.—Mr. W. T. Blanford, F.R.S., President, in the chair.—The President stated that a circular letter had been received from the Secretary of the Committee on Geological Photographs, formed at the last meeting of the British Association for the Advancement of Science, to arrange for the collection, preservation, and systematic registration of photographs of geological interest in the United Kingdom, in which the aid and co-operation of geologists is earnestly requested. Copies of instructions, &c., drawn up in order to secure uniformity, are to be obtained on application to Mr. O. W. Jeffs, Secretary to the Committee, 12 Queen's Road, Rock Ferry, Cheshire, and one would be suspended on the Society's notice-board.—The following communications were read :—On remains of small Sauropodous Dinosaurs from the Wealden, by R. Lydekker.—On a peculiar horn-like Dinosaurian bone from the Wealden, by R. Lydekker. Among a series of vertebrate remains sent from the Dorsetshire County Museum to the British Museum, there is an imperfect, stout, short, cone-like bone from the Wealden of Brook, Isle of Wight. It appears to present a close resemblance to the horn-cores of the Dinosaur described by Prof. Marsh as *Ceratops*. The author did not regard the specimen as affording conclusive evidence of the existence in the Wealden of a large Dinosaur furnished with horn-like projections on the skull like those of the American *Ceratops*, but suggested that such might really prove to be its true nature.—The igneous constituents of the Triassic breccias and conglomerates of South Devon, by R. N. Worth. The reading of this paper was followed by a discussion, in which the President, Prof. Bonney, Dr. Geikie, Dr. Hicks, Mr. Hudleston, Prof. Hughes, and Prof. Judd, took part.—Notes on the glaciation of parts of the valleys of the Jhelam and Sind Rivers in the Himalaya Mountains of Kashmir, by Captain A. W. Stiffe. After referring to the previous writings of Messrs. Lydekker, Theobald, and Wynne, and Colonel Godwin-Austen, the author gave an account of his observations made during a visit to Kashmir in 1885, which appeared to him to indicate signs of former glaciation on a most enormous scale. A transverse valley from the south joins the Sind valley at the plain of Sonamurg, and contains glaciers on its west side. These, the author stated, filled the valley at no remote period, and extended across the main Sind valley, where horseshoe-shaped moraines, many hundred feet high, occurred, and dammed the river, forming a lake of which the Sonamurg plain was the result. The mountains which originated the above glaciers were described as being cut through by the Sind river, and the rocks of the gorge were observed to be striated, whilst rocks with a *moutonnée* appearance extended to a height of about 2000 feet. The whole of the Sind valley was stated to be characterized by a succession of moraines through which the river had cut gorges, whilst the hillsides were seen to be comparatively rounded to heights of 2000 feet or more. The author had also formed the opinion that at Bâramulla the barrier of a former lake occupying the Kashmir valley was partly morainic, before reading Prof. Leith Adams's view of the glacial origin of some of the gravels of this point. The whole valley of the Jhelam from this point to Mozufferabad showed extensive glacial deposits, which had been modified by denudation and by the superposition of detrital fans, widely different in character from the glacial deposits. Below Rampoor the valley was thickly strewn with enormous granite blocks resting upon gneiss, and the author believed that they had been transported by ice. In conclusion, it was noted that the existing torrential stream had further excavated the valley since Glacial times, and, in places, to a considerable depth. Comments on this paper were offered by the President, Mr. Lydekker, General MacMahon, and Prof. Hughes.

