THURSDAY, AUGUST 18, 1887.

THE PHYSIOLOGY OF PLANTS.

Lectures on the Physiology of Plants. By Julius von Sachs. Translated by H. Marshall Ward, M.A., F.L.S. (Oxford: Clarendon Press, 1887.)

IT is significant of the progress which the science of botany has made in the last twelve years that the accepted text-book of Sachs, which was published in 1873 as a single volume of 850 pages, is now represented by three volumes with an aggregate of about 1900 pages. The anatomical treatment in the original text-book was condensed, and wanting in detail; it is now replaced by the comparative anatomy of De Bary. Book II. of the text-book, which dealt with special morphology, has been re-edited by Goebel as a separate work, a translation of which has recently appeared (see NATURE, vol. xxxv. p. 577). The physiological portion of the original text-book, entirely remodelled and re-written by its author, appeared in Germany in the form of the "Vorlesungen über Pflanzenphysiologie," a translation of which is the book now under review. In producing this as the last of the series of three volumes above mentioned, the Clarendon Press has completed an undertaking which must earn the heartiest thanks of English students of botany.

It is not improbable that the publication of this volume will mark a stage in the history of the science in this country. The period of dependence mainly on translated text-books has now been of some duration, and it is not to be expected or desired that translation should altogether cease. Nevertheless it is unsatisfactory to receive the bulk of our supply at second hand, and subject to those delays which necessarily attend translation. It is to be confidently hoped that a period of home production, which has already begun, will now ensue, and thus demonstrate at once the healthy growth of the science amongst us, and the fact that there is still alive that skill of exposition in which this country has not been deficient in the past.

Written in the lecture form, and in an easily-flowing style, which the translator has successfully reproduced, the book is aimed at, and should surely attract as well as satisfy, "students and cultivated readers." The first five lectures are devoted to organography, and writing as a physiologist, with the express purpose of preparing the way for a physiological treatment of the subject, the author has adopted a method of "physiological organography," protesting against that "purely formal morphology," which has been prevalent during the last thirty or forty years, and which he complains of as having left the physiological relations of organs entirely out of account.

In laying down his system of "physiological organography," the author ranges all organs in five categories: (1) root, (2) shoot, (3) sporangia and spores, (4) archegonia, (5) antheridia. It will be noted at once that the term shoot is used in a comprehensive sense including leaf and stem where these are distinguishable. The shoot as a whole is thus co-ordinated with the root, a method which commends itself physiologically as more suited to the time than the old distinction of stem, leaf, and root as co-ordinate categories. Secondly, it will be observed that the time-honoured attempt to recognize in the sporangium the result of metamorphosis of some part of the vegetative system, in fact, to define it as representing a metamorphosed leaf, pinna, &c., is abandoned, and Goebel's generalization that the sporangium is an organ of independent nature is accepted. The author then proceeds to apply his method of treatment to the vegetative organs. Referring, by way of illustration, to numerous plants, he distinguishes as *typical forms* of root or shoot those which "present the essential peculiarities in great perfection," he recognizes as *rudimentary* those parts of plants low in the scale, in which "the organic differentiation generally is not so far advanced as in the typical ones," and as *reduced forms* those in which it may be assumed "that, in consequence of special modes of life, more simply organized forms have again arisen from those more highly organized." Lastly, he designates as *metamorphosed forms* those "which have, it is true, been derived later from the typical ones, but which contribute to the greater perfection of the entire organism," such as flowers, tendrils, &c.

In the application of this system the rhizoids of mosses, of fern prothalli, and liverworts, the organs of attachment of various Algæ, and even the mycelium of Fungi, are designated "roots," while the term "shoot," including the distinctive parts of stem and leaf, where these are distinguishable, is applied indiscriminately to the aërial parts of vascular plants, mosses, Algæ, and even to the fructification of the Fungi. While accepting this method as throwing a certain light on the various forms of plants, when regarded from the physiological point of view, it cannot be too strongly impressed upon us that it is in no sense a substitute for the purely formal morphology. This is clearly stated by the author himself, when he says (p. 72) that his method "is by no means intended to exclude the purely formal comparison as it has hitherto been conducted under the name of morphology; its effect on the latter is only to be that of explaining and enlightening." While reading these admirably-written lectures, some whose bent is strongly physiological may think that pure morphology has had its day, and is effete, while the true and only point of view is the physiological; but it is not the author's object to teach this doctrine, and it is to be regretted that, in order to avoid any uncertainty of interpretation, a more distinct terminology was not introduced. The author, who draws a clear distinction between the morphological "member" and the physiological "organ," might well have devised a system of terms applicable exclusively in this physiological sense, and so have both cleared the way for his own views and have saved from risk of error those whose morphological sense is dull.

A concise exposition of the internal structure of the plant follows, the cellular character of most plants being contrasted with the structure of the Cœloblastæ, which Sachs has designated "non-cellular plants." This part, though illustrated by many of the familiar figures from the old text-book, has been entirely re-written in accordance with more recent researches. It is not merely a descriptive and comparative treatment; the physiological end is constantly kept in view, so that the first twelve lectures may be regarded as preparatory to the more purely physiological part which follows. After a short explanation of the external conditions of vegetable life, and of the physical properties of plant-tissues, the remainder of the book is assigned to physiology properly so called, and it is divided into four parts dealing respectively with nutrition, growth, irritability, and reproduction. It is impossible, within the limits of a short review, to give an adequate idea of this comprehensive work; but it may be stated at once that it is as a whole decidedly preferable to the physiological part of the old text-book, which it has replaced. Its superiority is based not solely on its more modern view and larger sphere of observation, but also on its more clear construction. The information it contains is more easily accessible to the student, and to this end the addition by Prof. Marshall Ward of a thorough working index will materially conduce.

It remains to mention certain points in the book which for various reasons will be of special interest to English readers. Sachs's views on the transfer of water in plants are well known from his other writings. Here he puts forward in a concise form his opinion that the transfer is effected through the substance of the lignified walls. Much has been written since the first publication of these lectures to shake confidence in Sachs's view, and a defence of his position against recent attacks would now be of greater interest than the plain statement of his own case which is here given. In the succeeding chapters, on the regulation of the stream of transpiration, and the consequent supply of salts in solution, and on the general nutrition of plants, there is little to demand detailed notice. The writing is clear, and works up the results of recent investigation in a very readable form.

In the next part, which treats of growth, there is much fresh material to interest English readers, the most notable being that in Lecture XXVII. Here Sachs gives a really masterly epitome of his researches on the arrangement of cells in embryonic tissues, reducing to a system what was before 1878 a chaos of isolated observations, and leading up to the important conclusion that "the mode of cell-division depends only upon the increase in volume, and the configuration of the growing organ," and further, that apical cells, where they occur, are merely to be regarded as gaps in the system of construction. After a series of seven lectures on irritability, the volume closes with a discussion of reproduction, both from the comparative and physiological points of view.

