THURSDAY, SEPTEMBER 20, 1877

THE WORK OF THE IRON AND STEEL INSTITUTE

IT cannot be denied that of late years the component parts of that great aggregation of the contributions of workers in a thousand different fields, and which is known by the name of Science, have arrived at their common destination as much through the paths opened up by the development of the applied sciences as through those of original research or the seeking after scientific truth for the truth's sake.

In this country the institutions set apart for the furtherance of the applications of science to the use and convenience of man form collectively a very powerful body. Their influence upon the greatest industries of the country renders them indispensable to trade and finance, and that connection places at their disposal large means, both monetary and influential, without which many of the most important scientific researches could never have been attempted. The mere mention of the names of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institute of Naval Architects, the Society of Telegraph Engineers, and the Iron and Steel Institute, suggests at once to the mind wealth, and influence, and scientific progress; and it is not too much to say that the wealth and influence of all those institutions has been brought to bear upon the advancement of applied science with remarkable success.

The Iron and Steel Institute ranks second to none for the importance of its objects to the welfare of the country, for the scientific value of its papers and discussions, and for the influence of its members. It was founded rather more than eight years ago for the purpose of advancing the knowledge of the manufacture of iron and steel, by bringing before its members the latest inventions and methods of working adopted in different establishments, for the encouragement of scientific research bearing upon the manufacture of iron and steel; whether in the domains of geology, metallurgy, chemistry, mechanics, or physics, and for the improvement of the operations of mining, smelting, and working the ferruginous ores of the country so as to obtain the highest perfection of the products at the smallest expenditure of capital and labour.

The field which the Iron and Steel Institute set itself to cultivate was partly covered by the domains of the institutions devoted to the advancement of the above sciences respectively, but a very large portion of it was never reached by any of them; and even the knowledge derived from discussions in other societies was too general to be of much practical value to the iron and steel manufacturer. No greater proof could be given of the need of such an institution in such an iron-working country as this than the very rapid rise and progress which it has made. It includes in its list of members, we believe without exception, all the leaders in the iron and steel trade of this country, as well as many of the eminent workers on the continent of Europe and in the United States of America; and among its most active members are the leading metallurgists and several of the first chemists, physicists, and engineers.

There cannot be any doubt that with so influential a body of members, with such varied and important objects, bound up as they are with the largest commercial interests of this great country, and with so many exceptional advantages, the Iron and Steel Institute has many and great responsibilities. Its only connection with trade is a scientific one (for the commercial interests of the iron and steel industries are represented by the British Iron Trade Association), and commercial matters have no right to be introduced into its discussions except in so far as accurate scientific knowledge, sound technical experience, and correct mechanical manipulation, by producing perfection in the products, and economy and certainty in the various processes employed, enable a manufacturer possessing these advantages to outdo those who do not, and by the guidance of scientific truth to command the market for his productions.

The iron and steel trade, represented in its scientific aspect by the Iron and Steel Institute, owes to pure science a deep debt of gratitude; but through that valuable institution it is year by year repaying that debt, at one time advancing the science of metallurgy, at another that of mechanics, at another adding to chemical knowledge, and so on. And we have little doubt, judging of its future by its past, that it will make still greater additions to scientific knowledge, in consequence of its increasing scientific organisation and the habit of scientific thought which it engenders among manufacturers and others by its meetings and published transactions.

The work of the Iron and Steel Institute is necessarily very varied. First and foremost it should promote, by every means in its power, the technical education required to make its various processes and operations understood by those who are entering the profession, and who in a few years will be its representatives. The importance of this can hardly be over-estimated. And it should be given in no grudging or half-and-half spirit; the days of the monopoly of knowledge, more especially of such as is based upon philosophical research, are long past, and though there must necessarily be some trade secrets, the results of knowledge and experience, still the knowledge which led to them is patent to all; and a technical society which has the best interests of its members at heart must be foremost in encouraging the dissemination of the scientific and technical knowledge required for advancing the interests which it represents. Another point for the consideration of such an institution is economy in fuel, and in the various processes employed in the making of iron and steel. In these days of close competition, when not only individuals but whole countries are doing their utmost to undersell one another, and a saving of a few shillings here and a few pence there may mean the difference between a profitable or a losing adventure, it becomes of the utmost importance to be working in a direction which is guided by scientific knowledge and proved by experiment and practical experience.

Then again the encouragement of the investigation of the physical and chemical laws which come into play within the smelting, puddling, and converting furnaces is a most important duty for the Institute to discharge, for if the amount of fuel consumed in proportion to the amount of metal produced can be reduced by only one per cent. an important step is gained and in large works a large addition to the returns is insured. The knowledge, however, necessary for such improvements can only be obtained through long experience, patient investigation, and the collection of data and information furnished by many workers towards the same end but in different paths.

The questions of the proper application of the hot blast and of the utilisation of waste heat are of the utmost importance, and with regard to the former the knowledge of the laws of radiant and specific heat has taught the engineer that economy in blowing and other engines can only be obtained by high piston speed, and that far greater advantages are to be had from small engines working at a high velocity than from engines of larger capacity working slowly.

No one has done more to advance the science of the iron and steel manufacture than the distinguished president of the Iron and Steel Institute, Dr. C. W. Siemens, F.R.S. His regenerative gas furnace, which is now made use of in so many industries in this country, in America, and on the Continent, is at the same time one of the most beautiful applications of science to industry that has been made in this or any other age, and one of the most, perfect economisers of fuel that has ever been invented. Then again the process of steel manufacture worked out by Dr. Siemens, and which bears his name, is the only equal competitor with the Bessemer process over which it possesses one great advantage, and that is that the progress of the operation may be watched and tested from commencement to conclusion, and may be arrested at any moment.

It is, of course, needless to point out the vital importance to the steel manfacturer of a knowledge of the chemistry of the blast, converting, and heating furnaces, and of the chemical properties of various qualities of iron, of various fuels, of spiegeleisen and ferro-manganese, and of various "*fettlings*," or furnace-linings. In connection with this subject the Iron and Steel Institute has done and is doing most valuable work, and the names of Mr. Edward Riley, of Mr. Isaac Lowthian Bell, M.P., F.R.S., of Dr. Percy, F.R.S., of Dr. Siemens, F.R.S., of Mr. Mushet, of M. Gautier, of Mr. A. L. Holley, and others, who have given to the Institute valuable communications both in papers and in discussion, will always stand foremost in this branch of scientific labour.

Again the construction of furnaces and the various mechanical systems of puddling, manipulating, rolling, and working the product in its various stages of manufacture, all call for the aid of science, and the Iron and Steel Institute is in no way deficient in recognising the importance of science to this branch of the profession, many interesting papers having been read and valuable discussions held in connection with this subject.

One great result brought about by the Institute is the establishment in nearly all the principal works of the country of experimental work and laboratory practice. It has, ever since its establishment eight years ago, been dispelling the clouds of darkness and of the "rule of thumb," and by allowing the light of science to illuminate the road has spread far and wide a desire for accurate scientific knowledge based upon practical experiment. But there is much yet to be done. There are still many manufacturing firms turning out many tons of metal in the course of the year who have exceptional advantages for the promotion of scientific knowledge, but who make no use of it; the advantages, however, which such an institution as the Iron and Steel Institute brings to all manufacturers must in time be recognised by all, and we cannot but believe that with all the national resources and with the advance of knowledge promoted by such institutions, this country will still be able to hold her own against foreign competition.

Much has yet to be learnt about the behaviour of many of the elements during the various processes of the iron manufacture, whether in the form of alloys or merely as substances present in the converter or puddling furnace. It would be well if the Iron and Steel Institute were to appoint a committee composed of practical analytical chemists and influential manufacturers of iron and steel, for the purpose of investigating the effect of various metallic alloys upon iron and steel as regards their tensile or compression strength, malleability, brittleness, &c. We feel sure that very interesting results would be obtained, and that the reports of this "Alloy Committee" would be found of great practical value to manufacturers, and would well repay the expenses incurred. It is well known that the metals chromium and tungsten form alloys with iron possessing valuable physical and mechanical properties; and the influence of carbon, silicon, boron, phosphorous, sulphur, arsenic, aluminium, and antimony, have been more or less examined; but there is very much yet to be learnt with regard to this subject.

The value of spectroscopic research in connection with the investigation of this subject can hardly be overestimated. It is, without exception, at once the most infallible and the most delicate test that has ever been placed in the hands of the chemist, and, when employed in conjunction with quantitative chemical analyses and with mechanical tests, cannot fail to clear away many of the mists with which that most mysterious substance, or compound of elements, which we know generally by the name *Iron*, is enveloped. Spectroscopic research presents several collateral advantages to the iron and steel manufacturer. There are many instances in which much valuable information may be obtained by its means without the progress of the various processes being disturbed. Nearly all other systems of testing require the taking of samples, and necessitate either the stopping of an operation at a critical time or the waiting until the process is perhaps too far advanced for the information gained to be of practical utility. The spectroscope, on the contrary, peering through the smallest crack, can detect all that is going on which concerns itself, and makes a report in unmistakable language, and before it is too late to be taken advantage of.

There is no better way of obtaining reliable results than by the systematic investigation by a committee which should certainly include in its list of members the names of Dr. Siemens, Mr. Riley, Dr. Percy, and Mr. Lowthian Bell.

There are so many important branches, both scientific and technical, of the iron and steel manufacture which come under the legitimate cognisance of the Iron and Steel Institute, the importance of which is every day increasing, that we cannot help thinking that such subjects as mining, mine ventilation, pumping and winding machinery may safely be left to the Institutions of Civil and Mechanical Engineers, as well as the consideration of the *applications* of iron and steel. The subject of corrosion is one, however, which, though rather appertaining to the finished product than to its manufacture, is one which should not be altogether overlooked, for if, by any variation in the process of production, the effects of corrosion may be diminished or modified, a new value will be given to the finished product.

There is one thing, however, which, as we hinted at the beginning of this article, has no place in the deliberations of a body holding a scientific position such as the Iron and Steel Institute, and that is the consideration of commercial questions as such and apart from the influence of science upon the cheapening of the cost of production or the lessening of labour. There must be, no doubt, in a society composed to so great an extent of men largely interested in the commercial aspect of the manufacture of iron and steel, a great temptation and tendency for the discussions occasionally to diverge into commercial questions; but it will be the duty of the president for the time being to check such digressions and to keep the discussions within legitimate channels; and it will be one of the objects of the council to allow no paper to come on for reading or discussion which is not calculated to advance the technical and scientific interests of the Institution over which it has been called to preside.

With the present council, and under the presidency of so distinguished a worker in science as Dr. Siemens, there is every prospect of the Iron and Steel Institute keeping up its high scientific character, and we cordially wish it every possible success. C. W. C.

COHN'S BIOLOGY OF PLANTS

Beiträge zur Biologie der Pflanzen. Herausgegeben von Dr. Ferdinand Cohn. Zweiter Band. Erstes Heft. (Breslau, 1876: J. N. Kern.)

THE first part of the second volume of Cohn's Beiträge contains five papers, two of them being illustrated with three plates each. The first paper is by Dr. Leopold Auerbach, "Cell and Nucleus," remarks on Strasburger's work, "Ueber Zellbildung und Zelltheilung." It is a critical paper, and hardly admits of any condensation. He tries to controvert the statements of Strasburger, and sums up thus:—1. The longitudinally striated body in the interior of the cell is not the "nucleus," but the middle part of the so-called "karyolitic figure," and therefore a product of the mixing of the special substance of the nucleus with the surrounding protoplasm; and 2, That the young nuclei do not develop by the fission of the mother nucleus.

The second paper is one of great importance, dealing as it does with one of the carnivorous plants. It is by Dr. A. Fraustadt. "Anatomy of the Vegetative Organs of Dionæa muscipula, Ellis," with three plates. As Dr. Fraustadt gives a very useful summary of results, we may here quote them. Each half of the lamina is slightly bent in a sigmoid manner, and forms a cavity to retain an insect, while the petiole is broadly winged and flattened. The cells of the epidermis, as well as those of the ground tissue, are elongated in the direction of the long axis of the leaf, in the petiole and midrib of the lamina, but in the transverse direction in the rest of the lamina. The cells forming the epidermis contain chlorophyll grains. The epidermis forms numerous stomata and stellate hairs on the upper and lower surface of the petiole, and under-surface of the lamina, but glandular hairs only on the upper surface of the lamina. The glands are placed in depressions in the epidermis, and are formed of a two-celled basal portion, a two-celled short stalk, and a round secreting part of two layers of cells convex on the upper side. The stellate cells are similarly constructed, except that the cells of the top layer grow out in radiating straight arms, giving the whole a star-like appearance. The stellate hairs appear early and are completely developed before the glands begin to form. The stellate hairs and glands are homologous structures. The lamina bears on its margin numerous (from fifteen to twenty) teeth or marginal setæ, and usually six spiny hairs (central setæ) on the upper surface. The marginal setæ are slender, triangular, pyramidal, and have stellate hairs and stomata on all sides. A fibro-vascular bundle is present running nearer the upper than the under side of the structure. Between each of the marginal setæ a single stellate hair is placed sometimes elevated on the top of a small projection, which, however, receives no fibro-vascular bundle. The central setæ consist of two parts, the lower forming a joint, and receiving an axile cellular string; the upper part is conical, contracted below, and has no cellular string. The cells of the central setæ show aggregation of the protoplasm (as described by Darwin in Drosera), as well as those of the glands. In the green parts of the petiole (above ground), and in the midrib of the lamina, the cells of the ground-tissue increase in length and in size of cavity from without inwards, the superficial cells, and those near the fibro-vascular bundles are green, the others colourless. In the lamina, with the exception of the midrib, the inner cells of the ground tissue are colourless, very broad, with sinuous walls and small intercellular spaces. The epidermal cells of the upper side of the lamina and the ground-tissue cells below it, are larger than those of the under side. The chlorophyll grains contain abundance of starch before the leaf has obtained any organic (animal) nourishment. The starch diminished after the reception of organic (animal) matter by the leaves, and lastly disappears entirely from the parts of the plant above ground. The bases of the petioles are dilated into colourless sheath-like portions developed underground and together forming a kind of bulb. The ground tissue consists entirely of equally broad and long cells completely filled with starch, as well before as after the reception and absorption of organic (animal) matter. The starch grains in the part above ground of the petiole and lamina are oval; in the basal sheathing part of the petiole, on the other hand, the grains are cylindrical or rod-like.

The living cells of the lamina and petiole contain a colourless substance dissolved in the cell-sap, precipitated by bases in the form of dark grains which are redissolved by acids. The glands contain no starch. The red colouring matter of the glands becomes converted into green by the action of strong bases as ammonia and potash, but is again restored by the action of acids. The colour seems, therefore, to be identical with the red colouring matter of plants so fully described by Prof. A. H. Church in a recent number of the *Journal* of the Chemical

Society, under the name of Coleine. Colourless glands become coloured artificially after the absorption by the leaves of red-stained albumin. The fibro-vascular bundles, as far as the petiole, are also coloured, thus rendering the absorption very evident. After death black granules form in the tissues of the leaf, visible as black specks on the surface.

In the midrib of the petiole a well-developed axile fibro-vascular bundle runs; from it straight branches proceed into the wings in a "curved veined" manner. The branches split into smaller and smaller twigs, the branching, however, not being symmetrical. In the midrib of the lamina there is a large axile fibro-vascular bundle, which gives off branches (at a right angle) running parallel towards the margin, where they fork and again unite. One bundle formed by the union of the fork-branches runs into each marginal seta of the leaf.

The phloem of the fibro-vascular bundle consists of soft bast; the xylem, in the lamina, chiefly of spiral vessels; in the petiole there are other vessels in addition.

In the youngest leaves the petiole and lamina are not separable. The part first formed, and springing from the flat vegetative cone represents the origin of the lamina, but it remains rudimentary for a long time, during which the petiole is rapidly developing at its base. The lamina at first forms a straight continuation of the stalk, then bending through an angle of 180° bends itself over into the grooved petiole. Afterwards it just reverses the process and straightens itself as it expands.

The margins of the lamina are in the early stages rolled inwards. Afterwards the petiole expands in a plane, and last of all the lamina becomes fully developed.