Entomological Society, December 4.—The Right Hon. Lord Walsingham, F.R.S., President, in the chair.—Prof. Franz Klapálek, of Prague, was elected a Fellow.—Mr. W. L. Distant exhibited, on behalf of Mr. Lionel de Nicéville, a branch of a walnut tree on which was a mass of eggs laid by a butterfly belonging to the *Lycænidæ*. He also exhibited two specimens of this butterfly which Mr. de Nicéville had referred to a new genus and described as *Chætoprocta odata*. The species was said to occur only in the mountainous districts of North-West India, at elevations of from 5000 to 10,000 feet above the sea-level.—Dr. D. Sharp exhibited the eggs of *Piezosternum subulatum*, Thunb., a bug from South America. These eggs were taken from the interior of a specimen which had been allowed to putrefy before being mounted. Although the body of the parent had completely rotted away, the eggs were in a perfect state of preservation, and the cellular condition of the yelk was very conspicuous.—Mr. J. H. Leech exhibited a large number of Lepidoptera recently collected for him by Mr. Pratt in the neighbourhood of Ichang, Central China. The collection included about fifty-four new species of butterflies and thirty-five new species of moths. Captain Elwes observed that he noticed only two genera in this collection which did not occur at Sikkim, and that the similarity of the insect fauna of the two regions was very remarkable; about fifteen years ago, in a paper "On the Birds of Asia," he had called attention to the similarity of species inhabiting the mountain ranges of India, China, and Java. Mr. McLachlan, F.R.S., remarked that he had lately received a species of dragonfly from Simla which had previously only been recorded from Pekin. Mr. Distant said he had lately had a species of *Cicada* from Hong Kong, which had hitherto been supposed to be confined to Java.—Mr. W. H. B. Fletcher exhibited a preserved specimen of a variety of the larva of *Sphinx ligustri*, taken in a wood near Arundel, Sussex. Mr. W. White exhibited drawings of the larvæ of this species, and called especial attention to one of a variety that had been exhibited at a previous meeting by Lord Walsingham.—Mr. F. D. Godman, F.R.S., read a letter from Mr. Herbert Smith, containing an account of the Hymenoptera, Diptera, Hemiptera, and Coleoptera, he had recently collected in St. Vincent, where he was employed under the direction of a Committee of the Royal Society, appointed to investigate the natural history of the West Indies. A discussion followed, in which Dr. Sharp, Captain Elwes, Lord Walsingham, and Mr. McLachlan took part.—Captain Elwes read a letter from Mr. Doherty, in which the writer described his experiences in collecting insects in the Naga Hills, by means of light and "sugar." Colonel Swinhoe said that the attractive power of light depended very much on its intensity, and on the height of the light above the ground. By means of the electric light in Bombay he had collected more than 300 specimens of *Sphingidæ* in one night. Mr. J. J. Walker, R.N., stated that he had found the electric light very attractive to insects in Panama. Dr. Sharp, Mr. Leech, Captain Elwes, the Rev. Canon Fowler, and others continued the discussion.—Mr. de Nicéville communicated a paper entitled "Notes on a New Genus of *Lycænidæ*." —Mr. F. Merrifield read a paper entitled "Systematic Temperature Experiments on some Lepidoptera in all their Stages," and exhibited a number of specimens in illustration of his paper. The author stated that the darkness of colour and the markings in *Ennomos autumnaria* resulted from the pupæ being subjected to a very low temperature. In the case of *Selenia illustraria*, exposing the pupæ to a low temperature had not only affected the colour of the imagos, but had altered the markings in a striking manner. Lord Walsingham observed that it appeared that exposure to cold in the pupa-state produced darker colouring in the imago, and that forcing in that stage had an opposite effect; that insects subjected to glacial conditions probably derive some advantage from the development of dark or suffused colouring, and that this advantage was, in all probability, the more rapid absorption of heat. He said he believed that an hereditary tendency in favour of darker forms was established under glacial conditions, and that this would account for the prevalence of melanic forms in northern latitudes and at high elevations. Captain Elwes, Mr. Jenner Weir, and Dr. Sharp continued the discussion.