Regarded as a whole the book is certainly a remarkable one. Prof. Sachs is a man who does not undervalue his own work, and who has no fear of stating his own convictions; and this volume may fairly be taken as expressing his opinion on vegetable physiology in 1882. In this respect it will always be a valuable work, and will maintain an historic interest long after the actual views expressed in it are either superseded, or have passed out of the range of controversy. F. O. B.

A DICTIONARY OF PHILOSOPHY.

A Dictionary of Philosophy in the Words of Philosophers. Edited, with an Introduction, by J. Radford Thomson, M.A., Professor of Philosophy in New College, London. (London: R. D. Dickinson, 1887.)

TO those who like to pick up information in a scrappy way, this volume will no doubt prove useful. Chancing, for example, on the word *realism*, and feeling somewhat hazy as to its exact meaning, the inquiring reader turns to his "Dictionary of Philosophy," and under the head "Realism or Dualism" finds a statement from Fleming of the theory "as generally held," and short paragraphs descriptive of (1) Sir W. Hamilton's natural realism, (2) Herbert Spencer's transfigured realism, (3) the reasoned realism of George H. Lewes, and (4) intuitive realism, McCosh. Still unsatisfied, he turns to the "Theories of the Concept," and learns of the doctrine of realism from Monck, Whately, and Mill; of its varieties (extreme realism and moderate realism) from Ueberweg; of its origin from Ferrier, Maurice, and Ueberweg; of its truth and error from Noah Porter and Whately; and he is perhaps rather shocked, in conclusion, to learn from Mill that it is "an abandoned doctrine."

An introduction (of 35 pages) has been written by the editor, "for the sake of beginners in philosophical studies, with the view of affording to such readers a general survey of the field of thought before them." We think the editor might have added, "and as an incentive to turn for explanations to the body of the work." We doubt whether the beginner would gain much from a "Sketch of the History of Philosophy" so short as that given in the fourth part of the introduction. We quote, by way of example, the description of post-Kantian German philosophy, with one sentence of which we are in complete accord:—

"The course of philosophy in Germany since the time of Kant has been very remarkable, but is very difficult thoroughly to trace. The following are, however, the chief developments:—(1) German idealism advanced with very rapid strides. It is common to say that Fichte's subjective idealism was followed by the objective idealism of Schelling, and that by the absolute idealism of Hegel. But such a description can convey no meaning to the ordinary reader. (2) In reaction from this tendency was the modern German materialism, expounded by Moleschott, Vogt, and Büchner—a modification of the ancient atomism, according to conceptions of modern science. (3) A development of one side of Kant's philosophy was the pessimism of Schopenhauer and Von Hartmann. According to the former of these, the absolute existence which Kant held to be unknown is will, whilst the latter lays the greatest stress on the unconscious. These thinkers are, however, better known for their theory of human life, of which both take a gloomy and despondent view. (4) Herbart by no means accompanied the progress of post-Kantian idealists; he is characterized by Schwegler as 'extending the monadology of Leibnitz.' (5) Ulrici and Lotze may be taken as examples of German philosophers who hold by the spiritual interpretation of human nature."

The arrangement of the body of the work is as follows:—Two preliminary sections are devoted respectively to (1) "Designations, Definitions, and Divisions," and (2) "The Mind." In the latter are subdivisions on (1) mind, (2) the intellect, (3) faculties of the intellect, (4) personality and the ego, (5) the nature of man, and (6) consciousness. Then follow four main divisions: (A) the psychology and philosophy of cognition, including three sections on ancient, mediæval, and modern schools; (B) the psychology and philosophy of feeling, with paragraphs on æsthetics; (C) the psychology and philosophy of the will, with a section on free-will and determinism; and (D) moral philosophy of ethics, with a concluding section on the immortality of man. The sections on cognition do not seem to be very happily arranged; but a double index—an index of names and an index of subjects—renders it easy to make use of the volume as a dictionary. It would have been well, however, if a synoptical table of contents had also been added.

Turning now to one or two points of more special interest to the man of science, we think that the promise in the preface that "a fair representation has been secured of the teaching of the physiological and evolutional psychologists of our own time," is by no means fully redeemed. Barely a page and a half is devoted to "The Brain and Nervous System." The page on "Sensibility and Muscularity" is not very satisfactory; while the information conveyed in the three pages or so devoted to "The Five Senses" is sufficiently meagre. Such observations as Goldscheider's on "pressure-spots" and "temperature-spots" are not alluded to. We have come across no mention of Lotze's theory of local signs. But it would be easier to enumerate the few elementary points that are mentioned than the many important generalizations that are ignored.

Looking up *evolution* under "Modern Philosophical Schools," we find Mr. Herbert Spencer's well-worn definition preceded by that given by Mr. Sully in his article in the "Encyclopædia Britannica," an extract happily chosen. Two or three paragraphs on mental evolution from "The Principles of Psychology" are then cited. Mr. Sully's criticism of the Spencerian position is succeeded by Mr. Stirling's sweeping and not very acute criticism of the evolution theory in general. A paragraph from Mr. Fiske, on evolutional religion, concludes the two pages and a quarter devoted to this subject. There are indeed other incidental quotations, but we cannot say that the doctrine of evolution is adequately represented.

Nothing, however, is easier than to find fault with the execution of a work of this kind. We trust the labours of the editor and of the "collator of experience" have not been expended in vain. There are in this "Dictionary" a great number of well-selected passages from philosophers of all shades of opinion; and there must be many men with but little leisure for philosophic study who will be glad to make or to renew acquaintance with the thoughts and the speculations here presented.

C. Ll. M.

OUR BOOK SHELF.

Hay Fever and Paroxysmal Sneezing. By Morell Mackenzie, M.D. Fourth Edition. Pp. 96. (London: J. and A. Churchill, 1887.)

Perhaps none of the minor ills to which humanity is prone has given rise to so much discussion as the subject under review. We have the views of those who regard it as a complaint due to "pollen"; of those, again, who look upon it as a neurosis, in which the much maligned and little understood "sympathetic system" is considered to play the chief part; and of others who attribute this and kindred disorders to the hurtful consequences of the presence of swellings, exostoses, bony ridges, &c., in the nasal cavities. The latter school relies on a mode of treatment which in its endeavours to clear the nose of all so-called obstructions, by the free use of the saw, the drill, the gouge, the dental engine and electric motor, &c., reminds one more of the efforts of a mechanic, anxious to bring the nasal cavities into comparison with a polished eburnated cylinder, than of the intelligent practitioner. This kind of thing is being carried to excess, and an earnest protest must be made against the officious and meddlesome surgery of the nasal passages which is advocated amongst a certain class of modern specialists.