The stem is short and thick with a ring of xylem. The bundles pass transversely, so that one enters each leaf and each root.

The lateral rootlets are long and strongly developed, but never branch. The cells at the apex are red in colour, the cortical cells become brown in centripetal order and die in as far as the sheath of the fibro-vascular bundle. The vessels develop first at the periphery of the axile bundle, increase in a centripetal direction, and ultimately form an eight-rayed star.

The third paper is by Dr. J. Schroeter, "On the Development and Systematic Position of Tulostoma, Pers." It describes the structure of a very interesting little fungus which passes part of its life below ground, then the stalk elongates, and the open periderm, with a capillitium, appears above ground. The plant described is *Tulostoma pedunculatum*, L. (*T. brumale*, Pers., *T. mammosum*, Fries. Cooke). The sporocarps are developed at a depth of from two to three centimetres below the surface of the ground. They spring from a white, branched, thread-like mycelium, running between grass-roots, and old moss-plants. The mycelium gives rise to fusiform structures of varying thickness, and these pass over by all gradations into true sclerotia. The sclerotia give rise to the sporocarps, but the development was not observed; apparently, however, they bud out from a spot on the surface of the sclerotium. At first the sporocarp is like a small bovista. The spores are developed on remarkable basidia. These form four elongations springing from the sides at unequal heights, and each develops a spore. The basidia only last a short time, and a capillitium is developed in the interior of the peridium, the spores lying between the meshes. Tulostoma has been placed among the Gasteromycetes, in the Lycoperdaceæ, but the peculiar development of the basidia at once separates it from the Lycoperdaceæ, and Schroeter proposes to place it in a new group of the Gasteromycetes, the Tulostomaceæ. The curious genus, Pilacre, seems also to Schroeter to belong to the same division, and he further suggests the possibility of the remarkable genus Batarea being also related.

The fourth paper is one of the highest interest and deals with a most remarkable group of plants. Exceedingly simple in structure, they attack many algæ and water-plants, and seem not unfrequently to have been described as the fruits of algæ by certain algologists. It is by Dr. Leon Nowakowski: "Contributions to the Knowledge of the Chytridiaceæ," and is illustrated by three plates. The genus Chytridium, which gives its name to the group, consists of only one cell. Rhizidium consists of two cells, the lower forming a root-like or branched mycelium-like structure, while Synchytrium consists of a group of cells. Zygochytrium and Tetrachytrium of Sorokine are the most highly developed, and in them the zoosporangia are produced as a branched bearer. Nowakowski describes a new genus, Cladochytrium, in which a branching mycelium is developed in the tissues of the host-plant. Another new genus, Obelidium, has a stalk to the zoosporangium and a well-developed mycelium. The spores of Chytridium are formed by free-cell formation in the zoosporangium, and generally possess a very highly refracting nucleus. The zoospores exhibit, as first pointed out by Schenk, peculiar amœboid modifications of form. The zoospores have only one cilium either before or behind. Conjugation of zoospores has not been observed. When the spores germinate the nucleus gradually disappears and the whole spore either at once grows into a new zoosporangium, or a sort of mycelium is formed. Resting spores have been observed in Chytridia as in Rhizidium, and probably occur in others. The position of these plants is at present doubtful, but probably they are allied to Saprolegnia.

Nowakowski has described certain new forms and carefully-observed forms already described but not fully studied. The following is a synopsis of the forms described:—

I. CHRYTIDIUM, A. Br.

1. *C. destruens*, nov. sp., occurs in cells of a new green gelatinous alga, developing zoospores, and described by Nowakowski under the name of *Chætonema irregulare*.

2. *C. gregarium*, nov. sp., in the ova of a Rotifer; found among the gelatinous matter of *Chætophora endiviæfolia*.

3. *C. macrosporum*, nov. sp., also in the ova of a Rotifer; found among the gelatinous matter of *Chætophora elegans*.

4. *C. coleochaetes*, nov. sp. In the oogonia of *Coleochaete pulviratum*, and never in the vegetable cells.

5. *C. microsporum*, nov. sp., a specimen of *Mastigothrix æruginea*, Ktzg., found in gelatinous matter of *Chætophora elegans*.

6. *C. epithemiæ*, nov. sp., an *Epithemia zebra*, one of the Diatomaceæ.

7. *C. mastigotrichis* nov. sp., a *mastigothrix æruginea*, as in No. 5.

II. OBELIDIUM, nov. gen., Now. The one-celled zoosporangium is elevated on a more or less developed bearer from the middle of a star-like dichotomously-branched mycelium, which radiates in a single plane. The zoosporangia are separated from the mycelia by a transverse wall. The zoospores are developed in small numbers, and escape by a lateral opening.

1. *O. mucronatum*, nov. sp. In the empty skin of a gnat-larva.

III. RHIZIDIUM, A. Br.

1. *R. mycophilum*, A. Br., is fully described and figured, and the resting-spores traced through their long period of repose.

IV. CLADOCHYTRIUM, nov. gen., Now. The zoosporangia are either developed as intercalar swellings of the one-celled mycelium in the tissue of the host-plant, and separated by transverse walls, or they are terminal at the end of single mycelium threads. The zoosporangia dehisce either by the opening of a long neck, or by a lid. Secondary zoosporangia are developed either in rows or in the interior of old empty zoosporangia.

1. *C. tenue*, nov. sp., in the tissues of *Acorus calamus*, *Iris pseudacorus*, and *Glyceria spectabilis*. Closely related to *Protomyces menyanthis*, De Bary found in the leaves and petioles of *Menyanthes trifoliata*.

2. *C. elegans*, nov. sp., in the gelatinous substance of *Chætophora elegans*.

The last paper is by Prof. Cohn himself—"Remarks on the Organisation of Certain Swarm-Cells." It is chiefly devoted to an account of *Gonium tetras*, A. Br., and certain subjects suggested by the examination of that plant, such as the nature of the "amylum kern," or starch nucleus, the inner organisation of swarm-cells, the cavities and contractile vacuoles in such cells, and the comparison of swarm-cells with one-celled animals. The whole number is one of great interest and will well repay perusal.

W. R. MCNAB

OUR BOOK SHELF

Physiography and Physical Geography. By the Rev. Alex. Mackay. (Blackwood and Sons.)

IN his preface the author draws attention "to the peculiar character of the present work," and quotes by way of explanation two paragraphs from the Directory of the Science and Art Department. He remarks that "the student will at once perceive that the author has discussed all the subjects embraced in the new syllabus" of the department. The spirit of this discussion and "the peculiar character of the work" will be best appreciated from a few extracts.

"The combined result of various experiments gives to the earth a density of 5·66 times that of water. But more reliance should be placed on the number indicated by the Great Pyramid, which in this as in so many other great cosmical data, has anticipated modern science by more than 4,000 years." "The sacred volume declares that in the days of Noah the whole world was inundated by a flood, which covered the highest mountains, and that, with the exception of one family, the entire human race was destroyed. A change in the inclination of the earth's axis would certainly produce such a catastrophe—a catastrophe which was accompanied with direful results to all future generations; the alternations of heat and cold became so rapid as to affect the longevity of man, which has from that date gradually shortened from nearly a thousand years to three-score years and ten." "Why the planets move in elliptical orbits" is the title of a paragraph, which, containing no reference to nor explanation of the *ellipticity* of the planetary orbits, is embellished with a diagram to show why the orbits are *circular*. "Mountain-chains of the same geological formation are believed to be of the same antiquity; and, however widely separate, are parallel to one another." "The slow increase in the saltness of the ocean may account for the otherwise inexplicable fact that frequently since the ocean became inhabited, its varied population became wholly or almost wholly extinguished." "The antiquity of the human species as indicated by geological evidence, no doubt conflicts with the chronology of Usher, founded on our modern Hebrew text. In the matter of antediluvian chronology, however, the Hebrew text has, in all probability, been tampered with, as we have shown at large in a separate work ('Facts and Dates,' p. 62-69). The Septuagint translation—a translation sanctioned by our Lord and his Apostles—assigns to our race an antiquity of nearly 1,500 years more than Usher does. Science is giving its emphatic verdict, in this particular, in favour of the Septuagint; and though the extended chronology may fail in meeting all the difficulties of the case, it will certainly meet many of them . . . Geologists are too apt to toy with millions of years as if they were playthings, and to show no regard to moderation or common sense. Science has not hitherto been able to determine the actual antiquity of the planet, and probably never will."

The Book of Algebra. By A. T. Fisher, B.A. (London: Stewart's Local Examination Series, 1877.)

MR. FISHER has aimed at writing a short work on algebra for students who have no intention of reading high mathematics. He has done his task well, and the result is a compact and carefully put together little book. The limit he has set himself is to enable a reader to understand all that is required as preliminary to the solution of higher simultaneous equations; hence we have nothing on the Progressions, Notation, Permutations, &c. On a perusal of the work we have been especially struck with the care taken by the author to bring out a book burdened as little as possible with mistakes. For three-fourths of the book he has been assisted by the printers, but in the chapters on surds, indices, and higher equations we have noticed a plentiful crop of typographical errors. Most of these are, however, easily corrected. There is an unfortunate mistake of $+$ for $\times$ twice on p. 47; of $-$ for $\div$ in Ex. 14, p. 52.

Some readers would require a larger number of examples; those that are given are, on the whole, very well chosen, and there are some useful problems neatly solved. It is possibly an objection, certainly in the elementary parts, that the answers immediately follow the questions. The book is neatly, and for the most part carefully, printed.

Bulletin of the United States Geological and Geographical Survey of the Territories. Vol. iii. No. 2. (Washington, 1877.)

THE second number of the above *Bulletin* contains three important entomological articles from the pens of Messrs. Osten Sacken, Uhler, and Thorell.

The first memoir, from the pen of that distinguished Dipterist, Baron C. R. Osten Sacken, bears the modest title of "Descriptions of New Genera and Species of Diptera from the Region West of the Mississippi, and especially from California," but he who takes up the paper expecting to find nothing but bare descriptions will be agreeably surprised to find it interspersed with analytical tables of the Diptera of the United States, with diagnoses and critical notes on many species already known, with remarks on their geographical distribution, synonymy, and in fact anything that could in any way contribute towards rendering this order of insects clear of comprehension or attractive to the student.

The second article, by Prof. P. R. Uhler, is a report on the insects collected by himself during the exploration of 1875, including monographs of the hemipterous families *Cydnidæ* and *Saldæ*, and an account of the hemiptera collected by Dr. A. S. Packard, jun. The monograph of the *Cyanidæ* commences with an excellent conspectus of the genera of that family, followed by detailed descriptions of both genera and species; two well-executed uncoloured plates accompany the paper.

In the third memoir Dr. T. Thorell gives an account of the *Araneæ* collected in Colorado in 1875 by Dr. Packard; the descriptions of the species are drawn up in the author's usual careful and exhaustive style, and leave nothing to be desired but illustrations, the absence of which we cannot but deplore; an appendix by Mr. J. H. Emerton (the well-known American arachnologist) describes two additional species of the genera *Epeira* and *Drassus*, with which two woodcuts are given.

A. G. BUTLER

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. No notice is taken of anonymous communications.*

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Temperature of Moon's Surface

IN a recent number of *Les Mondes* (tome xliv., No. 1, September 6, 1877), M. l'Abbé F. Raillard puts forward a theory to explain the reddish tinge acquired by the moon during a total eclipse, attributing it possibly to the great elevation of temperature caused by the continuous exposure of its surface for many days previous to the solar rays, which he thinks may be adequate so to raise its temperature as to render it self-luminous.

In support of his theory he refers to my experiments with the thermopile, and states that I have found the lunar surface to acquire under solar radiation a temperature of more than 500° Centigrade. Now in a paper published in the *Proceedings* of the Royal Society, No. 112 (1869), I estimated the radiation to be equal to that of a lamp-blacked surface 500° Fahrenheit higher in temperature at full moon than at new moon, but on repeating the experiments[1] with more care, 197° Fahrenheit, or 100° Centigrade, was found to be a far more probable value, a large error having crept into the former result. It is, moreover, shown in my last paper that near the middle of the partial eclipse of 1872, Nov. 14, the radiant heat was only about one-half of what it had been two hours before, having kept pace in its diminution with the light. Observations made during the recent eclipse, so far as they go, fully confirm this result, and I much doubt if five per cent. of the heat acquired since new moon is retained till the middle of a total eclipse; heat, too, which we have shown from its low mean refrangibility as compared with that of the direct heat of the sun to have been truly *absorbed* by the lunar surface.

M. l'Abbé Raillard appears to be mistaken in supposing it to be the generally received theory that the red tinge is due to dispersion rather than to simple refraction and preponderant absorption of the more refrangible rays in passing through the earth's atmosphere.

There appears to be, therefore, no ground for supposing that the difference between the "lumière cendrée" of the unilluminated surface of the new moon and its reddish hue during a total eclipse is to be ascribed to a difference of temperature, and I think that we must fall back on the usual explanation.

It may also be expected that independently of any tinge due to unequal absorption by the earth's atmosphere the preponderance of blue and green on the terrestrial surface may not be without influence on the colour of the "earth-light" which gives rise to the "lumière cendrée" and may contribute to an appreciable degree towards forming a contrast between its hue and that acquired by the moon when totally eclipsed.

September 15 ROSSE

Rainfall and Sun-Spots in India

As Prof. Balfour Stewart says the true test of a physical cycle is its repetition, and since he evidently regards the tendency to repetition which he has shown to exist in the rainfall of Madras as a favourable indication of the presence of a physical cycle such as that claimed by Dr. Hunter, I may perhaps be allowed to supplement my former statements regarding the tendency of the winter rainfall in many stations of Upper India to vary in a cycle corresponding inversely with the solar spots, by exhibiting a similar tendency to repetition in the rainfall of Calcutta. The following table represents the winter rainfall of Calcutta from 1833 to 1876.

The rainfall is taken for the months of January, February, March, and April in each year, together with that for December of the preceding year. The November fall is excluded chiefly because experience and an inspection of the register show that it properly belongs to the summer monsoon rainfall, occurring almost entirely in those years in which the summer monsoon rains are either very heavy or prolonged, and in fact being nothing else than the last drop they shed before they take their departure. The real winter rains commence in the Christmas week, so December really includes their actual first appearance. As the summer rains seldom begin before the second week in June, we are well within correct limits in taking the rainfall from December to April inclusive. The following table is arranged after the model of that given by Prof. Stewart in his letter to NATURE (vol. xvi. p. 161):—

Years employed.	Years of Series—Calcutta.											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	
1833–43	4·34	7·34	3·12	2·97	2·16	1·98	3·19	1·24	5·11	7·49	6 69	A.
1844–54	4·51	9·21	6·30	3 85	1·77	6 75	5·79	7·28	9 50	1·60	9 54	B.
1855–65	5·54	3·91	2·76	1 80	7·26	2·56	1·75	5 51	3·83	3·42	8·58	C.
1866–76	7·46	3·21	5·86	8·41	4·83	6·47	5 08	3·02	8·68	5·45	7·49	D.
Whole period average.	5·46	5·91	4·51	4·25	4·00	4·44	3·95	4·26	6 78	4·49	8·07	

The years of minimum sun-spot occur in the first and second series, and the years of maximum sun-spot in the fifth and sixth series. The series of heaviest average winter rainfall are 9, 10, 11, 1, 2, and those of lightest average rainfall are 5, 6, 7, 8. Taking the mean of the averages of the five series of heaviest rainfall we get 6·14 inches, and taking the mean of the averages of the four series of lightest rainfall the result is 4·16 inches. The same result is exhibited by each cycle individually, thus:—

	Max. group, inches.		Min. group, inches.
Cycle A	6·19	... ...	2·14
,, B	6·87	... ...	4·31
,, C	5·05	... ...	4·27
,, D	6·45	... ...	4·85

The evidence of repetition is thus quite as manifest as in Dr. Hunter's case, the only difference being that in the present case the years of minimum sun-spot are those of heaviest, and maximum sun-spot those of lightest, rainfall. In order to render it still more apparent that the cyclical connection with the sun-spots is not the result of accident I will exhibit the difference between the rainfalls in years of absolute minimum and maximum sun-spot:—

Years of minimum sun-spot.	Total of the five months.	Years of maximum sun-spot.	Total of the five months.
	inches.		inches.
1834, 1844, 1856, 1867	18·97	1837, 1848, 1860, 1870	11·32
Average for each year	4·74	Average for each year	2·83

The same connection is maintained when the fall in April is left out or that in November included, so that it is evidently not due to the effect of any particular month, but as may reasonably

[1] *Philosophical Transactions*, 1873.

be inferred, an indication of the presence of some physical cause tending to increase the rainfall in years of minimum and diminish it in years of maximum solar maculation.