Linnean Society, December 5.—Mr. J. G. Baker, Vice-President, in the chair.—Mr. George Murray exhibited and made some remarks upon specimens of *Struvea macrophylla* and *S. plumosa*.—Mr. A. W. Bennett communicated some observations on a new and a little-known British fresh-water Algæ—*Schizothrix anglica* and *Sphæroplæa annulina*. It was pointed out that *Schizothrix* of Harvey's "Phycologia Britannica" is really an *Inactis*.—Mr. E. M. Holmes exhibited, as a new British marine Alga, a specimen of *Gracilaria divergens*, a rare native of the warmer portions of the Atlantic and the Mediterranean, which had been recently found at Brighton by Mr. J. Myles. The specimen exhibited possessed tetrasporic and cystocarpic fruits not described by Agardh.—Mr. Pascoe exhibited (with a view of eliciting information as to the *modus operandi*) a number of Crustacea and certain shells of the genus *Phorus* having various foreign substances attached to them. Commenting upon these specimens, Prof. Stewart gave an interesting account from personal observation of the way in which certain Crustacea collect and adorn themselves with fragments of shell, seaweed, &c., apparently as a protective covering.—Mr. T. Christy exhibited and made remarks on some "liquid-amber" or resin (*Attingia excelsa*) from Cochin China.—A paper was then read by Mr. George Massee on the life-history of a stipitate fresh-water Alga, illustrated by some excellent diagrams. A discussion followed, in which the chairman, Mr. Murray, and Mr. Bennett took part.—In the absence of the author, Mr. Harting detailed the chief points of interest in a paper by Mr. George Sim on the anatomy of the sand grouse (*Syrrhaptes paradoxus*), and the habits of this bird as observed on the sand hills of the coast of Aberdeenshire. A comparison was made of the sternum and the alimentary organs with the same parts in the pigeon and red grouse.

Chemical Society, December 5.—Dr. W. J. Russell, F.R.S., in the chair.—The following papers were read:—Compounds of phenanthraquinone with metallic salts, by Prof. F. R. Japp, F.R.S., and Mr. A. E. Turner. The authors have obtained several double compounds of phenanthraquinone with metallic salts, viz. $C_{14}H_8O_2$, $ZnCl_2$, crystallizing in dark, reddish-brown needles; $(C_{14}H_8O_2)_2$, $HgCl_2$, crystallizing in red, obliquely truncated prisms; and $(C_{14}H_8O_2)_2$, $Hg(CN)_2$, crystallizing also in red forms. They have prepared a similar compound from mercuric chloride and β-naphthaquinone, but could not obtain double compounds from benzoquinone, α-naphthaquinone, anthraquinone, diacetyl, or benzil. It would, therefore, appear that compounds of this class are derivable only from orthoquinones, and not from paraquinones or open-chain α-diketones. The intense colour of the double compounds indicates that in them the quinone preserves its distinctive character. In this respect they differ from the colourless compounds of the orthoquinones with sodium hydrogen sulphite, which, inasmuch as their formation involves reduction, are to be regarded as quinol derivatives.—Action of aldehydes and ammonia on α-diketones, by Mr. G. H. Wadsworth.—Phenylhexamethylene derivatives, by Dr. F. S. Kipping and Prof. W. H. Perkin.—Diphenylfurfuran, by Prof. W. H. Perkin and Dr. A. Schloesser.

Royal Microscopical Society, November 13.—Dr. C. T. Hudson, F.R.S., President, in the chair.—The Rev. Armstrong Hall exhibited a Bacillus from urine, which closely resembled *B. tuberculosis*.—Mr. Hardy exhibited and described a little apparatus which he had devised for the purpose of photographing an object under the microscope, without having to alter the position of the instrument in any way. He had originally made it in metal, but had found it too heavy; the one now before them was made of wood, and weighed about one ounce, the cost being nothing at all beyond the trouble of making it.—Mr. Watson exhibited and described a new pattern microscope for students (the "Edinburgh student's microscope"), and a student's petrological microscope made upon the same lines; also, a small box for holding slides, for which a patent had been obtained by Mr. Moseley, its inventor. The slides were held in flat trays in the usual way, but they were so arranged that, upon opening the front of the box, the trays were drawn forward so as to form a series of layers overlapping sufficiently to expose the labels at the front end of each row, and enabling the position of any particular slide to be seen without the necessity of removing the trays in search of it.—Mr. Crisp exhibited apparatus by which it was proposed to convert a microscope into a microtome by placing the embedded substance in the lower end of the tube, and cutting sections by means of a blade fitted to move upon the stage plate.—Mr. J. Mayall, Jun., described the various microscopes and accessories which he had examined at the Paris Exhibition, pointing out that, whereas at former International Exhibitions most of the best makers in England, America, and other countries were exhibitors, on this occasion they had been rather conspicuous by their absence. The French opticians were fairly well represented as to numbers, but the instruments they exhibited were for the most part of the old, not to say antiquated, types. He had seen very little that was new in the matter of design.