It is an old idea that hay-fever is produced in persons having a certain nervous erethism, or predisposition, by the contact of the pollen of certain flowering grasses with some portion of the upper respiratory tract, or the conjunctiva. Dr. Mackenzie is an advocate of this view, and he regards the action of this pollen as more dependent upon its "vital, than chemical or physical characteristics." Those grains with the longest pollen-tubes (Liliaceæ) are less irritating than the pollen of Graminaceæ, the pollen-tubes of which are quite rudimentary. Pollen rubbed into the noses of hay-fever patients is exceedingly irritating, and is more active than alum or tannin. Dr. Mackenzie thinks that the absence of vibrissæ, or want of mobility of the alæ nasi, or dryness of the mucous membrane, leads to the entry of pollen into the nasal cavities. Many interesting facts are referred to in this book which substantiate the author's views; and it is difficult to come to any other conclusion, in the face of such an able exposition, than that, whatever may be the condition of the sympathetic or central nervous system, which in a word constitutes the necessary "predisposition," the introduction of pollen into the eyes, nose, or throat, is necessary for the production of "hay-fever." Some interesting experiments are related by Dr. Mackenzie on dredging the atmosphere during the hay-fever season, with the object of counting the pollen-grains floating in the air. While these were enormously increased during the month of June when hay-making was general, and diminished during July in the country, even the air of the streets of London was only on one or two days during this season found to be free from pollen-granules. Thus persons, even in the heart of a large town, are not free from this external irritant.

The section on paroxysmal sneezing is very good. The author regards the affection as one of the respiratory centre, the afferent impulse of which is conveyed by the trigeminal nerve-fibres. Dr. Mackenzie rightly condemns much of the unscientific jargon written about the power of isolated ganglia, such as Meckel's ganglion, to be directly concerned in these conditions, and justly refers the nervous mechanism to the cerebro-spinal centres, quoting at length Gaskell's recent researches on the sympathetic nervous system, on which, indeed, he founds his views. The author's ideas are set forth with great ability and moderation, and this book forms a valuable contribution to the discussion of this much-vexed subject. The treatment of these complaints is fully dealt with in the book.

The Owens College Course of Practical Organic Chemistry. By Julius B. Cohen, Ph.D., F.C.S. (London: Macmillan and Co., 1887.)

Whatever may be the failings of this little book, there is no doubt it is a step in the right direction—that of making what is called organic chemistry really a practical study, as is the case with inorganic. The introducers of the author, in a short preface, seem to imply that the practical study of organic chemistry should of necessity be connected with, and indeed lead up to, research. Now, however desirable it may be that a considerable number of people should do organic research, there are a great many cases where the student of chemistry will gain as much as will be useful to him by simply making some careful preparations, just as is done with ordinary quantitative analysis, with no intention of making analysis a profession.

It has no doubt been a standing disgrace in this country that, up to within the last few years, organic chemistry has been a "*black-board*" subject in most, if not all, schools; and for this neglect there is little excuse, for a great number of most important experiments may be made without more expenditure than in the case of ordinary quantitative analysis.

A somewhat similar plan of work to the one in this little book has been followed for the last three or four years at the summer course of the Normal School of Science, and no doubt other Colleges where chemistry is a leading subject will have adopted some plan of practical organic instruction. The publication of this book will save some trouble to teachers in directing the preparations. The book is divided into two parts, and, curiously enough, what is generally considered the easier, viz. marsh-gas derivatives, are put in the second part. The author gives as his reason for this, that the selected examples offer fewer difficulties. That is a matter of opinion to some extent, and may depend on the course of lectures the student is hearing at the time.

In Part I., after the purification of alcohol, ether, benzene, and short descriptions of boiling-point determination and fractional distillation, we pass on to formation of benzene derivatives, commencing with bromobenzene, ethyl benzene, &c., to typical members of different families, ending with ethyl benzoate. The descriptions of process to be followed are short, but generally to the point, and are preceded in each case by references to the literature on the subject, which is a very valuable addition, and should be useful to beginners. The appendix, consisting of notes on the preparations, is very good, but would have been better placed, probably, in the text, or in connexion with the most typical substance of a group or family. As to the physical constants, melting and boiling points and specific gravity only are mentioned. Surely a great number of substances, the preparation of which is described, allow of their vapour-densities being taken by Victor Meyer's method? Beyond that there is little to complain of. The book is fairly well adapted for its ostensible purpose.

My Microscope. By a Quekett Club Man. (London: Roper and Drowley, 1887.)

IT is impossible to give in a small volume of some sixty pages a clear description of the microscope and the wonders it reveals. Still the author has managed to make his little essays interesting; and if there is not much depth in his work, he has perhaps written enough to induce some of those who are not already the possessors of a microscope to get one. It is surprising that he has not laid more stress on the advantages of a binocular over a monocular instrument.

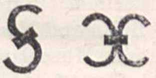
LETTERS TO THE EDITOR.

[*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 insure the appearance even of communications containing interesting and novel facts.*]

Sun and Fire Symbolism.

THERE is a phase of sun and fire symbolism in our very midst which seems hitherto to have received but little attention, viz. the presence of such symbols as crests or in the coats-of-arms of many of the oldest noble families and landed gentry of the British Isles. We find them in the greatest numbers in the armorial bearings of our Scottish families, and those belonging to the most northern counties of England; probably for the same reasons that they are most numerous on objects which have been found in the northern portions of Scandinavia, *i.e.* that the light and warmth of the sun were naturally prized in such districts, and also because they have there survived longer, owing to the isolated position of the inhabitants depriving them of free intercourse with the outer world.

In a letter in NATURE (vol. xxxv. p. 558) headed "The Svastika both as Sun and Fire Symbol," I gave illustrations of some of the emblems of the sun and of the svastika as a fire symbol, and also alluded to the wheel as being in use in some countries to this day as a preservative against fire. A type of fire symbol exists in some parts of England at our very doors. In Gloucestershire and Herefordshire—possibly also in some of the other south-western counties of England—it is not an uncommon circumstance to see on the external walls of some of the older houses one or two pieces of iron in this form  and sometimes thus . It seems evident that they could not have added much support to the building, since they were bolted on to it at one point only—the centre.

A most interesting explanation of them was given a few years ago by an old servant of our family who died about five years ago; his age went with the century. He was a Gloucestershire man, and on being asked the reason of the  form of these irons, he replied "that they were made thus in order to protect the house from fire, as well as from falling down."

In the little village of Kingstone, in Herefordshire, it is still the custom for the people on the eve of May-day to take two short pieces of wood and nail them in this form  over the door of a house or a stable, removing the one of the previous year. On inquiry why this was done, the reply was, "To scare the witches or the evil spirits away."

In the crests and armorial bearings of many of our families we find at least three distinct forms of sun and fire symbolism.

(1) The *sun* in splendour.

(2) *Fire*, represented sometimes by a mountain in flames.

(3) The *sun* as a ring, or as a simple circle, the heraldic terms for this latter type being amulets (Collins's "Peerage of England," London, 1779) and annulets (Sir Bernard Burke's "Peerage, Baronetage, and Knightage," London, 1880).

I propose now to give examples of a few of the most typical of each kind.

Blount, Bt.—This family is of French extraction, and formerly Lords of Guisnes, in France; their crest is an armed foot in the sun. Motto, *Lux tua via mea*.