Bankipore, Patna E. D. ARCHIBALD

The Australian Monotremes

IT is certainly news to me, and I believe to most other European naturalists, that *Tachyglossus* and *Ornithorhynchus* occur in Northern Queensland. Perhaps W. E. A. will kindly state, for our information, the exact spots where they have been discovered and their extreme *northern* limit, so far as this has been ascertained.

W. E. A. speaks of an adult female *Echidna* (*sive Tachyglossus*) having "a fine healthy young one in the pouch." Is there not some error here, as the monotremes have, strictly speaking, no marsupial pouch? P. L. S.

WITH reference to the existence of *Tachyglossus* (*olim Echidna*) in North Australia, and the recent discovery of one (or possibly two) species in New Guinea, the following account, which I lighted on a few evenings ago, when looking over an old volume of the *Field*, seems to be of sufficient interest to warrant its transfer to the pages of NATURE. The account in question occurs in an article "A Week at Plain Creek, Queensland," by Mr. E. B. Kennedy, which appeared in the issue of that journal for September 20, 1873. It runs as follows:—" . . . Whilst so engaged we heard our dogs making a tremendous noise, high up the bank in the scrub, and upon going to ascertain the cause found them scratching, yelling, and pulling at a porcupine which was half imbedded in a hole; we were at least ten minutes digging him out with sharp-pointed sticks, such was his tenacity in holding on and burrowing. The quills were not nearly so long as the Cape of Good Hope species (of course a true *Hystrix*), and he differed from that quadruped in having a sort of beak instead of a regular jaw." It is to be regretted that Mr. Kennedy did not preserve his specimen, which was ultimately cooked and eaten! I should have mentioned that Plain Creek lies in 21 lat. S., so that this is certainly the northernmost locality on the Australian continent, where we have certain knowledge that the *Echidna* occurs. As we now know that many North Australian species of birds range also into southern New Guinea, it would hardly be surprising if the *Tachyglossus* of the Fly River and south New Guinea were nothing more than the well-known *Tachyglossus hystrix*. It is to be hoped that this point may soon be solved by the arrival of specimens from both localities. W. A. FORBES

English Names of Wild Flowers and Plants

To all who are interested in the history of the English language the derivations proposed for the vernacular names of many plants in the Rev. W. Tuckwell's lecture (see NATURE, vol. xvi. p. 385) will be highly appreciated. And even in the few cases where the etymologist may feel doubtful as to the verisimilitude of the suggested pedigree it will for the most part be difficult to propose another with any great confidence.

There is, however, one of these doubtful cases, the derivation of woodruff from wood-roue, in lieu of which I have to offer a conjecture which appears to need no lengthy argument to insure its acceptance.

Is not the ruff of woodruff identical with the riff of sherriff? Is not, in short, the woodruff the wood-reeve, just as the sherriff is the shire-reeve? That the German wald-meister has the same connotation and is applied to the same plant is evidently a striking confirmation of this view, and it would be interesting to know whether the word wald-graf (*i.e.*, wald-ge-raf = wood-y-reeve), or any equivalent form, is to be met with in high or low German literature.

I used to be told by a school-fellow that the way to spell woodruff was—

Double U, double O, double D, E,
Double R, double O, double F, E.

Even under the disguise of woodderrooffe, however, the origin of the word is perceptible.

As regards the main purpose of the Rev. W. Tuckwell's paper, I feel strongly that scientific accuracy is compatible with a much freer use of vernacular words than is customary amongst us, and that their adoption by science teachers would remove a great stumbling-block from the path of learners.

Manningham, September 10 J. WILLIS

Some of the Troubles of John O'Toole respecting Potential Energy

"IT is the people's *right* to demand of their teachers that the information given them shall be, at least, definite and accurate as far as it goes," and "whenever there appears to be a confusion about fundamental principles it is the *duty* of a scientific man to endeavour by all means in his power to remove it." These are the words of one of the teachers.[1] I am one of the people—as indeed, my name testifies, Toole (*Tuathal*) being the Irish equivalent of the Latin *Publius*—and I would now, on behalf of myself and every brother Publius, assert our above "right" in respect of the matter now in hand, and demand the performance by the doctors of their corresponding "duty." Now there is much "confusion about the fundamental principles" of physical Energy in the minds of the public who care about such things; and it is principally, though I admit not entirely,[2] the doctors who are to blame for this. Their own ideas on the subject being so clear and correct they are superior to the phraseology they use respecting it, and they are not injuriously affected thereby; but those who are dependent on that phraseology for their knowledge are in very different case. Let me, as one of the latter, point out some of the perplexities under which we labour from no fault of our own, and which we should be spared if our teachers would only condescend to use their words discreetly and consistently. It may be well to premise that we know the definition of physical Energy, which is—"the power or capacity of performing work;" and that we are not now making any confusion between Energy and force.

The word "potential" has two very different meanings—(1) Of, or belonging to, potency or power; (2) Existing *in posse*, or in possibility, as opposed to existing *in esse*, or in actuality; and the expression, "potential Energy," can have no less than three references or meanings, which we shall mark with A, B, and C; and each meaning has its own proper inconveniences independent of the perplexities arising from their mutual relations.

A.—*Potential E., as meaning "Energy existing* in posse."

The phrase "potential E." is in the first place very generally intended to mean E. existing *in posse*, according to one proper signification of the word "potential." The phrase was first used by Rankine,[3] and apparently in this sense; he contrasted "potential" and "actual" E. This antithesis is still very generally implied and sometimes expressed. Clerk Maxwell tells us[4] (the statement being *repeated* only last year[5]) that "potential E." "signifies the E. which a system has not in actual possession, but only has the power to acquire." Wormell says[6] —"It has been aptly called possible or *potential* E., because it represents the power the body has of acquiring actual or kinetic E." Many of our doctors use the phrase "potential E." without explaining it, and of course, unless there be some particular reason to the contrary, such must be understood to give it, as one of its significations, at least, the original meaning intended by its proposer (or if not they are guilty of a very misleading omission, *utrum horum mavis accipe*); and this is especially undeniable in the case of those who apply the title "actual" to the other type of E. Balfour Stewart, though he seems to have quietly dropped the name "potential,"[7] has really retained the idea implied thereby, for he still habitually calls the other type of E., that of motion, "actual E.," as its *distinguishing* title. Moreover, this idea is involved in other statements, &c., of our teachers. For instance, we occasionally find language used which seems to imply that potential E. must first emerge as actual E. before it can produce work, as by Deschanel,[8] by Dunbar Heath,[9] and by Balfour Stewart.[10] Observe, also, the expression "E. of actual motion," which is frequently used by the last-mentioned doctor,[11] and accepted at least by Tait.[12] "E.

[1] Tait Evening lecture during meeting of Brit. Assoc at Glasgow in 1876. NATURE, Sept. 21, 1876.

[2] That brother Publius who wrote the article on Tyndall's "Heat," in *Blackwood's Mag.*, December, 1863, was partly responsible for his own confusion about Energy.

[3] *Phil Mag.*, February, 1853. He says: "All conceivable forms of E. may be distinguished into two kinds, actual or sensible, and potential or latent"

[4] "Theory of Heat," p. 91, 1871.

[5] "Matter and Motion," p. 81, 1876.

[6] "Dynamics," p. 185.

[7] At least it never occurs in his "Conserv. of Energy," 1874, though frequently in "Elem. Physics," 1870.

[8] "Nat. Phil.," p 78, edition of 1870.

[9] "Energy," p. 64. [10] "Elem. Physics," pp. 104–106. But see p. 360.

[11] "Conserv. of Energy," p. 25, and elsewhere.

[12] "Unseen Univ." (last edition), p. 109, twice.

of actual motion," as a *distinguishing* title, cannot mean anything else than this—that the other E., potential E., is E. of about-to-supervene motion, or that it does not perform work except through the resulting E. of motion. We do not say that these doctors intended what we have mentioned, but their words unquestionably go to convey that impression; and what makes this so particularly mischievous is that poor Publius is already so susceptible to that impression, being prepared for it by the titles "potential" and "actual" E.

I should not be at all surprised if some would try to argue that the phrase "potential E." need not be taken to mean more than simply this, viz., that the E. so called exists in possibility *relatively to the body or system* that may be in question, that its potentiality merely implies that it is absent from and acquirable by that body or system, and not that it is altogether out of actual existence.

1. Now even supposing this to be true, though I have never seen any evidence of it, and even if we should grant this to be a right usage when the *body* or *system* is followed through the history of its changes, it is a wrong usage when, as in a book or chapter on E., Energy is the subject, when it is the conserved E. *itself* which is to be followed through its migrations. Why should this grand conserved E. be stigmatised as merely potential when it does not happen to be in a certain mass? Relatively to that mass it may be some times potential, but relatively to itself it is, as we shall see, always actual.

But we cannot concede that the potentiality of this mode of E. implies merely the above. I believe it is usually intended to mean much more; and, at any rate—whatever those who use the word may intend—it logically involves much more; and this is what poor Publius is chiefly concerned with. Now if we consider the words of Clerk Maxwell quoted above, we shall see that in the case of a separate unconnected system, such a statement coming from him cannot possibly mean that the said E. is in actual existence outside of the system, and is waiting there until the system takes possession of it. If it is not in the system there is nowhere else where it can be; therefore it is not in actual physical existence at all, although connected with existence by some inconceivable paraphysical link. The acquiring of it is a kind of creation of it. Curiously enough Stewart and Tait[1] speak of the "creation" and "annihilation" of both types of E.

2 Here, then, comes our second complaint. E. is "the power of performing work;" therefore potential E., which is intended to be the power of acquiring E., is the power of acquiring the power of doing work. E. is already a potentiality; therefore potential E. is a potentiality which, itself, exists only in potentiality. There is here a double remotion from tangibility, which may be gratifying to the metaphysicians, who rejoice the more the harder the nuts you give them to crack; but poor Publius finds *bonnes bouches* of this sort rather trying to his molars.

3. Potential E., in the present sense, being, as we have seen, undeniably out of actual physical existence, poor P. does not feel that he has gained much when he learns that the sum of the actual and potential E.s of the universe is a constant quantity—for this is the form in which the grand principle of the conservation of E. is usually, or at least frequently, presented to him by the doctors. A rigid physicist, who himself believes in nothing but the physical, teaches poor P. something which compels *him* to stand with one foot on the land of physics and the other in the sea of metaphysics, in order to reach it all. This *teacher* forces poor P. to recognise the metaphysical, while he scorns to do so himself. The combination of the two characters of conductor and of pure finger-post, in the same person puzzles Publius a good deal. Sometimes, when poor Publius thinks that he has grasped the principle in the above form, it seems to him to turn out only a truism, after all; and indeed no less a man than Sir John Herschel sympathised with him in this idea.[2] I am not sure that they are right; they seem to overlook that this potential E., though undeniably out of physical existence, is by some mysterious paraphysical operation, recoverable in its former quantity. However, P. and Sir John are right, so far, that the doctors will sometimes inadvertently allow themselves to present a physical principle of E., which is very far from self-evident, in a form which has all the appearance of a logical truism; *e.g.* when we are told that "the E. exerted is equal to the work performed." P. says I could have told you that from the definition of E., which is "the power of performing work."

4. Potential E. being that which is not had in actual possession by the body (or system) in question, how can that body be "a store of potential E.?"[1] How can the body contain that which is not in it? The doctors should explain this. However, I am glad to find that my cousin Barney was not so wrong, after all, when he complained that Ireland was swarming with absentee landlords.

5. But to pass now from *à posteriori* objections to the phrase "potential E." in the present sense. This potential E. is so called to *distinguish* it from actual E. so called, and yet it is just as immediately and directly efficient in performing its work as actual E. itself, and, therefore, as truly actual as any E. can be. When a certain quantity of potential E. is followed by its equivalent actual E., what is the actual E. of the body but the *direct work* of the potential E. done against the inertia of the body? It is from the doctors themselves, of course, that I learn this. And yet it is very curious to observe how often they shrink from directly stating this, and how ingeniously they will avoid it (one doctor actually denies it). They will sometimes tell you that the potential E. is "*transformed*" into the subsequent actual E. and *v. v.* Sometimes, when they feel that this evasive euphemism is unsuitable to their immediate purpose, they will use what I, with the utmost deference as well as difference, hold to be the proper word, viz., "transfer"; but having made this concession they refuse to proceed further, and shirk telling us from what or to what the transference is made (more of this presently). As we have said the kinetic E. of the moving body is the direct work of the equivalent potential E. that preceded it; and if the work be, as it is, actual, the E. must be so too; as long as we remain in the realm of physics.

But more than this; the potential E. of a mass, as it is expressed, can do other direct work than that of producing actual E. in the mass concerned. Take the case of a clock weight, which is so often adduced, though never, as far as I know, for the purpose of illustrating its own proper lesson. When wound up it has, as we are told, potential E.; but in its descent, while working the clock, it never acquires more than the indefinitely small quantity of actual E. which is due to its excessively slow motion; and this actual E. is doing no work during the descent, since the velocity of descent is uniform. The only work that this actual E. performs is to produce an infinitesimal amount of heat at the instant of the weight's reaching the lowest point of its descent; that is to say, when the clock has stopped. This is only one instance of a whole class of cases in which, as it is expressed, a mass does work by means of its potential E. which exists only in possibility, without ever having any actual E. which it can apply to that work! Moreover there are cases outside of molar physics in which it is not yet known, for certain, whether the E. present is conventionally actual or potential; and yet, in either case, the work is done immediately and directly; and therefore the E. is truly actual whether conventionally so or not. Therefore "potential E.," in the present sense, is a wrong title for this or any mode of E., and this being so, "actual E.," as the *distinguishing title* of the other E., is wrong too; since both are actual.

6. There are a very few of our doctors who use the name "potential E." with another reference solely, and who, as it would appear, designedly abstain from giving it the meaning of "E. existing *in posse*," probably on account of some of the inconveniences we have mentioned; and yet they will use epithets which at least tend somewhat in the same direction. They speak of it as being "E. of repose"[2] (meaning of course reposing E.), as being "of a quiet nature,"[3] "dormant,"[4] "quiescent,"[5] "tranquil,"[6] and "passive"[7] (!), in opposition to the other type of E., which they correspondingly call "active"[8] and "living."[9] Now poor Publius is strongly inclined to think that if *he* had spoken thus they would have said that he had not yet got hold of the precise scientific meaning of E. It seems to him, though he trembles to say it, that although in popular usage the phrases, "quiet," "dormant," &c., and "active energy" may do very well, and convey a correct meaning, viz., that intended by the

[1] "Unseen Univ.," p. 114.
[2] "Familiar Lectures," p. 469. See Rankine's answer to Herschel, *Phil. Mag.*, February, 1867.

[1] Thomson and Tait (*Nat. Phil.* p. 178) virtually say this, but with them pot. E. does not mean E. existing in possibility. So they are all right in doing so.
[2] Balfour Stewart, "Cons. of E.," pp. 27, 143. [3] *Op. cit.*, p. 23.
[4] Stewart and Tait, "Uns. Univ.," p. 109; also Tait's 'Glasgow Lect."
[5] *Op. cit.*, p. 111. [6] Do., p. 147. [7] Tait, "Glasgow Lecture."
[8] "Uns. Univ.," p. 111; Tait, "Glasg. Lect.," and Tyndall, "Heat," 2nd edition, p. 140. [9] Stewart, "Cons. of E.," p. 27.

speaker, yet that physical E., according to its definition, is not capable of having such epithets applied to it, except in senses which are not intended by those doctors. Active E. would not be E. or "the *power of performing* work," it would be rather the *performing* of that work. "Active E." being thus incorrect, its above antithetics, or approximate antithetics, are incongruous expressions, or else have meanings different from what is intended. If "reposing," "dormant," "quiescent" E. have any meaning, it is that of "*unavailable* E." If "quiet" and "tranquil" E. have any meaning, it is that of E. spending itself slowly and equably. Poor P. thinks that the expression, "passive E.," would sound very like a bull, whether used in a taproom or in a lecture theatre. He dares not entertain the suspicion that these expressions had their origin in a momentary, latent, unconscious confusion between kinetic E. and action in the minds of the writers; but he knows that they are eminently calculated to cause a chronic intentional muddling of them both together in his own brain-pan.