Zoological Society, December 3.—Mr. Osbert Salvin, F.R.S., Vice-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 November 1889.—An extract was read from a letter received from the Rev. G. H. R. Fisk, concerning some specimens of *Bipalium kewense*, which he was keeping in captivity at Cape Town.—Mr. Henry Seebohm exhibited and made remarks upon some specimens of new or rare species of birds lately received from the Bonin Islands, North Pacific.—Mr. Sclater exhibited and made remarks on an egg of the crested screamer (*Chauna chavaria*), from the collection of Mr. J. J. Dalgleish.—Mr. F. E. Beddard read the first of a series of contributions to the anatomy of Picarian birds. The present communication treated of some points in the structure of the hornbills (*Bucerotidæ*), particularly of the syrinx, and of the muscular anatomy of these birds.—Mr. Beddard also read a paper upon the anatomy of Burmeister's cariama (*Chunga burmeisteri*), and pointed out the differences between this form and *Cariama cristata*.—Mr. G. W. Butler read a paper on the relations of the fat-bodies (subperitoneal and subcutaneous) of the Sauropsida. The author showed that a consideration of the subperitoneal fat-bodies appeared to throw light on the condition of the abdominal membranes in the monitors.—A communication was read from the Rev. H. S. Gorham, containing descriptions of new species of the Coleopterous family Erotylidæ from various localities.—A communication was read from Mr. L. Taczanowski, containing the description of a new warbler of the genus *Locustella* from Corea, which he proposed to call *Locustella pleskei*.—Mr. Oldfield Thomas pointed out the characters of a new mungoose, allied to *Herpestes albicaudatus*, which he proposed to call *H. grandis*. The type specimen (a skeleton) had been obtained by Mr. T. E. Buckley in South-East Africa.

STOCKHOLM.

Royal Academy of Sciences, December 11.—The Ascoceratidæ and the Lituitidæ of the Upper Silurian formation of Gotland described, by Prof. G. Lindström.—Researches on the constitution of the spectra of emission of the chemical elements, by Dr. T. R. Rydberg.—On the observations at the Observatory of Upsala to determine the equinoctium of the spring 1889, by Dr. K. Bohlin and C. Schulz-Steinheil.—Definitive elements of the orbit of the comet 1840, by C. Schulz-Steinheil.—On the ores and minerals of the Gellivard district, especially the apatite, by Herr A. Sjögren.—The English edition of the atlas of fac-simile maps, by Prof. A. E. Nordenskiöld, exhibited by himself.—On the conductibility of snow, by Dr. S. Hjältström.—On the influence of the averting force of the telluric rotation on the movement of the air, by Dr. N. Ekholm.—A large collection of mosses from Japan, Korea, and East India, presented to the State Museum by Captain S. Ankarcrona, R.N., and determined by Dr. W. Brotherus, of Helsingfors, and by Dr. Carl Müller, in Halle, exhibited by Prof. Wittrock. On the recently-published first part of the second supplement to C. F. Nyman's "Conspectus floræ Europeæ," by Prof. Wittrock.—Echinologica, by Prof. S. Lovèn.—Some morphologic researches on the arteries of the brain of the Vertebrata, by Herr A. Klinkowström.—Derivatives of ortho-amido-benzyl alcohol, ii., by Dr. G. H. Söderbaum and Prof. Widman.—On distri azol combinations, by Dr. Bladin.—On naphtoe acids, by Dr. Ekstrand.—Derivatives of sulphate of ammonium, by Herr O. S. Hector.—Demonstration of some theories of Poincaré, by Herr de Brun.

DIARY OF SOCIETIES.

LONDON.

SATURDAY, DECEMBER 28.