Blunt, Bt.—Probably originally the same family. These latter have for a crest the sun in glory, charged in the centre with an eye, issuing tears.

In the Earl of Clancarty's arms—the Trenches came from Poitou in 1575—on the first and third quarters is the sun in splendour, and in the centre an escutcheon with the coronet of a Marquis of the Netherlands, charged with a wheel with six spokes. (The wheel is still used as a preservative against fire, both in Holland and in Denmark.)

Musgrave, Bt., of Hayton, has, for his crest, two arms in armour embossed, sustaining the sun; so has also Musgrave, Bt., of Tourin, co. Waterford; and their arms are the same.

The rising sun and the sun in his splendour is also borne—

By the Marquis of Lothian, by the Earls of Stamford and Warrington, by Lords Polwarth and Hammond—Lord Polwarth's crest is a lady richly attired, holding a sun in her right hand and a half moon in her left; and it also forms the crest of Tyrwhitt, Bt., Fairbairn, Bt., the Earls of Antrim, Nicholson, Bt., where it is placed between two stars of eight points, and of many more families.

We find fire symbols in connexion with the sun in the armorial bearings of Macleod of Lewis. Their crest is the sun in splendour, and in their arms they have a mountain in flames on the first quarter and the three-legged Manx man in the second quarter; the motto belonging to this latter is *Quocunque jeceris stabit.*[1] The Duchess of Sutherland (Countess of Cromartie) bears this symbol in her arms for Macleod, in the first and third quarters.

The crest of the Earls of Seafield is a salamander in flames; the Marquis of Hertford has a phœnix in flames out of a ducal coronet; Mackenzie of Scatwell, co. Ross, has on the second quarter of his arms a rock in flames, and on the third quarter three legs of a man armed, for Macleod of Lewis; Lord Ongley, a phœnix in flames holding in its beak a fire-ball; Verney, Bt., a demi-phœnix in flames looking at the rays of the sun; and Carmichael, Bt., has in the second and third quarters of his arms, a cup with flames of fire issuing therefrom.

We will now turn to the third portion of our subject—the sun as a ring, or a simple circle—bearing in mind that the former type is in heraldry called *amulets* or *annulets*, and that the simple circle is styled a *bezant*.

The Earl of Lonsdale has in his coat-of-arms six annulets forming a triangle; the Earl of Bantry one annulet in the first, and ten bezants in the fourth quarter of his coat-of-arms; Barron, Bt., on a Saltier gu., five annulets. Amory Bagge, and Bailey, Bts., bear also annulets.

In the possession of a member of the writer's family is a seal of rock crystal, on which is the motto *Luceo non uro*;[2] beneath this is a baron's coronet (for the Barony of Strange, which came to the Dukes of Athole through the female line), and below this, again, the sun in glory. It is believed (but none are now living who know this for a fact) that this seal formerly belonged to Marjory, second wife of the fourth Duke of Athole, eldest daughter of James, sixteenth Lord Forbes, and widow of John Lord Macleod, who died s.p. in 1789; she married the Duke in 1794, and died in 1842, having had by him a son and a daughter who predeceased her.

The Isle of Man belonged at one time to the Macleods—when, is apparently not known—but in 1405–6 it came into the possession of the Stanleys (afterwards Earls of Derby), through Sir John Stanley, Kt., who in conjunction with Roger Leke received a commission to seize the city of York and its liberties, and also the Isle of Man upon its forfeiture by Henry Percy, Earl of Northumberland. The Stanleys held the Isle of Man until the death of Ferdinando, the fifth Earl, without male heirs, when the Barony of Strange—which title had been borne by the second Earl, who died in 1522—fell into abeyance between his daughters, and the earldom went to his brother William, sixth Earl, who bought from his nieces their claims on the Isle of Man. His son, again, the seventh Earl, was summoned to Parliament in 1627 as Baron Strange, under the impression that his father had enjoyed it; this was, however, not the case, and the summons was virtually a new peerage, which eventually devolved upon the ducal house of Athole, through the marriage of Amelia Anna Sophia, youngest daughter of the seventh Earl of Derby, by his wife Charlotte de la Trémoille, daughter of the Duc de Thours in France, with John, second Earl and first Marquis of Athole. Failing male heirs to her father, Charlotte, daughter of the second Duke of Athole, became Baroness Strange on his death in 1764, and also succeeded to his rights in the Isle of Man. She married her cousin, John Murray, who became the third Duke.

Another seal, also in the writer's family, has an impression which differs essentially from the armed legs of the Isle of Man. It is known to have been the private seal of the fourth Duke. The Manx emblem correctly described is "the three legs of a man armed ppr. conjoined in the centre at the upper part of the thighs, placed in triangle garnished and spurred *or*": but on this seal the three legs are bare, and conjoined in the centre by a sun with rays. In fact, it is the trinacria of Sicily.

HARRIET G. M. MURRAY-AYNSLEY.

[1] Signifying, "However you throw me I stand." This is true of the svastika, a fire symbol likewise.

[2] "I give light, but I do not burn."

Bishop's Ring.—The Sky-coloured Clouds.

DURING a recent visit to the Alps I carefully looked for Bishop's ring, and found that it was generally visible at high altitudes in the middle of the day when the sky was clear. On the whole, the higher one ascended, the plainer it was, up to a height of 9000 feet, beyond which I did not go. On one occasion it was visible nearly or quite as low down as Chamounix, altitude 3400 feet; but this was the lowest point I saw it from. It was always extremely faint, so much so that if I had not seen it previously in its greater brightness I should not have noticed it at all,—indeed, it could usually only be detected by a careful comparison of the colour of different parts of the sky. Its dimension seems the same as heretofore.

About sunrise and sunset this circle continues occasionally conspicuously visible here, but it is long since I saw it in the middle of the day, when the sky has been really clear; sometimes, however, I have seen a similar circle, but with much duller colours and extremely feeble, giving one the impression that it was lower in the atmosphere than Bishop's ring as caused by the volcanic dust, and that it might be caused by smoke.

Last evening, and still more this morning, there was a bright display of the "sky-coloured clouds" (if I may so call them). I seldom or never saw them more brilliant than they were this morning, when I observed a circumstance as regards their colour that I have not noticed before: the greater part of them was coloured as usual, the lower part a dull yellowish green, and the upper part a bright, though light, blue; but there was a border of yellow above the blue, very faintly lit up it is true, but unmistakable. The display was almost confined to that part of the horizon between north-north-east and north-north-west, the cloud-mass evidently not extending further east or west to any extent, and the upper border after 2 a.m., at least, was evidently the actual southern edge of the cloud sheet.

I had the opportunity of watching these clouds gradually fade away in the increasing daylight, showing that in all probability they did not evaporate, but simply became invisible owing to the increasing light of the sky, and perhaps also to their losing light themselves. It is again evident, therefore, that they are of an exceedingly filmy and transparent nature, and indeed can hardly be considered real clouds at all.