Dublin (*To be continued.*) X.

On the Supposed Action of Light on Combustion

THE results obtained in the experiments mentioned by M. C. Tomlinson are to be attributed to the elevation of temperature of the candles exposed to solar *light* and *heat*.

The influence of light on combustion has been mistaken for the action of heat, which, in this instance, seems to have accelerated combustion, and in other instances *retards it* by increasing *the heat of the air* and diminishing the *draft*. That is why the sun shining over chimney-pots is said to cause smoke; it diminishes the ascensional speed of the air through the pipe.

Jersey, September 2 G. SAVARY

[On referring to Mr. Tomlinson's paper we find that out of four trials, with a number of candles to each, there was a greater consumption of material in the first and fourth trials in the light than in the dark; and in the second and third trials the consumption was greater in the dark than in the light; but in any case the difference was so small, amounting only to from two to seven grains per hour, that it may fairly be referred to accidental circumstances, such as differences in temperature, in currents of air, and in the composition and matter of the candles. Some of the trials were made in the diffused light of day, and in all the trials the differences in temperature between the dark and the light spaces were but small.—ED.]

OUR ASTRONOMICAL COLUMN

THE SATELLITES OF MARS.—The following ephemeris of the outer satellite is deduced from the elements given in this column last week, except that the daily motion is corrected to 285° 5'·147 by observations to Sept. 16:—

	At 8h. om. Pos.	Dist.	At 10h. om. G.M.T. Pos.	Dist.
	°	"	°	"
Sept. 24	247	75	237	61
„ 25	280	49	276	68
„ 26	52	54	26	34
„ 27	83	70	75	77
„ 28	192	29	129	31
„ 29	252	76	243	68
„ 30	297	35	274	55
Oct. 1	60	63	44	44
„ 2	90	59	80	71
„ 3	217	38	167	25
„ 4	257	72	249	70
„ 5	328	26	286	41

For the inner satellite the following elements may be taken as representing closely the Washington measures, August 17–20:—

Passage of Ascending Node, August 17·89788 G.M.T.

Longitude of node	82° 48'
Inclination of orbit	25 24
Period of revolution	0·31841 days.
Log. radius of orbit at mean distance of Mars from the sun	0·9286

They show the following differences of the calculated angles from those observed:—

Aug. 17	− 0°·1	Aug. 19	+ 1°·9
„ 18	− 0·7	„ 20	+ 0·1

The outer satellite has been observed on several nights by A. A. Common, Esq., of Ealing, with an 18-inch silver-on-glass reflector. On the 15th and 16th inst. excellent measures were made with this instrument, by means of which the period of revolution was corrected before calculating the above ephemeris. Mr. Common has stated to the writer that the satellite is ruddy, even more deeply-coloured than the body of the planet. It has also been observed on several occasions by M. M. Henry at the Observatory of Paris.

Employing Kaiser's value of the mean diameter of Mars at distance unity (9"·472) it results that the inner satellite is distant from the centre of the primary 2·730 and the outer one 6·846 semi-diameters. As seen from the inner satellite the globe of Mars will subtend an angle of 40°, and as seen from the outer satellite, one of about 16°. The orbital motions per minute are respectively seventy-nine miles and fifty miles. Our own moon has a mean orbital velocity of thirty-eight miles per minute.

THE SATELLITE OF NEPTUNE.—The subjoined ephemeris is derived from Prof. Newcomb's tables:—

At 13h. Greenwich M.T.

	Pos.	Dist.		Pos.	Dist.
	°	"		°	"
Sept. 30	30	15·2	Oct. 9	25	13·6
Oct. 1	314	5·7	„ 10	101	6·3
„ 2	231	14·9	„ 11	46	16·2
„ 3	209	14·7	„ 12	23	13·0
„ 4	122	5·7	„ 13	294	7·5
„ 5	49	15·4	„ 14	225	16·5
„ 6	27	14·2	„ 15	201	12·3
„ 7	291	5·9	„ 16	86	7·5
„ 8	228	15·8	„ 17	44	16·7

The motion of this satellite is *retrograde* both with reference to the equator and to the ecliptic, and thus it presents the most decided case of retrograde motion in the planetary system; the motion of the satellites of Uranus, though retrograde upon the ecliptic, is direct upon the equator. For 1877 we have for the satellite of Neptune, from Prof. Newcomb's investigation—

	For Equator.	For Ecliptic.
Node	183° 3'	184° 33'
Inclination	121 42	145 13

Adopting the mean of Mr. Lassell's and Mr. Marth's measures of the diameter of Neptune, taken at Malta in 1864-65, as the most reliable value hitherto published, we find that Prof. Newcomb's mean angular distance of the satellite from Neptune corresponds to a true distance of 14·552 semi-diameters of the primary (or about 219,000 miles), which will therefore present an angular diameter of rather less than 8° as viewed from the satellite. The period of revolution being 5·8769 days, the mean orbital velocity of the satellite is 162 miles per minute.

THE BINARY *α* CENTAURI.—Mr. Gill has found time to measure this fine star with Lord Lindsay's heliometer at his present station, Mars Bay, Ascension, on four nights between July 22 and August 5. The distance of the components was then little over two seconds, the bright star preceding. The measures are evidently difficult from the magnitude and closeness of the stars, the separate night's results differing by more than 10°; but Mr. Gill will doubtless establish an important epoch, and we may hope at the end of the year to have something like reliable elements of this the most interesting of all the revolving double stars.

METEORIC ASTRONOMY.—The second part of the publications of the Royal Observatory at Münster has appeared, and is entitled, "Resultate der in den 43 Jahren 1833-1875 angestellten Sternschnuppen-Beobachtungen, von Dr. Eduard Heis." It was close upon completion at the time of Dr. Heis's decease on June 30, the revision of the final sheets having been undertaken by one of his pupils. The work contains the times of occurrence and the points of first and last appearance of some 13,000 meteors observed by Heis and the various colleagues who assisted him from time to time, followed by partial discussion of the results and catalogues of radiant points. A fuller account of this valuable publication must be reserved for a future note. The first number of this series contains Heis's long-continued observations on the zodiacal light.

A NEW COMET.—M. Coggia, of the Observatory at Marseilles, discovered a faint comet on September 14. Its position at 14h. 38m. 8s. mean time at Marseilles, was in R.A. 8h. 32m. 3·1s.; N.P.D., 41° 45′ 59.″ Daily motion in R.A. − 45 seconds, in N.P.D. + 18 minutes. The comet has a central condensation, with trace of a tail.

CHEMICAL NOTES

ACTION OF ORGANIC SUBSTANCES INCREASING THE SENSITIVENESS OF CERTAIN SILVER SALTS.—Mr. M. C. Lea, of Philadelphia, has criticised, in a short paper, the theory brought forward by Poitevin and Vogel, that increased sensitiveness was imparted to the halogen compounds of silver by certain organic substances in virtue of their affinity for hydrogen. From experiments he has made he is led to the conclusion that these organic substances do not form substitution products as might be expected if they possessed an affinity for hydrogen, but that they all act as reducing agents. The natural view, therefore, of their action which Lea deduces is that the affinity of the organic substance for oxygen assists that of halogen for hydrogen, and, under the influence of light, a molecule of water becomes decomposed. That, in the case of tannin and silver iodide for instance, the tannin is oxidised, the iodine converted into hydriodic acid, and the silver salt more or less reduced. According to this theory traces of free acid would be found instead of the iodine substitution product. His experiments have confirmed this supposition, and he concludes, therefore, that the increase of sensitiveness produced by organic substances takes place in virtue of their affinity for oxygen promoting the decomposition of water by the halogen employed.

HEAT OF COMBUSTION OF OXYGEN AND HYDROGEN IN CLOSED VESSELS.—In a recent number of the *Journal* of the German Chemical Society there are some experiments on the above subject communicated by Than. He has modified Bunsen's ice calorimeter, so as to make it available for heat determinations in chemical action, and by this means he has obtained accurate results of the heat of combustion of electrolytic gases in closed vessels. The terms "heat of combustion," or "total difference of energy," are used by Than to express the quantity of actual energy evolved when the combining gas, in the case of oxygen and hydrogen at 0° and 760 mm., is completely converted in a closed vessel into water. Taking the atom of hydrogen as unity he finds that a gramme of hydrogen uniting with the requisite quantity of oxygen in a closed vessel to form water, produces 33·982 units of heat, which number agrees closely with that found by Andrews, viz., 33,970.

ON VAPOUR VOLUMES IN RELATION TO AVOGADRO'S LAW.—In the same journal (*Ber. chem. Ges.*, x.) there is a paper by Troost, detailing experiments made to determine the accuracy of Avogadro's theory that "equal volumes of substances in the state of vapour contained the same number of molecules," *i.e.*, that the volume of the molecule of hydrogen being called 2, the volume of all other molecules must also be 2; instead of as happens in certain cases, apparently 4, 6, or 8. The method of experiment adopted was to introduce into the vapour of chloral hydrate a salt containing water having a dissociation-tension nearly equal to that of chloral hydrate; if the chloral hydrate vapour undergoes dissociation, and consists of equal volumes of chloral and aqueous vapours, then the vapour volume will remain constant; but if chloral hydrate is volatile as such, its vapour will be free from water, and on introducing the salt it will give up water, and the volume of vapour will increase till the dissociation-tension is reached. The salt used was potassium oxalate, containing one molecule of water. Troost has found that the volume increases on the addition of the oxalate, leading him therefore to the conclusion that chloral hydrate undergoes volatilisation without decomposition.

CHEMICAL CONSTITUTION OF THE MINERALS HATCHETOLITE AND SAMARSKITE, FROM NORTH CAROLINA.—Mr. O. D. Allen has lately had an opportunity of making some further experiments on the above minerals lately described by Mr. J. L. Smith, and of which a short note was given some time ago in NATURE. His analytical results confirm those of Mr. Smith, and from these he deduces a ratio among the elements closely corresponding to that of $\overset{\text{II}}{R}_2\overset{\text{V}}{R}_3 2H_2O$, or

$$\overset{\text{II}}{R}_2\overset{\text{V}}{R}_2O_7 + 2\overset{\text{II}}{R}\,\overset{\text{V}}{R}_2O_6 + 4H_2O,$$

when $\overset{\text{II}}{R}$ represents one atom of a bivalent radical, or two of sodium, and $\overset{\text{V}}{R}$, tantalum or columbium. The investigations of Rammelsberg point to the conclusion that three columbates (having columbium replaced by tantalum) occur in minerals, viz., $\overset{\text{II}}{R}Cb_2O_6$, $\overset{\text{II}}{R}_2Cb_2O_7$, and $\overset{\text{II}}{R}_3Cb_2O_8$, which, singly or combined with each other, constitute mineral species. Mr. Allen regards hatchetolite as composed of the first two, with a small quantity of normal titanate. He also thinks that it may have resulted from the alteration of a mineral possessing essentially the same composition as pyrochlore, by hydration, and removal of alkaline fluorides. From his analysis of samarskite a ratio is obtained closely approximating to that required by the formula $\overset{\text{II}}{R}_2\overset{\text{V}}{R}_2O_7 + \overset{\text{II}}{R}_3\overset{\text{V}}{R}_2O_8$. From this it would appear that samarskite closely resembles fergusonite in chemical constitution, the formula of that latter body, deduced by Rammelsberg, being $R_3(Cb, Ta)_2O_8$.

ON A NEW CLASS OF BODIES TERMED PLATOIODNITRITES.—Nilson has lately described in the *Ber. Berl. chem. Ges.* x., a series of bodies to which he has assigned the above name, and which he prepares by acting on potassium or barium platinonitrite with an alcoholic solution of iodine. Aldehyde is evolved on heating the mixture, which latter, originally brown, becomes of an amber colour. The platoiodnitrite is deposited in crystals. He has prepared the potassium salt in four-sided amber prisms, and assigns to it the formula $K_2N_2O_4I_2Pt(H_2O)_2$. He represents the reaction by the following equation:—

$$K_2(NO_2)_4Pt + I_2 + (C_2H_6O)_3 = K_2N_2O_4I_2Pt + C_2H_4O + (C_2H_5ONO)_2 + 2(H_2O).$$

He describes also a new acid obtained by decomposing barium platinonitrite with sulphuric acid and evaporating in vacuo. The first product consisted of an acid corresponding to the platotetranitrosylic acid of Lang, but on evaporating the solution to dryness, after removal of the first crystals, a permanent residue of a brownish-green colour remained, which, after drying over sulphuric acid, gave on analysis the following composition: $H_4(NO_2)_8Pt_3O \cdot 2(H_2O)$. The author calls this triplato-octinitrosylic acid.

A NEW ACID.—At the last meeting of the Niederrheinische Gesellschaft für Natur und Heilkunde of Bonn Prof. Mohr announced the discovery of a new acid of phosphorus and oxygen, by Herr Th. Salzer, of Worms. The new acid stands between phosphorous acid and phosphoric acid, and consists, according to old notation, of one atom of phosphorus and four atoms of oxygen. It has been named hypophosphoric acid. It forms a rather insoluble soda salt. Herr Salzer found that the "acide phosphatique" described by Pelletier consists of a mixture of phosphorous and hypophosphoric acids.

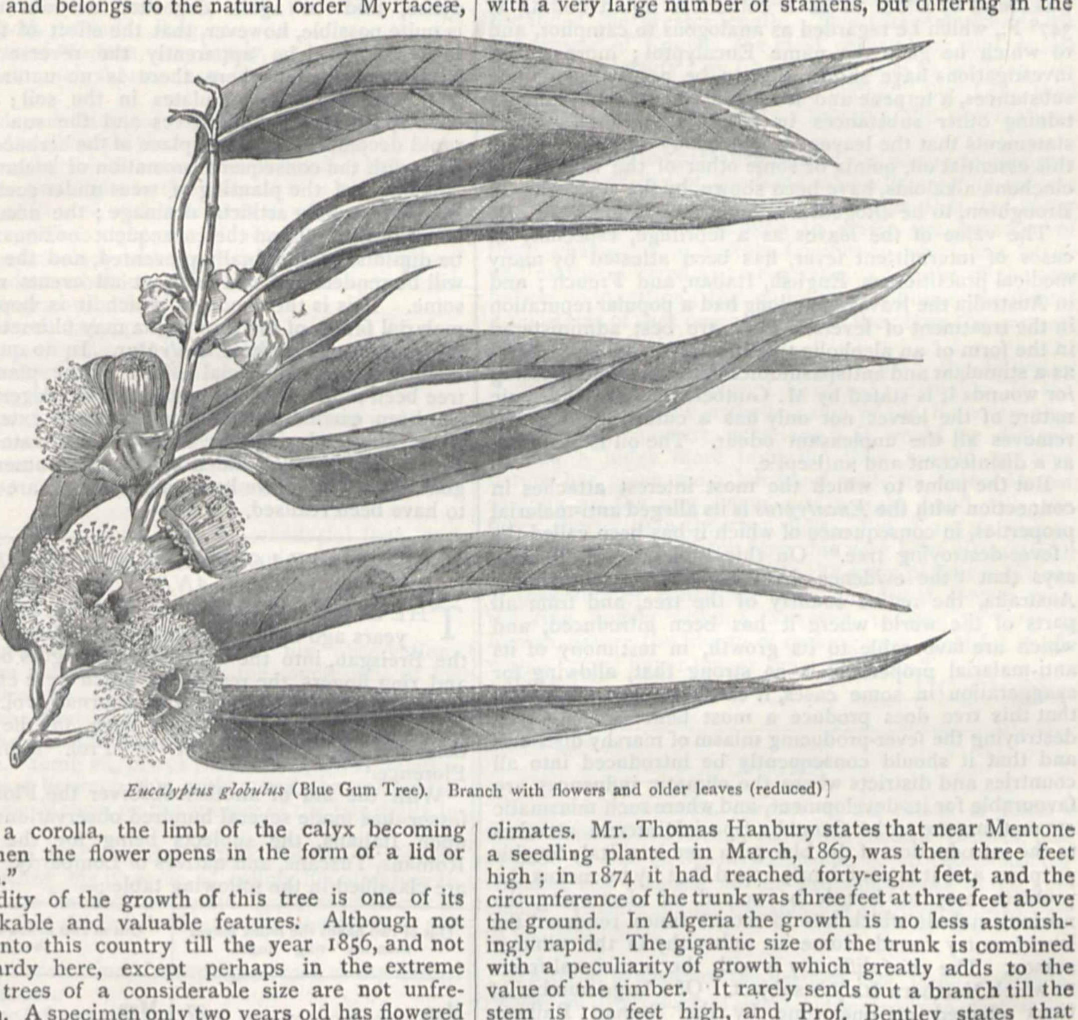
REMARKABLE PLANTS

IV.—THE BLUE GUM TREE (*Eucalyptus globulus*, Labil.).