ROYAL INSTITUTION, at 3.—Electricity (adapted to a Juvenile Auditory): Prof. A. W. Rücker, F.R.S.

TUESDAY, DECEMBER 31.

ROYAL INSTITUTION, at 3.—Electricity (adapted to a Juvenile Auditory): Prof. A. W. Rücker, F.R.S.

WEDNESDAY, JANUARY 1.

SOCIETY OF ARTS, at 7.

THURSDAY, JANUARY 2.

ROYAL INSTITUTION, at 3.—Electricity (adapted to a Juvenile Auditory):

FRIDAY, JANUARY 3.

GEOLOGISTS' ASSOCIATION, at 8.

SATURDAY, JANUARY 4.

ROYAL INSTITUTION, at 3.—Electricity (adapted to a Juvenile Auditory): Prof. A. W. Rücker, F.R.S.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

The Bala Volcanic Series of Caermarthenshire and Associated Rocks: A. Harker (Camb. University Press).—The Popular Works of Johann Gottlieb Fichte, 2 vols.; translated by Dr. W. Smith (Trübner).—Astronomy with an Opera-Glass: G. P. Serviss, 2nd edition (Appleton).—Logic Taught by Love: M. Boole (Edwards).—The Collected Mathematical Papers of Arthur Cayley, vol. ii. (Camb. University Press).—Aperçu des Travaux Géographiques en Russie: Baron N. Kaulbars (St. Pétersbourg).—Magnetic and other Physical Properties of Iron at a High Temperature: Dr. J. Hopkinson (Trübner).—On a Fossil Fish: M. Browne (Leicester).—Journal of the Chemical Society, December (Gurney and Jackson).—Brain, Part 47 (Macmillan).—Proceedings of the Geologists' Association, vol. xi. No. 5 (Stanford).—The Prevention of Measles: C. Candler (K. Paul).—Lectures on the Religion of the Semites: W. Robertson Smith (Edinburgh, Black).—Le Temps de Pose: A. de la Baume Pluvinel (Paris, Gauthier-Villars).—Manual de Phototypie: M. G. Bonnet (Paris, Gauthier-Villars).—The Proceedings of the Linnean Society of New South Wales, vol. iv. Part 2 (Sydney).—Internationales Archiv für Ethnographie, Band ii. Heft 5 (Trübner).

CONTENTS.

PAGE
Recent Ornithological Works. By R. Bowdler Sharpe 169
Descartes. By W. J. L. 171
A Text-book of Organic Chemistry 172
Our Book Shelf:—
Du Chaillu: "The Viking Age; the Early History, Manners, and Customs of the Ancestors of the English-speaking Nations."—F. Y. P. 173
Dunman and Wingrave: "A Glossary of Anatomical, Physiological, and Biological Terms 173
Letters to the Editor:—
Acquired Characters and Congenital Variation.—The Duke of Argyll, F.R.S. 173
Who Discovered the Teeth in Ornithorhynchus?—Prof. Oswald H. Latter 174
Galls.—Prof. George J. Romanes, F.R.S.; Dr. St. George Mivart, F.R.S. 174
The Permanence of Continents and Oceans.—Joseph John Murphy 175
Does the Bulk of Ocean Water Increase?—T. Mellard Reade 175
A Natural Evidence of High Thermal Conductivity in Flints.—Prof. A. S. Herschel, F.R.S. . . . 175
Foreign Substances attached to Crabs.—Francis P. Pascoe 176
A Marine Millipede.—R. I. Pocock 176
Suggestions for the Formation and Arrangement of a Museum of Natural History in Connection with a Public School. By Prof. W. H. Flower, F.R.S. . 177
The Fishery Industries of the United States . . . 178
Notes 180
Our Astronomical Column:—
Objects for the Spectroscope.—A. Fowler 183
Variable Star in Cluster G.C. 3636 183
Changes in Lunar Craters 183
Sir Henry Roscoe on Technical Education 183
A First Foreshadowing of the Periodic Law. (*With Diagram.*) P. J. Hartog 186
Scientific Serials 188
Societies and Academies 189
Diary of Societies 192
Books, Pamphlets, and Serials Received 192