Their motion was very slow, but appeared on the whole much as usual—viz. from a north-easterly direction.

Sunderland, July 30. T. W. BACKHOUSE.

The Electricity of the Contact of Gases with Liquids.

SINCE the delivery of Helmholtz's famous Faraday Lecture, "the charge on the atom" has been assumed by physicists, notwithstanding the very serious objections urged by Maxwell against such a theory. A re-perusal of the latter, some eighteen months ago, excited me to make some experiments on the subject. It occurred to me that by allowing such solutions as potassic iodide and chlorine water to react in an insulated vessel some information might be obtained as to the equality or inequality of the atomic charges.

My object at present is not to give an account of the many experiments of this kind which I made, but briefly to call attention to one result to which they led, and I shall describe only such experiments as are necessary for this purpose.

One of the electrodes of a quadrant electrometer was "put to earth," the other was connected to an insulated stand on which was placed a porcelain dish containing a small quantity of distilled water. The instrument was in a rather sensitive state. A high-resistance Daniell, through which a current never passed, gave a deflection of 94 divisions either way. A small fragment of potassium was cast on the water. The spot went rapidly to the left, indicating a negative charge on the porcelain dish, and a positive charge on the escaping hydrogen. A second fragment of K was thrown on the liquid in the insulated dish. The spot moved 28 divisions to the left, then turned and went up the scale to the right 300 divisions. A third piece of K was thrown on the liquid in the insulated basin, and the spot moved 40 divisions to the right. This behaviour was extremely perplexing. The connexions were looked up, and the experiment repeated with like irregular results.

Na was used instead of K, and although the deflections then obtained were also irregular, the tabulated results showed a contrast. When Na was used, 40 per cent. of the deflections were *first* to the left; when potassium was used, 70 per cent. of the deflections were *first* to the left. Speaking broadly, this seemed to indicate that with K the hydrogen came off charged positively, with the sodium it came off charged negatively; and as I thought that such a result would throw some light on the atomic charges I tried very hard to eliminate what I then believed to be accidental exceptions, and to prove that in reality such was the case. But I tried in vain.

Retaining the same method of testing the electrification, other combinations, such as H_2SO_4 and Na, H_2SO_4 + Zn, HNO_3 and K, &c., were tried, and in most cases irregular deflections such as those above described were obtained. Ultimately I got two constant and definite results: (1) Na thrown on strong and pure acetic acid invariably left a positive charge on the insulated dish, the escaping hydrogen being negative; (2) a fragment of zinc thrown into strong HCl invariably left a negative charge on the insulated dish, the escaping hydrogen being positive.

This last is a gross and unmistakable result. In fact its very magnitude was for some time a source of embarrassment. I shall not stop to describe the steps by which the next experiment was reached, but shall proceed at once to describe it; and I shall venture to give it somewhat in detail, as the title at the head of the paper is mainly founded on it.

The electrometer was not in a very sensitive state. The high-resistance Daniell aforesaid gave a deflection of 38 divisions on either side. A glass beaker 7½ inches high and 5 inches in diameter was placed on the insulated stand. A porcelain dish, 2¾ inches in diameter and 1⅛ inches high, was nearly filled with a 10 per cent. solution in distilled water of strong HCl, and placed at the bottom of the glass beaker just described. The insulated stand was now connected to one pair of quadrants, the other pair were put to earth. The "spot" stood at 378 on the scale. Three small fragments of granulated zinc were now dropped into the dilute HCl in the insulated dish. A very slight effervescence at once appeared. This gradually increased but never became violent. No trace of spray could be detected at the end of the experiment above the lower half of the beaker. In 4 minutes from dropping the zinc the spot could be perceived moving, and in 4½ minutes more it moved 28 divisions to the left, indicating the charge on the dish negative and the escaping hydrogen positive. The insulated stand, &c., was now disconnected from the quadrants. The spot maintained its position on the scale. In 1½ minute after, the quadrants were again connected to the insulated stand: the spot moved instantly 20 divisions more to the left. In 1½ minute more it had moved 10 divisions further to the left, but with a slower pace, and it presently stopped and turned back, at first slowly, taking 5 minutes to go back the 68 divisions to the zero. In 4 minutes more it had moved 80 divisions to the right. The insulated stand was once more disconnected from the quadrants, and at the end of 2 minutes they were re-connected, when the spot instantly bounded up 55 divisions further to the right. It continued to move in the same direction until the effervescence ceased owing to the acid being exhausted. A quantity of the zinc survived. On short-circuiting the quadrants the spot returned to within 4 divisions of the original zero.

As the reaction between zinc and hydrochloric acid proceeds, the quantity of chloride of zinc in solution continually increases, and so it appears demonstrated that when hydrogen passes through hydrochloric acid it acquires a positive charge, when it passes through chloride of zinc it acquires a negative charge. I believe that this inference may be safely very much generalized, but for the present I forbear. In confirmation of it, however, it may be well to mention that at any stage of the last experiment a deflection may be obtained to right or left as required by adding an excess of saturated chloride of zinc (for the first), or of hydrochloric acid (for the second).

When it is known that the sign of the charge on escaping hydrogen depends upon the substance it has been in contact with, the very irregular results with K and Na already mentioned become less mysterious. J. ENRIGHT.

Newton's Laws of Motion.

THERE is a point in connection with Newton's laws of motion which the text-books on dynamics, which found the science upon those laws, seem to me to leave very inconveniently and unnecessarily mysterious. The point to which I allude is the meaning of the words "rest or uniform motion in a straight line" in the first law. The difficult words are "uniform" and "straight," which of course are each of them meaningless until it is explained what the motion is with reference to; but this explanation is not given explicitly in any of the books on dynamics which I am acquainted with; and a comparison of their various statements leaves me in some doubt as to what is intended to be implied. May I therefore appeal to those of your readers who accept Newton's laws to say whether the following is correct?

I find that Law III. is interpreted by the most influential authorities, such as Maxwell and Tait, to mean that force occurs only as one side of a mutual action, consisting of two equal and opposite forces between two portions of matter. I am therefore led to suppose that the freedom from force action, which is spoken of in Law I., should be explained (by means of Law III.) as meaning isolation from the influence of all other matter; and that Law I. must be considered as containing a definition of an arbitrary meaning to be given in dynamics to the words "rest or uniform motion in a straight line," namely, that it is the motion possessed by any particle isolated from the influence of all other matter, which influence is to be traced by its mutual character. Law I. would then go on to say, as an experimental result, that all isolated particles move with reference to one another in a way consistent with this definition.

In order to reach this conclusion I find it necessary to interpret some statements in text-books in a somewhat awkward fashion (*e.g.* Maxwell, "Matter and Motion," article xl.), and to suppose some others to be incorrect; hence my doubts, and my appeal for their resolution. W.

August 9.

On the Constant P in Observations of Terrestrial Magnetism.