SO much attention has been directed during the last few years to the various remarkable virtues attributed to this tree, that an exaggerated idea of its value may exist in many minds. Sufficient has, however, been established on irrefragable authority to justify a brief account, in this series of papers, of the known properties and qualities of the *Eucalyptus*. We rely for a considerable proportion of our facts on a lecture delivered before the Royal Botanic Society of London in 1874, by Prof. Bentley, and on the account of the tree in Bentley and Trimen's "Medicinal Plants," part 15, our illustration being also, to a considerable extent, copied from that in the latter work.

The genus *Eucalyptus* is a large one, numbering about 150 species, and belongs to the natural order Myrtaceæ, distinguished by the number of trees and shrubs included in it which yield aromatic properties. The species are all, with a few doubtful exceptions, natives of Australia or Tasmania, and are known in the Colonies as "gum-trees" and "stringy-bark trees." They are all evergreen trees, several of them of enormous height. The one we are describing, a native of Tasmania and temperate Australia, is perhaps the most gigantic of them all, not unfrequently attaining a height of upwards of 300 feet.

The leaves vary remarkably according to the age of the plant; when it is young they are large, sessile, and opposite, of a bluish glaucous-white colour, and placed at right-angles to the branches on which they grow, while on older plants they are much narrower (as shown in the drawing), alternate, bluish green, and, by a twisting of the petiole, appear as if placed obliquely, or in the same plane as the branches, with their flat surfaces lateral. Th: flowers are large and not very unlike those of the myrtle, with a very large number of stamens, but differing in the



Eucalyptus globulus (Blue Gum Tree). Branch with flowers and older leaves (reduced)]

absence of a corolla, the limb of the calyx becoming detached when the flower opens in the form of a lid or "operculum."

The rapidity of the growth of this tree is one of its most remarkable and valuable features. Although not introduced into this country till the year 1856, and not perfectly hardy here, except perhaps in the extreme south-west, trees of a considerable size are not unfrequently seen. A specimen only two years old has flowered this year in the Economic House at the Regent's Park Botanic Gardens. In its native country it is stated that in a grove planted only sixteen years, the average height of the trees is seventy-two feet, and the girth of the stems six feet; while a tree ten years old presents the development of a well-grown oak of a century. In fifty years they are said to attain a height of from 160 to 200 feet, and the trunk a circumference of from 50 to 60 feet at the base. Even where the *Eucalyptus* is not indigenous, well-authenticated instances of a rapidity of growth almost equalling this are on record in favourable climates. Mr. Thomas Hanbury states that near Mentone a seedling planted in March, 1869, was then three feet high; in 1874 it had reached forty-eight feet, and the circumference of the trunk was three feet at three feet above the ground. In Algeria the growth is no less astonishingly rapid. The gigantic size of the trunk is combined with a peculiarity of growth which greatly adds to the value of the timber. It rarely sends out a branch till the stem is 100 feet high, and Prof. Bentley states that planks have frequently been cut 160 feet long, twenty inches broad, and six inches thick. The timber is stated to be at the same time remarkable for its hardness and durability.

This rapid growth renders the *Eucalyptus* an invaluable tree for planting in countries where deforesting has been carried to so great an extent as to prejudicially diminish the rainfall; and it has now been more or less successfully cultivated for this purpose in France, Spain, Portugal, Greece, Italy, Corsica, Algeria, Egypt, St. Helena, Palestine, the uplands of India, Natal, other parts of

South Africa, Cuba, and various parts of North and South America. It has already been stated that it is not hardy in this country, a temperature below the freezing point—or even in some cases a little above it—appearing to kill it. Another useful quality of the tree is that, in consequence of its deciduous bark, it is not attacked by parasites. Baron von Mueller, the director of the Botanic Gardens at Melbourne, states that the ashes of the wood of this and of other species of *Eucalyptus* contain a very large proportion of potash, in some cases as much as twenty-one per cent.

The medicinal properties of the *Eucalyptus globulus* are due to the presence, so common in trees and shrubs belonging to the Myrtaceæ, of a volatile oil, in various parts of the plant, but especially in the mature leaves. This oil may readily be obtained by distillation with water, is of a yellow colour when freshly distilled, and resinifies by exposure to the air. Its principal constituent was found by Cloëz to be a colourless liquid boiling at 347° F., which he regarded as analogous to camphor, and to which he gave the name Eucalyptol; more recent investigations have shown this to be a mixture of two substances, a terpene and a cymol, the essential oil containing other substances in addition to these. Older statements that the leaves of *Eucalyptus* contain, besides this essential oil, quinia or some other of the well-known cinchona alkaloids, have been shown, by the researches of Broughton, to be altogether without foundation.

The value of the leaves as a febrifuge, especially in cases of intermittent fever, has been attested by many medical practitioners, English, Italian, and French; and in Australia the leaves have long had a popular reputation in the treatment of fevers. They are best administered in the form of an alcoholic tincture, which is also useful as a stimulant and antispasmodic. As an external dressing for wounds it is stated by M. Gimbert that the balsamic nature of the leaves not only has a curative effect, but removes all the unpleasant odour. The oil is also used as a disinfectant and antiseptic.

But the point to which the most interest attaches in connection with the *Eucalyptus* is its alleged anti-malarial properties, in consequence of which it has been called the "fever-destroying tree." On this subject Prof. Bentley says that "the evidence that has been adduced from Australia, the native country of the tree, and from all parts of the world where it has been introduced, and which are favourable to its growth, in testimony of its anti-malarial properties, is so strong that, allowing for exaggeration in some cases, it can scarcely be doubted that this tree does produce a most beneficial effect by destroying the fever-producing miasm of marshy districts; and that it should consequently be introduced into all countries and districts where the climatic influences are favourable for its development, and where such miasmatic emanations are to be found." Special interest attaches to the introduction of the blue gum tree into Italy for this purpose, and it is confidently hoped that by its means the problem may at length be solved of destroying the noxious malaria which has in recent times rendered the level country round Rome so unhealthy in the summer season. The chief difficulty is with the occasional frosts to which Northern Italy is subject. Of a large number of trees planted at one time by the Roman Railway Company along the line from Rome to Naples, only those in the neighbourhood of Naples survived the first winter. It is possible, however, that if they became established through a succession of mild winters, and attained a good size, they might then be able to resist slight frosts.

The mode in which the trees thus act in influencing the climate is open to somewhat more controversy. The popular idea is that the efficient cause is the odorous and antiseptic emanations from the leaves. It is quite likely that some influence is exerted in this way, but it seems most probable that the chief effect produced is by the action of the roots on the soil. This function of trees is often greatly overlooked. The effect of the planting of forests in decreasing the rainfall is frequently erroneously stated to be due to the attractive force of the trees on the moisture in the air, similar to that exerted by a range of mountains; but it is difficult to conceive that the small mass of the entire foliage of a forest can exert any appreciable influence in this direction. The mode in which trees mainly act is by their roots arresting the rainfall, which would otherwise escape by the natural drainage of the country; the combined forces of capillarity, osmose, and transpiration then cause the ascent through the tissues of the tree of the water thus arrested, and the larger portion is eventually given off into the air through the stomata of the leaves. In this way a forest tree will in a very short time give off into the air its own weight in water, which must eventually condense, and be again deposited as rain or dew. It is quite possible, however, that the effect of the planting of trees may be apparently the reverse of this in swampy countries where there is no natural drainage. The water then accumulates in the soil; and, if the country is bare of timber-trees and the sun powerful, a rapid decomposition takes place of the herbaceous vegetation, with the consequent emanation of malarial vapours. The effect of the planting of trees under such conditions will be to supply artificial drainage; the accumulation of water in the soil and the consequent noxious effluvia will be diminished and finally prevented, and the atmosphere will be rendered, if not drier, at all events more wholesome. This is the mode in which it is hoped that the malarial fevers of the Campagna may ultimately succumb to the influence of the *Eucalyptus*. In no quarter of the world have the beneficial effects of the planting of this tree been more distinctly seen than in Algeria, where it has been carried on to a considerable extent for some years, mainly through the exertions of private individuals, French and English, aided by the Government. All the good things that have been said about it are there found to have been realised.

A. W. B.

MANTEGAZZA ON THE RELATIVE LENGTHS OF THE INDEX AND "RING" FINGERS

THE curious and suggestive researches made about two years ago by Prof. Ecker, of Freiburg University, in the Breisgau, into the comparative lengths of the index and ring fingers, the results of which were embodied in an article contributed to this journal (vol. xiii. p. 8), entitled, "A new Palmistry," have, in the meantime, been further followed out by Prof. Mantegazza, of Florence.[1]

With the aid of another observer the Florentine professor has made several hundred observations, almost all upon Italians, the subjects being for the most part Romans, Tuscans, and natives of Lombardy. The results are classified in the following table:—

Out of two hands the index longer than the "ring" finger.		Out of two hands the index the shorter.	
Men	27	Men	309
Women	64	Women	194
Total	91	Total	503
Men :: 6·7 : 100		Men :: 76·67 : 100	
Women :: 20·71 : 100		Women :: 62 78 : 100	
Total :: 12·77 : 100		Total :: 70·65 : 100	

[1] "Della Lunghezza relativa dell' Indice e dell' Anulare della Mano umana. Nota del Professore Paolo Mantegazza." *Archivio per l'Antropologia e la Etnologia*, vol. vii. p. 19. Firenze, 1877.

In one hand the index longer. In the other shorter or = "ring" finger.		Index of same length as "ring" finger in both hands.	
Men	57	Men	10
Women	45	Women	6
Total	102	Total	16
Men :: 14·14 : 100		Men :: 2·48 : 100	
Women :: 14·56 : 100		Women :: 1·94 : 100	
Total :: 14·32 : 100		Total :: 2·25 : 100	

The following instances of this "carattere oscillante" (*schwankender character*, Ecker) of the human hand are taken from what the professor terms "our feminine Olympus":—

1. A pretty Piedmontese girl, with the most lovely hands. In both the index longest.

2. A Jewess of Modena, very lovely, and with beautiful hands. Index much shorter than "ring" finger on both sides.

3. A handsome lady of Imola, with pretty hands. The index a little shorter than the "ring" finger.

4. A Tuscan lady with a most lovely hand. Index the longest of the two digits in question.

5. A lady of Rimini, with a lovely and very small hand. Index longer on both right and left sides.

6. A Neapolitan lady with a wonderful face and figure, and with handsome but large hands. Index shorter than the "ring" finger on both sides.

7. A Ferrarese lady, pretty, and with a hand of rare beauty. Index the shortest in each hand.

8. The prettiest lady in Meldola, with lovely hands. Index the longer on both sides.

9. A lady with the most lovely face and figure and with beautiful hands. Index the shortest in both hands.

10. A Jewess of Livorna, handsome, and with the most lovely hands. The right index the longer, the left the shorter.

11. A lady of Cremona, with a wonderful face and figure, and with large but beautiful hands. Index longest on both sides.

12. A Venetian lady, very beautiful, and with "divine" hands. Index slightly longer on both sides.

Prof. Mantegazza considers that his observations partly confirm and in part check the conclusions of his German colleague. To the examples taken by Prof. Ecker from the domain of art, the former adds the following interesting passage from Prof. Casanova ("Mémoires de Casanova," tome vi., p. 252; Bruxelles, 1871), relative to an argument between this author and the celebrated painter Rafaele Mengs, on the subject of the two digits in question:—

"I remember that one day I took the liberty, in the course of viewing his pictures, of calling his attention to the fact that the hand of a certain figure seemed out of drawing. In fact the fourth finger was shorter than the second.

"'A pretty observation,' he replied; 'look at my hand,' and he held it out.

"'See mine,' I answered, 'I am convinced it does not differ from that of other sons of Adam.

"'From whom, then, would you have me descend?' he replied.

"'Ma foi!' I said, after examining his right hand, 'I do not know to what species to refer you, but you certainly don't belong to mine.'

"'Then your species is not a human one, for the form of the hand of man and woman is just like that.'

"'I bet you a hundred pistoles that you are mistaken,' said I.

"Furious at my contradiction, he throws aside palette and brush, rings for his servants, and makes them all show their hands. His rage was great when he discovered that in all of them the ring finger was longer than the index. Feeling however, the absurdity of his conduct, he ended the scene by the following *mot*:—

"'I am delighted, at any rate to be, to a certain point, unique of my kind.'"

Sig. Paolo Lioy—evidently a trustworthy observer—having been asked by Prof. Mantegazza to direct his attention to the subject in question, returned the following answer:—"I have examined about two hundred individuals but it is remarkable that only in *one man* and in the *left hand* have I seen the index longer than the ring finger. In all the rest, and in both sexes, the ring finger is always the longest, and, with the exception of nine persons, in whom it is but a little longer, it is generally much so; in this, too, in hands fairly beautiful—'in manine assai belle.' It is, therefore, remarkable that, as far as I have been able to see, painters and sculptors give the index the greater length. This I have noticed in all the designs of Canova, the most painstaking and purest idealiser of beauty; as I have been able to verify in certain figures of Titian and Ary Scheffer." Sig. Lioy, thus confirms, as Prof. Mantegazza remarks, the observations of Dr. Ecker.

With regard to the transmission from parent to offspring of the peculiarity of the hand which forms the subject of this article, Prof. Mantegazza states that in many cases he has been enabled to verify the heredity of these characters in certain families in which the father and mother differed as to the relative lengths of the two fingers in question; the children exhibiting the digital proportions of that parent to which they bore the greatest resemblance.

This interesting paper concludes with the following remarks:—"If, however, I have been mistaken in the interpretation of the æsthetic value of the Eckerian character ('del carattere eckeriano'), it would be difficult to find a judge more impartial than myself, in that nature has given me a left hand with an index almost as long as the ring finger, and a right hand with the index shorter than the ring digit. But if artists wish to deduce a practical lesson from this very brief dissertation, I would advise them to give to the more perfect creations of their tool or pencil an index somewhat longer than the ring finger, without, however, wishing to deny to human nature the liberty of making very beautiful hands with a 'ring' finger longer than the index."

J. C. GALTON

NOTES

FILIPPO PARLATORE, Director of the Museo di Fisica è Storia Naturali, at Florence, and of the Botanic Gardens, died suddenly, of a fit, on Sunday, September 9. He elaborated the Gnetaceæ and Coniferæ, for the sixteenth volume of De Candolle's "Prodromus," and was author of a partly completed work on the Italian flora.

WE regret to announce the death of Prof. Jacob Nöggerath, lecturer on Mineralogy at Bonn University, who died at the advanced age of 90 years, on Thursday last the 13th instant.

SIR JOSEPH HOOKER and Prof. Asa Gray, who, as our readers know, are accompanying Dr. Hayden on a scientific tour in Western America, had, the *American Naturalist* states, collected, previous to August 1, nearly 400 species of rare plants, being thus enabled to study critically in their native habitats the species they had during past years described from dried specimens brought in by expeditions. Both Sir J. Hooker and Prof. Gray will prepare reports on the botany of the West for the Eleventh Report of Hayden's Survey.