ON page 304 of vol. ii. of their excellent treatise on "Practical Physics," Messrs. Stewart and Gee give the usual expression for the constant depending upon the distribution of magnetism in a pair of magnets employed for measuring terrestrial horizontal force; namely—

$$P = \frac{A - A'}{\frac{A}{r^2} - \frac{A'}{r_1^2}}.$$

Instead of this awkward and troublesome form, I would suggest

$$P = \frac{r_1^2 r^2}{r_1^2 - r^2}\left(1 - \frac{A'}{A}\right),$$

which can be readily deduced from Gauss's original equations, and is much better adapted to logarithmic computation; especially when r and r_2 remain constant throughout a series of observations, and Gaussian logarithms are used to form the factor $(1 - A'/A)$. WM. HARKNESS.

Washington, D.C., August 1.

The Stature of the Human Race.

IN your "Notes" of last issue, p. 348, you mention General Pitt-Rivers conducting a party of the Royal Archæological Institute to Woodcutts, where skeletons dug out show that the people who inhabited the ancient Romano-British village were of very inferior stature, the males being only on an average 5 feet 2 inches, and the females 4 feet 10 inches. I think it would be a very interesting inquiry to ascertain the average height of the human race in the past, as it appears to me from such data as I have been able to collect that the human race has continuously increased in average stature. I have measured a great many Roman coffins, where I happened to come across them, and my average shows that the Roman could not have greatly exceeded 5 feet 5 inches. In taking measurements of ancient armour, I find that the English aristocracy have decidedly increased in average height within 500 years. For a paper I read before our local Society, I measured twenty-five mummies in the British Museum as nearly as I could through the cases, making estimate for wrapping, and I found the average height of males 61 inches, females 55 inches. The mummy of the celebrated Cleopatra measures about 54 inches, about the height of the present average European girl of 13. The most ancient mummy of an Egyptian king yet discovered measured 52 inches. With research I have no doubt interesting data could be obtained on this subject. Limiting the matter to my own observations, I have formed the idea that the average stature of the human race increases at about the rate of 1·25 inches per 1000 years.

WM. F. STANLEY.

Cumberton, South Norwood, August 13.

A Spider allowing for the Force of Gravity.

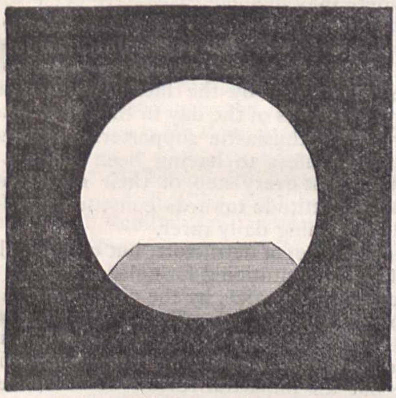
THE manœuvres of the small hunting spider, so common on the West Coast of Africa, are always attractive, and my interest in them had been specially aroused by seeing a house-fly, which had previously narrowly escaped capture, swoop down on his mortal enemy and touch him on the back with his claws (as though twitting him on his failure), the spider apparently taking no notice whatever. On seeing, therefore, one of these spiders stalking a small moth on my wall in Cape Coast Castle, I devoted my attention to the operation.

After moving off several times the moth at length settled on the ceiling, and I thought the chase was over. The spider, however, followed on to the ceiling, and approaching within striking distance (about two inches) anchored his web; then moving round in a circle from the moth until he was about equi-distant from his anchor and his prey, he made his spring. He had evidently calculated how much loose web he would require to reach his prey, for when he fell (as was inevitable from the force of gravity) he was suspended in mid-air by the loose web. The spider regained the ceiling by his own web, having narrowly missed a good meal. C. B. LYSTER.

19 Waterloo Crescent, Dover, August 12.

The Lunar Eclipse of August 3.

IT would be interesting to know if the following phenomenon was observed at other places. At 9.30 p.m., local time, at Hamburg, a small cumulus cloud was observed a little distance below the moon, and the darkened part of the lunar surface was taken to be part of the cloud, from its upper edge being flattened. Ten minutes later the cloud had passed away, but the



Sketch of Lunar Eclipse of Wednesday, August 3, 1887 (as observed at Hamburg).

flattened appearance on the moon remained, and it was evident that the earth's shadow was distorted, as seen in the annexed sketch. Several persons noted the peculiarity, which was visible until about 10.30 p.m. in a very clear sky. H. H.

August 8.

BOTANY OF SAN DOMINGO.

THE vegetation of this, the largest of the West India Islands next to Cuba, has long been almost totally unknown to botanists. The absence of all but the scantiest data about its flora has made any general conclusions as to the main facts of the geographical distribution of plants in the West Indies very uncertain. It has usually been supposed that any attempt to explore any part of the island botanically would present almost insuperable difficulties. The following extracts from a letter from San Domingo received at Kew from Baron Eggers, who has laboured so assiduously in the investigation of West Indian botany, will be read therefore with much interest. W. T. THISELTON DYER.

Puerto Plata, Sto. Domingo, July 11, 1887.

I HAVE now been about three months in this island. I arrived in Samana on April 14, and the following day in this place. After having spent a couple of weeks in exploring the lower mountains here (2600 feet), I proceeded to Santiago, where again I spent some time in exploring the Vega Real and the Monte Christi range. From Santiago I went further into the interior to Jarabocon and the Valle de Constanga (3860 feet), from where I made an expedition up to the highest peaks I could find (Pico del Valle, 8680 feet), and which I succeeded in climbing, though with considerable hardship and fatigue. From this Sierra I returned to Santiago, and from thence to Puerto Plata, where I have latterly been exploring the region to the east towards the rivers Yasica and Jamao.

This, in short, is an outline of my travels here. I have been so far very fortunate, as I have succeeded in penetrating to regions where no European seems ever to have been before: my collections are very rich—about 1200 species—and my health has not suffered from the rather hard life here.

This island is, to a considerable extent, in a state of uncivilization: the roads are frightful, and hardly deserve that name; in fact, there is not one single good road in the whole island. You could hardly believe that the principal road from Santiago to Puerto Plata, on which the greater part of the traffic of the island goes, in the rainy season is impassable often for weeks. With regard to the vegetation, it does not strike me as being very luxuriant. It is much less so than I expected, and is certainly less luxuriant than that of Dominica.

The Cacti, which are a good criterion with respect to dryness of climate, are seen very frequently in the Vega by Santiago; higher up, the mountains in the interior are covered with pine forests to an immense extent. There the soil is gravelly and rather sterile. I found the pine growing from 600 feet up to the very highest peaks. The Sierra and Monte Christi, a coast range, consists of Tertiary limestone, and has no pines at all. But here you find also Cacti, Acacias, and Agaves not unfrequently. Palms are comparatively scarce—only about six or seven species are known (*Oreodoxa*, *Sabal*, *Thrinax*, *Euterpe*, and one called "Yarey" here, which I believe is a species of *Thrinax*), comparatively few *Orchideæ*, and no *Cycadeæ* at all. I believe in the south, near San Domingo, there is a *Zamia;* and, on the whole, the eastern part of the island is more moist, especially near Samana Bay and along the river.

Of remarkable plants I have found here a *Clavija*, which seems to be known only from Trinidad among the West India Islands, *Phyllocoryne jamaicensis*, a *Stanhopea* or *Lælia*, and several tree ferns. In the high mountains, of course, I found a greater number of interesting species: several *Tupæ*, two *Ericaceæ*, two Fuchsias, of which one has a most beautiful large pendulous flower, *Ranunculaceæ*, Ferns, *Loranthus*, and others which of course were all unknown there. The *Juglans cinerea* grows here at a height of about 1800 feet; I obtained a number of seeds.

Among *Coniferæ* I should especially mention a splendid *Taxodium*, the wood of which is dark red and very odorous. It is called Sabium here.

The *Cacti* are, no doubt, very rich and interesting, but as they require to be preserved in alcohol, and the means of transport are so very difficult, I have not made any collections of them this time. The beautiful *Rudolphia rosea* grows from the coast up to 4000 feet.

On the stems of the pines a number of curious Bromeliads are growing, none, however, very conspicuous; at about 1000 feet a bulbous Oxalis with white flowers is found, commonly among the pines in the sandy soil. A number of herbaceous *Synanthereæ* were found among grasses in the upper regions above 7000 feet.

The *Podocarpus* of Jamaica I did not see here at all. A number of beautiful *Echites* are found in the lowlands, as well as some striking Orchids (*Bletia*, *Læliopsis*); also two remarkable Coccolobas, the immense-leaved *C. macrophylla*, and another species with somewhat lesser leaves. The first-named has, as you know, large dark purple flower spikes of 2 feet long; the other, on the other hand, only short spikes with small white flowers. On these Coccolabas are found several nice Epidendrums.

The savannahs are frequent and extensive here, and afford a number of smaller plants of various descriptions.

In several parts of the island there are tracts of mahogany, which are cut for export.

The climate is generally cooler than in the smaller islands. I found the nights quite fresh. In the higher mountains, of course, it was quite cold at night. On the Pico del Valle I passed one night. We had a large fire blazing all night; in the morning, at 6 o'clock, the thermometer only showed 11° C.

Rivers and brooks are innumerable, but on account of the freshets and the violent current after rain, hardly any aquatic plants are seen, at least in this part of the island. I missed the beautiful *Pontedera* of Porto Rico.

I send you to-day, by mail, seeds of the only palm which I have been able to obtain, a species of *Euterpe*, which is common here above 1200 feet, and the fruit of which is much eaten by half-wild hogs. It is called "Manacla" here, and grows to a height of about 30 to 40 feet.

Towards the end of the year I propose continuing my explorations of the West Indies, having in view a further investigation of this island, especially of the east and south, and furthermore of the Bahamas (especially Andros) and the two islands of Tobago and Grenada, both of which, I believe, are very little explored. The northern part of Dominica is also still *terra incognita*, unless something has been done there since my visit in 1879 and 1880. This island is particularly interesting to me. I believe it is one of the most luxuriant of the West India Islands.

CONSTITUTIONAL FORMULÆ AND THE PROGRESS OF ORGANIC CHEMISTRY.

IF the mere increase in the number of known facts were an accurate measure of the growth of a science, the question as to the progress of organic chemistry would be easily answered. Let the reader open a text-book on chemistry of fifty or sixty years ago, and he will find, sheltering itself under the wing of the inorganic chemistry of that day, the half-fledged science of organic chemistry. Then let him turn to Beilstein's gigantic *Handbuch der organischen Chemie*, with its more than two thousand large closely-printed pages—a mere classified catalogue of the known facts, written moreover in the highly-condensed elliptical style appropriate to catalogues. Here is increase.

But life is not measured by days, nor chemistry by new compounds; and the reader might resent the invitation to appraise the progress of organic chemistry by this rough quantitative method. A qualitative analysis is necessary here.

But how? The really important facts, even with the aid of the most judicious selection, could hardly be packed within the compass of a single article; nor would they be interesting, or, in such compression, even intelligible, to the non-chemist. There are of course the usual *pièces de résistance* in the shape of the coal-tar colours, and the various naturally-occurring compounds that have been artificially prepared; but probably the general reader has heard enough of these already, and might feel inclined to ask whether organic chemistry has nothing further to say for itself.

There is, however, a peculiarity of organic chemistry which distinguishes it from the remainder of the science. The aim of all chemistry is to ascertain the constitution of matter, and the said peculiarity of organic chemistry is, that it expresses its views on this important subject in greater detail, more precisely (or, as some will have it, more dogmatically), than inorganic chemistry. Its articles of belief on this head are embodied in its constitutional formulæ.

Here we touch on matter which every chemist will at once recognize as debatable. But, for good or for evil, these constitutional formulæ are, apart of course from the dry facts, the main scientific outcome of organic chemistry: they form the particular contribution which organic chemistry has been able to make towards solving the central problem of all chemistry—the constitution of matter. At present they crown the edifice of organic chemistry. Are they the keystone of an arch, or a mere meaningless architectural embellishment? This is the most general question which organic chemistry can put to itself at the present moment, and an attempt to answer it is the most fitting mode of reviewing the past work of the science. Let us therefore turn our attention to these constitutional formulæ, and ask ourselves what they are: what their meaning is, their scope, their justification.

According to some unfriendly critics, constitutional formulæ have done incalculable harm to chemistry by causing chemists to desert accurate experiment and observation for idle speculation—to substitute for the arduous work of the laboratory the easy task of stringing together atomic symbols, according to certain rules, on paper. There may in some cases have been some small measure of truth in this accusation—in other words, there may have been some occasional abuse of constitutional formulæ; but the injustice of the accusation as a whole is sufficiently proved by the fact that the most successful experimenters of the day in the domain of organic chemistry are enthusiastic supporters of constitutional formulæ, and confess to having been guided by these formulæ at almost every step of their researches. This actively-hostile attitude towards constitutional formulæ is fortunately becoming daily rarer.

Another class, not of detractors, but of rather lukewarm friends, of the constitutional formula, regard it as a convenient mnemonic device, by the aid of which the composition of otherwise hopelessly complex compounds may be successfully impressed on the memory. It is perfectly true that constitutional formulæ do perform this important function; but an impartial review of the case will, we imagine, lead to their being rated somewhat more highly than this.

A third class may be described as the undiscriminating admirers—the injudicious friends—of the constitutional formula. To them the constitutional formula is a final expression of the position of the atoms in the molecule—a picture of the molecule itself. This is a phase of belief which many pass through in making their first acquaintance with organic chemistry, and its existence is due to the circumstance either that the teacher is so much engrossed in impressing the complex array of facts and theories upon the mind of the student that he has not time to introduce philosophic limitations and doubts, or that he considers such an addition only calculated to render an already somewhat tough intellectual fare totally indigestible by a beginner. However this may be, it is certain that the faith of the beginner is quite as frequently appealed to as his reason.