MR. R. S. NEWALL, F.R.S., telegraphing to the *Times*, from the Observatory, Gateshead, last Thursday night, states that on August 23, during the total eclipse of the moon, he observed that Mars is surrounded by a whitish envelope, the diameter being about twenty times that of the planet. He saw it again on September 7, and again last night distinctly. It has a well-defined edge, and is densest nearest to Mars. Small stars were seen though it. It is easily visible, Mr. Newall states, in the 61½-inch finder.

THE regular proceedings of the Iron and Steel Institute commenced at Newcastle on Tuesday. According to the report of the secretary the effective strength of the Institute is now close on 1,000 members. After a discussion on two papers read at the last London meeting Mr. Lowthian Bell, M.P., read a paper on the separation of carbon, silicon, sulphur, or phosphorus in the refining and puddling furnace and in the Bessemer conversion. The afternoon was devoted to visits and excursions, as we announced last week.

HERR BRUIJN'S last expedition to New Guinea, which started from Ternate in January last, returned to that island on June 15, having accomplished good results. Examples of both sexes of the wonderful new monotreme, *Tachyglossus bruijnii*, were obtained in the mountains on the north coast of New Guinea at an elevation of about 3,500 feet. The expedition was commanded by M. Leon Laglaize, a young French naturalist, who, with the rich collections he has made, is expected to return to Paris by the next French mail.

MR. A. BOUCARD, the well-known naturalist and collector, has just returned from a successful expedition to Costa Rica, where he passed some four months at the commencement of the year. Mr. Boucard has formed a good series of Costa Rican birds, comprising examples of about 200 species. Amongst these are several new to science. Mr. Boucard has also obtained the female of the rare and little known Cotingine bird described a short time ago by Mr. Salvin as *Carpodectes nitidus*.

LETTERS have been received from Mr. Everard F. im Thurm, announcing his safe arrival at Georgetown, British Guiana, where he has accepted an appointment as Curator of the British Guiana Museum. Mr. im Thurm will shortly proceed upon an expedition into the interior of the Colony to obtain specimens for the collection under his charge.

WE have received the Daily Programme of the meeting of the American Association at Nashville. Judging from the number of members registered and elected the attendance must have been large, considering the almost tropical heat that prevailed. Eighty-seven papers were entered for reading, all of them on points of scientific importance Prof. Newcomb gave an evening lecture on the two important astronomical discoveries recently made in America, viz., that of oxygen in the sun by Prof. Draper, and that of the satellites of Mars by Prof. Hall. Prof. Pickering, vice-president and president of Section A, was unable to be present, but an address by him was read, in favour of the endowment of research. He described what he thought would be a suitable building and arrangements for a physical laboratory. Prof. Pickering gave elaborate details of his project, and pointed out the numerous advantages that might be expected to result when those facilities were afforded to investigators. The plan includes the appointment of a presiding officer and a staff of assistants. From the reports in the local paper, the *Daily American*, the meeting as a whole seems to have been well managed and successful. Without doubt the prominent feature of the meeting was Prof. Marsh's address on the Succession of Vertebrate Life in America, which we are happy to be able to print elsewhere.

THE days of meeting of the third annual conference of the Cryptogamic Society of Scotland, at Dunkeld, have been changed to October 17, 18, and 19.

IN the *Scientific and Literary Review* for September, 1877, there is a notice of the Spined Soldier-bug as a *newly-discovered* enemy to the Colorado beetle. In the "Fourth Annual Report of the Noxious, Beneficial, and other Insects of the State of Missouri (1872)," Mr. Riley speaks of this insect as "now so well known for its efficiency in thinning out the ranks of our potato pest." Mr. Riley also figures two other Hemiptera of the family *Scutelleridæ* as enemies to this beetle—the Ring-banded Soldier-bug and the Dotted-legged Plant-bug (*Euschistus punctipes*).

NEWS from Naples has been received announcing an increased activity of Mount Vesuvius. The glow of fire in the crater is so intense that it can be distinctly seen from Naples at night.

IN our number for August 9 we briefly noticed the ascent made by Mons. Wiener of the mountain Illimani, one of the highest—if not the highest—of the Bolivian Andes, which forms a noble object from the city of La Paz, and was formerly reputed (on the authority of Mr. Pentland) to have an altitude of no lesss than 24,200 feet. M. Wiener, however, makes its height only 20,112 feet, while Mr. Minchin, as we have already observed, places its altitude at 21,224 feet. If the latter estimate be correct, Mons. Wiener has, we believe, not only made the highest ascent which has been made in the Andes, but has attained a greater altitude than has hitherto been reached *on* the earth out of Asia, and in Asia has only been beaten by Mr. Johnson, who some years ago got to a height of 22,300 feet in Cashmere. As the recorded ascents to the height of 21,000 feet are extremely few, we shall be glad to hear further particulars respecting Mons. Wiener's exploit, and more especially whether he experienced much exhaustion through the rarefaction of the air. Practised mountaineers who have climbed to a height of 17,000 to 18,000 feet have been of opinion that even at such altitudes there is a very important and perceptible diminution of the bodily powers, and think it probable that the height of 25,000 or 26,000 feet will be found to be about the limit which will ever be reached on foot. As a set-off to this opinion we may mention the facts that hunters in the Himalayas frequently pursue their game at heights exceeding 20,000 feet without experiencing any notable inconvenience from the low barometric pressure, and that natives living on the base of Demavend, near Teheran, often ascend to its summit to gather sulphur from its crater without any great difficulty. The height of this mountain, there is reason to believe, also exceeds 20,000 feet, although it has never been accurately determined. If, therefore, severe work can be done with impunity at such elevations, it seems not unreasonable to suppose that much greater heights might be attained by men who had previously accustomed themselves to life at high altitudes. Aëronauts, anyhow, have proved that life can exist at 30,000 feet above the level of the sea, and that at 25,000 feet, and upwards, one may positively be comfortable if sufficiently warmly clad. That such is the case is sufficiently remarkable, for "travellers in the air" have to sustain incomparably more rapid variations of pressure and temperature than mountain-climbers. Mr. Glaisher, on his memorable ascent on September 5, 1862, left the earth at 1 P.M., and in *less than an hour* shot up to a height of 30,000 feet. At starting the temperature of the air was 59°, and at its greatest altitude it was sixty-one degrees lower! Mountaineers experience no such extreme variations as these. They rarely ascend more rapidly than 1,000 feet per hour, never so much as 15,000 feet in a *day*, and become to some extent acclimatised as they progress upwards. On the whole we are inclined to think that man will not rest until he has at least attempted to reach the loftiest summits on the earth, though we will venture to assert that it will be long before anyone crushes down the snow on the summit of Mount Everest.

SINCE we last noticed the progress of the great Government Map of Switzerland several further instalments of it have been issued. In all 108 sheets have been published out of the 540 which will compose the map. Amongst the more recently-published sheets the following will especially be found useful by English travellers in Switzerland:—La Chaux de Fonds, Thun, Engelberg, Wassen (embracing the Titlis district), Guttanen (with the basin of the Gauli glacier), and St. Mauritz (giving the country round Pontresina). The whole of the sheets as yet published are most admirably drawn, and reflect the highest credit on those who have been concerned in their production; and the celerity with which they are issued makes us desire that a little more life could be infused into our own topographical departments.

PETERMANN'S *Mittheilungen* for October will contain a long paper, embodying the results of considerable research, on the German and Latin Elements among the Population of the South Tyrol and Venetia. A new map of a large portion of Costa Rica will show the results of the surveys of Gabb, Collins, and Martinez. A letter from Dr. Schweinfurth describes his journey through the Arabian Desert of Egypt, from Heluan to Keneh, between March 28 and May 18 of this year. He has obtained, besides important topographical data, much valuable information as to the geological and botanical conditions of the region.

THERE is on view at present at the Alexandra Palace an interesting collection of fourteen Nubians with a number of animals, comprising six ostriches, six giraffes, five elephants, twenty-one racing dromedaries, three rhinoceroses, two hunting dogs, two Abyssinian spotted donkeys, four buffaloes, two zebus, monkeys, &c. Some specimens of *Cynocephalus gelada*, which are said to live from 7,000 feet to 11,000 feet high in the Abyssinian hills are expected to follow. The European who organised and accompanied the caravan for Messrs. Rice and Hagenbeck, says that the men from the different tribes speak different patois, so that he very often cannot understand them, and they cannot understand one another. The different districts in which the various animals were captured does not, therefore, seem to be known to the present owners. As to the men, they have been interrogated as to their ages and the tribes to which they belong. There are four Hadendoes aged fifteen, twenty-three, twenty-three, and twenty-five. The characteristic manner of dressing the hair is well seen in the three men, but the lad does not seem to have adopted yet the artificial arrangement. They are all tall, fine men. There are two Hallengas from Cassala, aged twenty-two and twenty-four. The general style of trimming the hair is much the same as of the Hadendoes, but the "fringe" is much longer and stands away from the head more. There are three of the Beni-Amer tribe, one of whom, aged twenty-four, having fallen ill in Paris, had his hair cut off; the "old man," aged thirty-two, wears a close white cap, and he alone of the party can read and write; while the third retains his hair in its original state. Of the remaining six men of the fourteen each represents a different tribe, and they all differ in appearance and style of hair arrangement from those tribes already mentioned. There is a Djaalein, aged twenty-six; a Homran, aged nineteen, who has the three rhinoceroses under his special care, and which follow him and lick his hand like pet lambs; a man, aged twenty-seven, from Amara, near Suakim; and a Takrouri, twenty-five, who has twice been to Mecca, the only one of the party who has; and the Bara "boy," who claims to be twenty-one. He has the negro hair and lips, and a very contented look. All the men seem happy, and sing, laugh, smoke, and go through the mimic war, dromedary racing, and their representation of crossing the desert with great delight.

IN a letter to yesterday's *Times* Mr. Henry Jeula, of Lloyd's, gives some interesting data to show that there is probably some connection between sunspots and the number of wrecks posted each year on Lloyd's Loss Book. His data are for two complete cycles of eleven years, 1855–1876, and the results Mr. Jeula has worked out along with Dr. Hunter. Dividing the eleven years as nearly as the number will allow, into three parts, and taking the percentages of losses posted, Mr. Jeula finds a coincident minimum period of four years at the extremities of the cycle, a maximum period of three years in the centre of the cycle, and an intermediate period of the four years lying between the maximum and minimum periods. Mr. Jeula expresses the hope that the great practical importance of the theory of the connection between sunspots and weather will lead to a full and exhaustive examination of all the evidence bearing upon it.

THE exhibition of the Photographic Society of Great Britain will be opened by a *conversazione* on Tuesday evening, October 9, at 5, Pall Mall, East

IN a paper presented recently to the philosophical faculty at Heidelberg University, Herr Richard Boernstein has published his investigations on the influence of light upon the electric resistance of metals. Mr. Willoughby Smith had found that the electric resistance of selenium, and in a much smaller degree that of tellurium also, decreases under the influence of light. Herr Boernstein has now made the interesting discovery that this property also belongs to platinum, gold, and silver, most probably to all metals, in fact. The electric current, according to Herr Boernstein, diminishes the electric conducting power, as well as the sensitiveness towards light, of its conductor, but after cessation of the current, both gradually return to their former values.

ROCK crystal seems to be growing more and more in favour amongst technical men on account of the stability of its physical properties. At the August meeting of the Bonn Society of Naturalists it was reported that the directors of the Imperial Mint of Germany have recently ordered of Herr Stern, at Oberstein, several absolutely correct normal weights made of rock crystal, which are to be used for the control of gold coins. These weights have the great advantage that it is unnecessary to determine the specific gravity of every weight, and in the case of measures to find the thermal co-efficient of expansion of every measure, as both are as near constant as possible. They have been found the same in all the specimens of rock crystal yet examined, viz., specific gravity at 0° C. = 2,6506 (reduced to water at 4° C.); coefficient of expansion for 1° C., parallel to the axis, 0·00000750 inch, *i.e.*, seventy-five ten-millionths of an inch.

AT the same meeting Prof. vom Rath read a report from Dr. Th. Wolf, the state geologist to the South American republic of Ecuador, on the province of Esmeraldas (the northernmost province of the republic), and on the rain of ashes which, coming from the north-east, *i.e.*, from the volcanic interior, fell along the whole *littorale* of Guayaquil between June 26 and June 30. Dr. Wolf, after giving a general geological description of Esmeraldas (in the auriferous sands of which he discovered platinum), adds the following general remarks:—Of all provinces of Ecuador Esmeraldas is the most uniform in its relief and geological structure. It reaches from the coast of the Pacific to the foot of the Andes. A great part of the province is quite flat, particularly in the north; another part is traversed by low mountains, the highest points of which scarcely reach 500 or 600 meters; the average height of the hills, however, is only 50–70 meters. The province is a magnificent country, and especially rich in the finest timber and many other vegetable products — none utilised. The only article which finds its way abroad is caoutchouc, and enormous quantities of this have been exported during the last ten years, but the export begins gradually to decrease, since the workmen, instead of only tapping the trees, destroy them completely. The province is inhabited by a population of only 10,000 natives, who live along the coast. The whole of the interior is covered by one gigantic virgin forest, and accessible only in canoes upon the rivers. Of the three months of my journey I spent more than two in canoes, which are rather small and hardly comfortable, or adapted for a travelling naturalist; the last twenty-three days I spent uninterruptedly in a canoe on the Esmeraldas River and its tributaries. The rivers are very rapid and not without dangers; but then my journey was made during the middle of the rainy season, when the rivers are very much swollen. On the Cayapas River I made the acquaintance of the wild Cayapas Indians, a very interesting tribe with a language and customs of their own. They keep in perfect isolation from other tribes, living in forests, hunting and fishing, going almost naked, and painting their bodies; on the whole they are very harmless, and may be some 2,000 in number."

IN the *Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen*, Herr Edmund Hoppe gives an account of some experiments he made with a view to determine the resistance offered by flames to the galvanic current. He arrived at the following results: (1) In each flame the greater galvanic conducting power depends on the greater heat and the greater quantity of burning gas. (2) With different flames the conducting power depends on the burning substances; the salts of potassium, sodium, barium, strontium, lithium, thallium, and copper in particular increase greatly the conducting power of the hydrogen flame. (3) Ohm's law applies perfectly to flames.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. A. S. Percival; an Osprey (*Pandion haliaëtus*) from Yorkshire, presented by Mr. W. H. S. Quintin; a Common Hangnest (*Icterus vulgaris*) from South America, presented by Mr. Hamilton Dunlop; a West African Python (*Python sebæ*) from West Africa, presented by Mr. Francis Lovell; two Guilding's Amazons (*Chrysotis guildingi*) from St. Vincent, a Violet Tanager (*Euphonia violacea*), a Yellow-winged Blue Creeper (*Cœreba cyanea*), a Common Boa (*Boa constrictor*) from South America, deposited; three Capybaras (*Hydrochœrus capybara*) from South America, purchased.

INTRODUCTION AND SUCCESSION OF VERTEBRATE LIFE IN AMERICA[1]

THE origin of life, and the order of succession in which its various forms have appeared upon the earth, offer to science its most inviting and most difficult field of research. Although the primal origin of life is unknown, and may perhaps never be known, yet no one has a right to say how much of the mystery now surrounding it science cannot remove. It is certainly within the domain of science to determine when the earth was first fitted to receive life, and in what form the earliest life began. To trace that life in its manifold changes through past ages to the present is a more difficult task, but one from which modern science does not shrink. In this wide field every earnest effort will meet some degree of success; every year will add new and important facts; and every generation will bring to light some law, in accordance with which ancient life has been changed into life as we see it around us to-day. That such a development has taken place no one will doubt who has carefully traced any single group of animals through its past history, as recorded in the crust of the earth. The evidence will be especially conclusive if the group selected belongs to the higher forms of life, which are sensitive to every change in their surroundings. But I am sure I need offer here no argument for evolution; since to doubt evolution to-day is to doubt science, and science is only another name for truth.

Taking, then, evolution as a key to the mysteries of past life on the earth, I invite your attention to the subject I have chosen: The Introduction and Succession of Vertebrate Life in America.

In the brief hour allotted to me I could hardly hope to give more than a very incomplete sketch of what is now known on this subject. I shall therefore pass rapidly over the lower groups, and speak more particularly of the higher vertebrates, which have an especial interest to us all, in so far as they approach man in structure, and thus indicate his probable origin. These higher vertebrates, moreover, are most important witnesses of the past, since their superior organisation made them ready victims to slight climatic changes, which would otherwise have remained unrecorded.

In considering the ancient life of America it is important to bear in mind that I can only offer you a brief record of a few of the countless forms that once occupied this continent. The review I can bring before you will not be like that of a great army, when regiment after regiment with full ranks moves by in orderly succession, until the entire host has passed. My review must be more like the roll-call after a battle, when only a few scarred and crippled veterans remain to answer to their names. Or rather, it must resemble an array of relics, dug from the field of some old Trojan combat, long after the contest, when no survivor remains to tell the tale of the strife. From such an ancient battle-field a Schliemann might unearth together the bronze shield, lance-head, and gilded helmet of a prehistoric leader, and learn from them with certainty his race and rank. Perhaps the skull might still retain the barbaric stone weapon by which his northern foe had slain him. Near by the explorer might bring to light the commingled coat of mail and trappings of a horse and rider, so strangely different from the equipment of the chief, as to suggest a foreign ally. From these, and from the more common implements of war that fill the soil, the antiquary could determine, by patient study, what nations fought, and perhaps when and why.

By this same method of research the more ancient strata of the earth have been explored, and in our western wilds, veritable battle-fields, strewn with the fossil skeletons of the slain, and guarded faithfully by savage superstition, have been despoiled, yielding to science treasures more rare than bronze or gold. Without such spoils, from many fields, I could not have chosen the present theme for my address to-night.

According to present knowledge, no vertebrate life is known to have existed on this continent in the Archæan, Cambrian, or Silurian periods; yet during this time more than half of the thickness of American stratified rocks was deposited. It by no means follows that vertebrate animals of some kind did not exist here in those remote ages. Fishes are known from the upper Silurian of Europe, and there is every probability that they will yet be discovered in our strata of the same age, if not at a still lower horizon.

In the shore deposits of the early Devonian sea, known as the Schoharie grit, characteristic remains of fishes were preserved, and in the deeper sea that followed, in which the corniferous limestone was laid down, this class was well represented. During the remainder of the Devonian fishes continue abundant in the shallower seas, and, so far as now known, were the only type of vertebrate life. These fishes were mainly ganoids, a group represented in our present waters by the gar-pike (*Lepidosteus*) and sturgeon (*Acipenser*), but, in the Devonian sea, chiefly by the placoderms, the exact affinities of which are somewhat in doubt. With these were elasmobranchs, or the shark tribe, and among them a few chimæroids, a peculiar type, of which one or two members still survive. The placoderms were the monarchs of the ocean. All were well protected by a massive coat of armour, and some of them attained huge dimensions. The American Devonian fishes now known are not as numerous as those of Europe, but they were larger in size, and mostly inhabitants of the open sea. Some twenty genera and forty species have been described.

The more important genera of placoderms are *Dinichthys*, *Aspidichthys*, and *Diplognathus*, our largest palæozoic fishes. Others are, *Acanthaspis*, *Acantholepis*, *Coccosteus*, *Macropetalichthys*, and *Onychodus*. Among the elasmobranchs were, *Cladodus*, *Ctenacanthus*, *Machæracanthus*, *Rhynchodus*, and *Ptyctodus*, the last two being regarded as chimeroids. In the

[1] Lecture delivered at the Nashville meeting of the American Association, August 30.

Chemung epoch the great dipterian family was introduced with *Dipterus*, *Heliodus*, and possibly *Ceratodus*. Species of the European genera, *Bothriolepis* and *Holoptychius*, have likewise been found in our Devonian deposits.

With the close of the Devonian came the almost total extinction of the great group of placoderms, while the elasmobranchs, which had hitherto occupied a subordinate position, increase in numbers and size, and appear to be represented by sharks, rays, and chimeras. Among the members of this group from the carboniferous were numerous cestracionts, species of *Cochliodus* of large size, with others of the genera *Deltodus*, *Helodus*, *Psammodus*, and *Sandalodus*. Of the Petalodonts there were *Antliodus*, *Chomatodus*, *Ctenoptychius*, *Petalodus*, and *Petalorhynchus;* and of the hybodonts, the genera *Cladodus*, *Carcharopsis*, and *Diplodus*. These elasmobranchs were the rulers of the carboniferous open sea, and more than one hundred species have been found in the lower part of this formation alone. The ganoids, although still abundant, were of smaller size, and denizens of the more shallow and confined waters. The latter group of fishes was represented by true lepidostidæ, of the genera *Palæoniscus*, *Amblypterus*, *Platysomus*, and *Eurylepis*. Other genera are, *Rhizodus*, *Megalichthys*, *Ctenodus*, *Edestus*, *Orodus*, *Ctenacanthus*, *Gyracanthus*, and *Cœlacanthus*. Most of these genera occur also in Europe.

From the permian rocks of America no vertebrate remains are known, although in the same formation of Europe ganoids are abundant, and with them are remains of sharks, and some other fishes, the affinities of which are doubtful. The palæozoic fishes at present known from this country are quite as numerous as those found in Europe.

In the mesozoic age the fishes of America begin to show a decided approach to those of our present waters. From the triassic rocks ganoids only are known, and they are all more or less closely related to the modern gar-pike, or *Lepidosteus*. They are of small size, and the number of individuals preserved is very large. The characteristic genera are *Catopterus*, *Ischypterus*, *Ptycholepis*, *Rhabdolepis*, and *Turseodus*. From the Jurassic deposits no remains of fishes are known, but in the cretaceous ichthyic life assumed many and various forms; and the first representatives of the teleosts, or bony fishes, the characteristic fishes of to-day, make their appearance. In the deep open sea of this age elasmobranchs were the prevailing forms, sharks, and chimæroids being most numerous. In the great inland cretaceous sea of North America true osseous fishes were most abundant, and among them were some of carnivorous habits and immense size. The more sheltered bays and rivers were shared by the ganoids and teleosts, as their remains testify. The more common genera of cretaceous elasmobranchs were *Otodus*, *Oxyrhina*, *Galeocerdo*, *Lamna*, and *Ptychodus*. Among the osseous fishes, *Beryx*, *Enchodus*, *Portheus* and *Saurocephalns* were especially common, while the most important genus of ganoids was *Lepidotus*.

The tertiary fishes are nearly all of modern types, and from the beginning of this period there was comparatively little change. In the marine beds sharks, rays, and chimæroids maintained their supremacy, although teleosts were abundant, and many of them of large size. The ganoids were comparatively few in number. In the earliest eocene fresh-water deposits it is interesting to find that the modern gar-pike, and *Amia*, the dog-fish of our western lakes, which by their structure are seen to be remnants of a very early type, are well represented by species so closely allied to them that only an anatomist could separate the ancient from the modern. In the succeeding beds these fishes are still abundant, and with them are siluroids nearly related to the modern cat-fish (*Pimelodus*). Many small fishes allied apparently to the modern herring (*Clupea*), left their remains in great numbers in the same deposits, and with them has been recently found a land-locked ray (*Heliobatis*).

The almost total absence of remains of fishes from the miocene lake-basins of the west is a remarkable fact, and perhaps may best be explained by the theory that these inland waters, like many of the smaller lakes in the same region to-day, were so impregnated with mineral matters as to render the existence of vertebrate life in them impossible. No one who has tasted such waters or has attempted to ford one of the modern alkaline lakes which are often met with on the present surface of the same deposits, will doubt the efficiency of this cause, or the easy entombment of the higher vertebrates that ventured within their borders. In the pliocene lake-basins of the same region remains of fishes were not uncommon, and in some of them are very numerous. These are all of modern types and most of them are cyprinoids related to the modern carp. The post-pliocene fishes are essentially those of to-day.

In this brief synopsis of the past ichthyic life of this continent I have mentioned only a few of the more important facts, but sufficient, I trust, to give an outline of its history. Of this history it is evident that we have as yet only a very imperfect record. We have seen that the earliest remains of fishes known in this country are from the lower Devonian; but these old fishes show so great a diversity of form and structure as to clearly indicate for the class a much earlier origin. In this connection we must bear in mind that the two lowest groups of existing fishes are entirely without osseous skeletons, and hence, however abundant, would leave no permanent record in the deposits in which remains of fishes are usually preserved. It is safe to infer from the knowledge which we now possess of the simpler forms of life, that even more of the early fishes were cartilaginous, or so destitute of hard parts as to leave no enduring traces of their existence. Without positive knowledge of such forms, and considering the great diversity of those we have, it would seem a hopeless task at present to attempt to trace successfully the genealogy of this class. One line, however, appears to be direct, from our modern gar-pike, through the lower eocene *Lepidosteus* to the *Lepidotus* of the cretaceous, and perhaps on through the triassic *Ischypterus* and carboniferous *Palæoniscus;* but beyond this, in our rocks, it is lost. The living chimæra of our Pacific coast has nearly allied forms in the tertiary and cretaceous, more distant relatives in the carboniferous, and a possible ancestor in the Devonian *Rhynchodus*. Our sharks likewise can be traced with some certainty back to the palæozoic; and even the *Lepidosiren*, of South America, although its immediate predecessors are unknown, has some peculiar characters which strongly point to a Devonian ancestry. These suggestive lines indicate a rich field for investigation in the ancient life-history of American fishes.

The amphibians, the next higher class of vertebrates, are so closely related to the fishes in structure, that some peculiar forms of the latter have been considered by anatomists as belonging to this group. The earliest evidence of amphibian existence, on this continent, is in the sub-carboniferous, where foot-prints have been found which were probably made by labyrinthodonts, the most ancient representatives of the class. Well preserved remains are abundant in the coal-measures, and show that the labyrinthodonts differed in important particulars from all modern amphibians, the group which includes our frogs and salamanders. Some of these ancient animals resembled a salamander in shape, while others were serpent-like in form. None of those yet discovered were frog-like, or without a tail, although the restored labyrinthodont of the text-books is thus represented. All were protected by large pectoral bony plates, and an armour of small scutes on the ventral surface of the body. The walls of their teeth were more or less folded, whence the name labyrinthodont. The American amphibians known from osseous remains are all of moderate size, but the foot-prints attributed to this group indicate animals larger than any of the class yet found in the Old World. The carboniferous amphibians were abundant in the swampy tropical forests of that period, and their remains have been found imbedded in the coal then deposited, as well as in hollow stumps of the trees left standing.

The principal genera of this group from American carboniferous rocks, are, *Sauropus*, known only from foot-prints, *Baphetes*, *Dendrerpeton*, *Hylonomus*, *Hylerpeton*, *Raniceps*, *Pelion*, *Lepidophractus*, *Molgophis*, *Ptyonius*, *Amphibamus*, *Cocytinus*, and *Ceraterpeton*. The last genus occurs also in Europe. Certain of these genera have been considered by some writers to be more nearly related to the lizards (*Lacertilia*) among true reptiles. Some other genera known from fragmentary remains or foot-prints in this formation have likewise been referred to the true reptiles, but this question can perhaps be settled only by future discoveries.

No amphibia are known from American permian strata, but in the triassic, a few characteristic remains have been found. The three genera, *Dictyocephalus*, *Dispelor*, and *Pariostegus*, have been described, but, although apparently all labyrinthodonts, the remains preserved are not sufficient to add much to our knowledge of the group. The triassic foot-prints which have been attributed to amphibians are still more unsatisfactory, and at present no important conclusions in regard to this class can be based upon them. From the Jurassic and cretaceous beds of this continent, no remains of amphibians are known. A few only have been found in the tertiary, and these are all of modern types.

The amphibia are so nearly allied to the ganoid fishes, that we can hardly doubt their descent from some member of that group. With our present limited knowledge of the extinct forms, however, it would be unprofitable to attempt to trace in detail their probable genealogy.

The authors to whom especial credit is due for our knowledge of American fossil fishes and amphibians, are Newberry, Leidy, Cope, Dawson, Agassiz, St. John, Gibbes, Wyman, Redfield, and Emmons, and the principal literature of the subject will be found in their publications.

Reptiles and birds form the next great division of vertebrates, the sauropsida, and of these the reptiles are the older type, and may be first considered. While it may be stated with certainty that there is at present no evidence of the existence of this group in American rocks older than the carboniferous, there is some doubt in regard to their appearance even in this period. Various foot-prints which strongly resemble those made by lizards, a few well preserved remains similar to the corresponding bones in that group, and a few characteristic specimens, nearly identical with those from another order of this class, are known from American coal measures. These facts, and some others which point in the same direction, render it probable that we may soon have conclusive evidence of the presence of true reptiles in this formation, and in our overlying permian, which is essentially a part of the same series. In the permian rocks of Europe, true reptiles have been found.

The mesozoic period has been called the age of reptiles, and during its continuance some of the strangest forms of reptilian life made their appearance, and became extinct. Near its commencement, while the triassic shales and sandstones were being deposited, true reptiles were abundant. Among the most characteristic remains discovered are those of the genus *Belodon*, which is well known also in the trias of Europe. It belongs to the thecodont division of reptiles, which have teeth in distinct sockets, and its nearest affinities are with the crocodilia, of which order it may be considered the oldest known representative. In the same strata in which the belodonts occur, remains of dinosaurs are found, and it is a most interesting fact that these highest of reptiles should make their appearance, even in a generalised form, at this stage of the earth's history. The dinosaurs, although true reptiles in all their more important characters, show certain well marked points of resemblance to existing birds of the order *Ratitæ*, a group which includes the ostriches; and it is not improbable that they were the parent stock from which birds originated.

During triassic time, the dinosaurs attained in America an enormous development both in variety of forms and in size. Although comparatively few of their bones have as yet been discovered in the rocks of this country, they have left unmistakable evidence of their presence in the foot-prints and other impressions upon the shores of the waters which they frequented. The triassic sandstone of the Connecticut Valley has long been famous for its fossil foot-prints, especially the so-called "bird-tracks," which are generally supposed to have been made by birds, the tracks of which many of them closely resemble. A careful investigation, however, of nearly all the specimens yet discovered, has convinced me that there is not a particle of evidence that any of these fossil impressions were made by birds. Most of these three-toed tracks were certainly not made by birds: but by quadrupeds, which usually walked upon their hind feet alone, and only occasionally put to the ground their smaller anterior extremities. I have myself detected the impressions of these anterior limbs in connection with the posterior foot-prints of nearly all the supposed "bird-tracks" described, and have little doubt that they will eventually be found with all. These double impressions are precisely the kind which dinosaurian reptiles would make, and as the only characteristic bones yet found in the same rocks belong to animals of this group, it is but fair to attribute all these foot-prints to dinosaurs, even where no impressions of fore-feet have been detected, until some evidence appears that they were made by birds. I have no doubt that birds existed at this time, although at present the proof is wanting.

The principal genera of triassic reptiles known from osseous remains in this country are, *Amphisaurus* (*Megadactylus*), from the Connecticut Valley, *Bathygnathus*, from Prince Edward's Island, *Belodon* and *Clepsysaurus*. Other generic names which have been applied to foot-prints and to fragmentary remains, need not be here enumerated. A few remains of reptiles have been found in undoubted Jurassic rocks of America, but they are not sufficiently well determined to be of service in this connection. Others have been reported from supposed Jurassic strata, which are now known to be cretaceous. It will thus be seen that, although reptilian life was especially abundant during the triassic and Jurassic periods, but few bones have been found. This is owing in part to the character of most of the rocks then formed, which were not well fitted for preserving such remains, although admirably adapted to retain foot-prints.

(*To be continued.*)

ON NOCTURNAL INCREASE OF TEMPERATURE WITH ELEVATION[1]

TILL the year 1862, when my first experiments were made by the use of the balloon, our knowledge of the temperature of the air was almost entirely confined to within four or five feet of the earth's surface, and the theory that the temperature was always lower at high elevations, and that the decrease of temperature with increase of elevation was at the rate of 1° Fahrenheit for every 300 feet of elevation, was generally received and acted upon. These theories were found not to be at all times true, and the assumption of the decrease of 1° of temperature in every increase of 300 feet of elevation was proved to be erroneous in every balloon ascent I have made; in some a decrease of 1° and more than 1° was experienced within 100 feet, and there is no doubt that, considering the quickness of motion on leaving the earth, the decrease at such times was really 2° or 3°, or more, within the space of 100 feet.

In some of the ascents a difference of 10° was met with within 1,000 feet of the earth, whilst in others but little or no difference was experienced even to heights exceeding 1,000 feet.

Towards the end of my balloon experiments it was evident that a very large number more were necessary, and in my last report I said:—

From all the experiments made it would seem that the decrease of temperature with increase of elevation is variable throughout the day, and variable in different seasons of the year; that at about sunset the temperature varies but very little for a height of 2,000 feet; that at night with a clear sky the temperature increases with elevation; that at night with a cloudy sky there was a small increase of temperature as the height increased; that in the double ascent of May 29, 1866, the one just before and the other after sunset, it would seem that after radiation from the earth began, the heat passes upwards till arrested where the air is saturated with vapour, when a heat greater by 5° was experienced after sunset than at the same elevation before sunset.

This was the state of our knowledge when M. Giffard most kindly placed the great "Captive" balloon, located at Ashburnham Park, Chelsea, near London, at my disposal for a series of experiments.

This balloon could ascend to the height of 2,000 feet on a calm day; its rate of ascension could be regulated at will; it could be kept stationary at any elevation, and experiments could be repeated several times in the day.

On two different days I ascended nine times on each day; there was a decrease of temperature with increase of elevation at every ascent, but, different in amount at every hour, being less and less as the day advanced towards sunset. The results of the experiments are shown in the following table, showing the amount of decrease of temperature per 100 feet of elevation, at different hours of the day with a clear sky, and a cloudy sky, as found by experiments with M. Giffard's captive balloon.

Height above the ground.		Clear Sky.						Cloudy Sky.				
From	To	10 A.M. to 11 A.M.	3 P.M. to 4 P.M.	4 P.M. to 5 P.M.	5 P.M. to 6 P.M.	6 P.M. to 7 P.M.	About 7 P.M.	3 P.M. to 4 P.M.	4 P.M. to 5 P.M.	5 P.M. to 6 P.M.	6 P.M. to 7 P.M.	7 P.M. to 8 P.M.
feet.	feet.	°	°	°	°	°	°	°	°	°	°	°
0	100	1·0	1·4	1·2	0·9	0·5	0·0	1·2	1·2	0·8	0·6	0·5
100	200	1·0	0·8	0·7	0·7	0·5	0·1	0·9	0·7	0·6	0·6	0·5
200	300	0·9	0·7	0·6	0·7	0·5	0·2	0·9	0·6	0·6	0·6	0·5
300	400	0·9	0·6	0·5	0·7	0·5	0·3	0·7	0·5	0·6	0·5	0·5
400	500	0·8	0·6	0·4	0·6	0·5	0·3	0·5	0·4	0·5	0·5	0·5
500	600	0·7	0·5	0·4	0·5	0·5	0·3	0·5	0·4	0·5	0·5	0·5
600	700	0·6	0·5	0·4	0·4	0·5	0·4	0·4	0·4	0·5	0·5	0·5
700	800	0·6	0·5	0·4	0·4	0·5	0·4	0·4	0·5	0·5	0·5	0·5
800	900	0·5	0·5	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·5	0·5
900	1000	0·5	0·5	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·5	0·4

[1] Abstract of a paper read at the Havre meeting of the French Association by Mr. James Glaisher, F.R.S.

This series of experiments proved that which was only indicated in the ascents with a free balloon, viz., that the change of temperature with increase of elevation has a diurnal range, the change being the greatest at about midday and the early afternoon hours, decreasing till about sunset, at which time, when the sky was free from clouds, there was little or no change of temperature up to the height of several hundred feet. I was not able, by means of M. Giffard's balloon, to take any observations at about noon and early afternoon hours, nor any observations after sunset, as the balloon never ascended at these times; but such observations were greatly needed, as there seemed to be at this time a very high probability that the temperature of the air at night must increase with elevation.

A thermometer was placed at the height of 22 feet, sufficiently protected from the effects of radiation, and a second one at the height of 4 feet, and eleven years' observations of these instruments have been taken daily at 9 A.M.; noon; 3 P.M.; and 9 P.M.

These observations were reduced by taking the difference between the readings of the two thermometers and affixing the sign + to that difference when the temperature was higher at the higher elevation; and the sign − when lower. By taking the mean differences for each month between the temperatures at 22 feet and 4 feet, it was found that at all hours of the day during the months of January, February, November, and December, in the afternoon hours of March, September, and October, and night hours throughout the year, the sign was + and that it was − at all other times, clearly indicating the fact of an increase of temperature with increase of elevation during the night hours throughout the year.

THE HEAT PHENOMENA ACCOMPANYING MUSCULAR ACTION

THE fact that in the living muscle heat always appears when the muscle does work (Heidenhain having shown that of two muscles equally weighted and undergoing equal contractions, one doing external work, while the other does none, the former gives out more heat than the latter), is an exception to the general rule in mechanics, that heat disappears when work is done. It is not, however, in contradiction to the general principle of the conservation of energy, but shows that in the living muscle, when stimulated to action, molecular processes occur, which, along with the doing of work, cause a development of heat. The relation of the heat developed to the work done had not been determined with any satisfactory accuracy, probably owing to the want of sufficiently delicate apparatus, though it might naturally be expected to help to an understanding of the phenomena. The subject has been taken up by M. Nawalichin, who, favoured by the experimental means at hand in M. Heidenhain's Physiological Institute, made a careful examination of the development of heat in the active muscle. The experiments were very difficult and tedious, and by reason of the smallness of the values to be measured, required very great foresight and care in the experimental arrangements. The full account of this investigation is given in *Pflüger's Archiv.*

The first series of experiments bore on the question of the production of heat when a particular muscle of the frog is excited, through the nerve, by stimuli of increasing strength to increasing contractions. As, during the experiments, the excitability of the preparation varies, the relation to the strength of stimulus was left out of account, and only the ratio between development of heat and height of contraction examined. The height of contraction was indicated graphically by the muscle itself on a smoke-blackened plate. The development of heat was measured by the deflection of a fine thermo-multiplier, and the stimulation of the nerve was effected by accurately measurable electric actions. The observations were only made when the needle was entirely at rest, which was very difficult to secure, so sensitive was the apparatus.

The tabulated numbers from experiment show: (1) that the sum of the *vis viva*, liberated in the muscle by increasing stimuli, increases only so long as the lifting-heights (*Hubhöhen*) increase. With a certain amount of stimulus when produced by the sending of a constant current, the height of contraction reaches a maximum, and therewith, too, the production of heat. With a particular method of stimulation there is, under certain conditions, a fresh increase of the amount of contraction above the maximum amount, the so-called "supermaximal" contraction; where this occurred, the heat-production also rose. It may therefore be said that in general the development of heat increases with increased lifting-height, and decreases with decreased lifting-height.

The increase in heat-production, however, does not take place proportionally to the increase in lifting-height, but in much quicker ratio. Of this unexpected result M. Nawalichin assured himself by repeated discussion of the numerical values obtained; but he did not succeed in determining more precisely the law of increase.

This result led to the expectation that the same mechanical work of a muscle would be accompanied by unequal heating when the muscle raised a weight to the same height by several small contractions, and when it raised it by one great contraction. In a great contraction more heat would become free than in several small ones, the sum of which was equal to the great. Experiments (though some were difficult) fully confirmed this, especially after it was ascertained that the cooling during the longer period of the several smaller contractions as against the shorter duration of the great contraction, did not play a part.

It is shown, then, that as the stimulation increases, the temperature of the muscle, and accordingly the exchange of material, increase in much quicker ratio than the mechanical work, and that the stronger the stimulation the less favourable is the relation of the exchange of material to the doing of work.

These facts are in accordance, as M. Nawalichin points out, with the common experience that the climbing of a hill is much less heating and exhausting when we go zigzag than when we go straight up. In the former case a greater number of small liftings of the body result in the same doing of work as occurs in the second case through a smaller number of great liftings. The exchange of material, as the second series of experiments show, must essentially be greater in the second case than in the first; and on the amount of it depends, on the one hand, the development of heat, on the other the exhaustion.

In order to get at the inner connection of the phenomena observed, M. Nawalichin sought first to decide the question whether the accelerated increase in production of heat was due to the increase of the stimulus in itself or to the increase of the contraction produced by the increased stimulation. According to Helmholtz's observations, when a muscle is subjected to two maximum stimuli, one following close on the other, the second stimulus produces an increase of contraction only when, at commencement of the second contraction, the first has already reached a considerable height. If this be not the case, as happens if the interval of the two stimuli be less than $\frac{1}{600}$th of a second, the two stimulations produce no greater contraction than each alone. Now in what way does the production of heat occur in this latter case? Experiment showed that also with double stimulation of the nerve, an increase of the heat-development only occurred when it had as result an increase in the height of contraction; the increase of the stimulus in itself is thus without influence on the amount of heat-production. Hence the cause of the quicker increase of the heat-production. That of the amount of contraction must be sought in conditions operative during the course of the contraction.

To determine these conditions the author made experimental inquiry into the relation of heat-development to the states of tension of the muscle during the progress of contraction. He found that the muscle developed less heat the less its tension before action; with which may be mentioned that this tension of the muscle, weighted and stretched by the weight, is smaller the more it has, through contraction, approximated to the natural length. Experiments, also, as to the relation of the heat-production to the change of state of tension during the act of contraction showed an influence of this, such that in each moment of action the quantity of heat depends on the tension. This suggested the idea that the greater heat-production with increasing stimulation is perhaps a consequence of the longer duration of the stronger contraction. The experiments proved, however, that this idea is not justified, for the muscle made small and great contractions in the same time.

As to the nature of the internal processes in the muscle, which may be the basis of the phenomena observed, M. Nawalichin offers the following remarks:—

"We know that the contracting muscle is a body of variable elasticity; with increased contraction its elastic force becomes less, its extensibility greater. When the muscle raises a given weight about four millimetres, the external work for each millimetre of the lifting-height is indeed the same but nevertheless the doing of the same external work for every successive unit-length of the lifting-height will require a larger sum of contractile forces than for every earlier one, since the muscle, even with progressive contraction, varies as to its elastic properties in the direction of an increase of its extensibility. Upon the weight hung to the muscle act, when contraction occurs, both the contractile and the elastic forces of the muscle. . . . In the sum $(c + e)$ of the contractile (c) and the elastic forces (e), e becomes at first (during the contraction) smaller, with the natural unweighted length of the muscle equal to *nil*, and later, even negative. If the weight, then, be lifted a number of units of length, the value of c must increase with increasing contraction. . . . . But an increase of the contractile force is only possible through increased transformation of elasticity into *vis viva*, that is, through exchange of material, which finds its expression in the increased formation of heat which I have observed. Thus, if I mistake not, the facts discovered by me connect themselves with other relations already known, and will find their application in a future theory of muscular forces."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—It is stated that the Home Secretary has appointed as joint secretaries to the Oxford University Commission the Rev. Thomas Vere Bayne, Censor and Student of Christ Church, and Thomas Francis Dallin, late Fellow of Queen's College, and Public Orator of the University of Oxford.

CAMBRIDGE.—The death is announced of Dr. Geldart, Master of Trinity Hall, Cambridge, in the eighty-first year of his age. He had held the mastership twenty-five years, having succeeded Sir Herbert Jenner Fust. Dr. Geldart graduated as seventeenth wrangler in 1818.

LONDON.—Besides those already announced, the Rev. J. F. Blake and Mr. Lebour are, we believe, candidates for the vacant geological chair in University College.

NOTTINGHAM.—The ceremony of laying the foundation-stone of the University buildings at Nottingham has been fixed for Thursday, the 27th inst. The ceremony will be performed at noon by the Mayor, and subsequently there will be a public luncheon in the Albert Hall, at which Mr. Gladstone is expected to be present. The cost of the buildings, including the land, will be 60,000*l*. Of this sum an anonymous donor has contributed 10,000*l*., and the remainder will be found by the Corporation, who have given the site. There will be lecture and class-rooms for the promotion of the Cambridge University Extension Scheme, which, it will be remembered, was first incorporated at Nottingham, and which has since been carried out successfully in several centres of industry. There will also be class-rooms, laboratory, &c., for the use of the students in the science classes in connection with the local Mechanics' Institution, as well as rooms for the Free Library and the Natural History Museum.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, September 10.—M. Peligot in the chair.—Experimental researches on the mechanism of the formation of sugar in the liver, by M. Cl. Bernard.—Referring to the preceding paper, M. A. Trécul then read a treatise on the formation of starch and of cellulose in plants.—M. Th. du Moncel then presented to the Academy a copy of his "Recherches sur les meilleures conditions des électro-aimants."—On the variation of atmospheric pressure at different altitudes, determined at the Puy-de-Dôme Observatory, during the cyclones of last winter, by M. Alluard. The author found, on comparing the barometrical readings at the Puy-de-Dôme Observatory with those of Clermont Observatory, that the most remarkable discrepancies existed, the barometer having frequently risen several millimetres at Clermont, when at the same time it fell considerably on the Puy-de-Dôme. He asks whether the supposition is justified that, while a cyclone passes over the land, other smaller cyclones are situated inside of it and remain at different heights, without reaching the ground? Or does the strange phenomenon result from local reasons which appertain to the relief of the Dôme's chain and to the relative position of the two observatories? In all cases this phenomenon shows the necessity of studying the atmosphere in different layers and the great importance of the Puy-de-Dôme Observatory.—On a process of preserving the flesh of fish (extract from a note), by M. R. M. d'Amélio.—On the presence of phylloxera in the department of Loir-et-Cher, by M. J. Duplessis. The writer has found that the pernicious insect has now penetrated as far as Villebarron, and the district infested near Orleans now has the shape of a vast equilateral triangle of 60 kilometres side.—M. Ed. Prillieux then read a note on the causes which have brought about the invasion of phylloxera into the Vendôme district.—M. J. Maistre in a letter to M. Dumas speaks of the effects of sulphocarbonates against the insects.—The Minister for Agriculture and Commerce wrote a letter to M. Dumas on the same subject.—M. Faye then drew the attention of the Academy to some interesting results obtained at Washington Observatory by the observation of the two satellites of Mars recently discovered. It appears from a communication made by Admiral J. Rodgers, that in the telegram first sent to Europe by the Smithsonian Institution at Washington there was a mistake, viz., in ascribing to the inner satellite a distance of fifty seconds; half of the major axis of its orbit amounts only to thirty-three seconds of arc.—A letter was then read by the president from M. Ch. Lamey on some observations he made during the winter of 1864–65, and which caused him to believe that Mars is surrounded by a ring of asteroids of all sizes, and as a whole resembling, in some respects, the ring of Saturn. M. Lamey had observed an uncertain reddish light on each side of the disk of the planet and corresponding nearly to its equator. He directs the attention of the observers of the two new satellites to this phenomenon.—M. Leverrier then announced the discovery of another new planet in the zone between Jupiter and Mars, by Mr. Watson, at Ann Arbor, on the 3rd instant, R.A. 23·10m. Dec. $+ 0° 45'$. Daily motion in R.A. 55s.; in Decl. $- 1'$; magnitude 11.—On the theory of the small motions of a weighty point on a fixed suface which is described round a vertical axis of revolution, by J. Boussinesq.—On locomotives of the compound system, by M. A. Mallet.—On the specific heat and the melting heat of platinum, by M. J. Violle. In the course of experiments made by this gentleman he found the true melting-point of pure silver at 954° C.—A note by M. V. Neyreneuf on the specific induction power.—On nitroso-guanidine, by M. Jousselin.—On the methods which the ancients must have employed to lift and transport the great Celtic or Gallic monoliths, by M. E. Robert.—A note by M. L. Hugo on some curves representing certain elements of the planetary system.

CONTENTS