We shall best be in a position to discern the meaning and to estimate the value of these constitutional formulæ, if we consider to what necessity they owe their origin, and how far they fulfil the purpose for which they were devised.

The atomic theory, as propounded by Dalton, satisfied for a time the requirements of chemists. For every properly-analyzed compound a more or less simple atomic proportion could be calculated, and this atomic proportion was expressed in the empirical formula of the compound. These empirical formulæ were combined into equations, and the equations formed a complete expression of the reactions, so far as the weights of matter taking part in them were concerned. Now it was experimentally proved that every definite compound possessed a constant qualitative and quantitative composition, and it seemed to chemists as something of the nature of an axiom that to a given composition one and only one compound could correspond. So convinced were they of the truth of this unproved and, as the event showed, totally erroneous proposition that, when in 1823 and 1824 the first cases of *isomerism*, or identity of composition together with diversity of properties, were discovered by Wöhler and Liebig, the results obtained by these eminent chemists were generally set down to faulty analysis. But the cases of isomerism multiplied rapidly, and chemists had to make their account with this altered state of things. But here the inadequacy of the empirical formulæ became evident. Wherever a case of isomerism occurred, the empirical formula was ambiguous, and the equations in which it was employed were neither a complete nor a precise expression of the reactions.

To some, the discovery that constancy of composition no longer involved constancy of properties may have seemed to sap the very foundations of chemistry as then understood. But this was not the case. The discovery necessitated an extension of the atomic theory, not its abolition. In fact, isomerism afforded a remarkable proof of the correctness of the view that matter consisted of atoms. On the alternative hypothesis that matter fills space continuously and homogeneously, isomerism is incapable of explanation; as it is inconceivable that the same given quantities of the same given kinds of matter, continuously and homogeneously filling space, should produce more than one compound. A difference of properties in such a case bespeaks a difference of *arrangement* of the component parts; and further, as each such compound displays, even in the state of the finest mechanical subdivision, perfect uniformity, the component parts, by the arrangement of which the difference of properties is produced, must be exceedingly small. We are thus led back to the atomic theory, whilst at the same time the extension is indicated which it was necessary to make in this theory in order that isomerism might find its proper place and explanation under it. It was necessary to determine, so far as possible, the *mode of arrangement* of the atoms in the various compounds. The results of this attempt are embodied in the constitutional formulæ which have been employed by chemists at various times.

The method resorted to in solving this problem was very similar to that which had been employed in determining the ultimate composition of compounds. Just as when, after isolating from a compound, or introducing into a compound, some particular kind of elementary matter, chemists concluded that the compound actually contained that particular kind of matter, so, when in a reaction a particular group of atoms was eliminated bodily from a compound, or introduced bodily into a compound, they concluded that this group existed as such in the compound. Unfortunately, the conclusion is not always quite so warrantable in the case of atomic groups as in the case of elements. The reaction, for example, by which an atomic group is eliminated from a compound involves the destruction of the parent compound, and in this process, which is generally more or less violent, it is only too easy for the atomic groups to undergo re-arrangement. In this way, alcohol (C_2H_6O), from the fact that it may be split up into ethylene (C_2H_4) and water (H_2O), was at one time regarded as containing these two atomic groups—a view which at all events is not that at present held. We thus see that from two different reactions, two totally distinct and mutually incompatible constitutional formulæ may be deduced for the same compound.

It would carry us too far to trace all the steps by which constitutional formulæ gradually became more precise and less self-contradictory, but a few important discoveries may be mentioned which have mainly tended to bring about this result. In the first place, the development of the idea of the molecule as distinct from that of the atom, and the discovery of a means of determining the molecular weight of bodies, led to the division of isomerides into two classes: those in which the proportions of the various atoms were the same, but the total number of atoms in the molecule was different—this mode of isomerism being distinguished as *polymerism;* and isomerism proper, in which both the proportions of the various atoms, and the total number in the molecule, are the same in the different compounds. But the knowledge of the molecular weight aided chiefly in the construction of constitutional formulæ by determining the exact number of atoms in the molecule, and thus facilitating the task of arranging these atoms by stating precisely how many atoms had to be arranged. The law of valency also exercised a most important influence, simplifying matters by greatly limiting the number of legitimate arrangements. In fact, in the case of some of the simpler compounds, such as methane (CH_4), ethane ($CH_3 . CH_3$), propane ($CH_3 . CH_2 . CH_3$), methyl alcohol ($CH_3 . OH$), and others, only one mode of arrangement is, according to the laws of valency, possible for each compound.

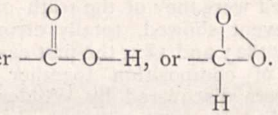
A modern constitutional formula, therefore, takes the various atoms of a compound in the proportions indicated by the empirical formula, and in the absolute number prescribed by the molecular weight, and arranges them in that way which, within the limits of the laws of valency, will best account for the reactions of the compound.

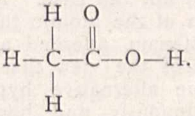
Let us consider what elements of uncertainty are involved in each of the various operations here enumerated.

The correctness of the empirical formula of a compound, as calculated from its percentage composition, depends upon the correctness of the atomic weights assigned to its component elements. In the case of organic compounds, to the consideration of which we shall confine ourselves here, the atomic weights of the component elements may be regarded as determined with a degree of probability approaching to absolute certainty. (This does not, of course, refer to the question whether the atomic weight of an element has been determined within 1/10,000 more or less of its true value, but whether, for example, in the case of carbon the atomic weight is 12, or some multiple or sub-multiple of 12.) The empirical formulæ of correctly analyzed organic compounds may therefore be regarded as standing on as sure a foundation as almost anything in the range of science which is a matter of deduction and not of direct observation or experiment. As regards the second point, the molecular weight, an almost equal certainty may be said to prevail in most cases in which the compound can exist in the state of vapour. Avogadro's law, that "when two gases or vapours are at the same temperature and under the same pressure, the number of molecules in unit of volume is the same in both gases or vapours"—this law, originally advanced as an hypothesis, has been shown to follow as a mathematical deduction from the kinetic theory of gases, a theory almost as well established at the present day as the atomic theory itself. Avogadro's law places in our hands a means of determining the molecular weight of substances which are capable of existing in the form of vapour, the only uncertainty attaching to its determinations being that occasioned by the tendency which many compounds exhibit, either to undergo decomposition, or to be incompletely vaporized, in passing into the gaseous state. But in the case of all compounds capable of existing undecomposed in the gaseous state throughout any considerable range of temperature, the molecular weight may be determined with a very high degree of probability. In cases where the compound is not volatile without decomposition, recourse must be had to indirect means in the determination of the molecular weight, and there is consequently more or less uncertainty in such determinations. As regards the third operation in the construction of a constitutional formula—the arrangement of the atoms so as to satisfy their valencies, and at the same time to account for the reactions of the compound in question—both parts of this process, but particularly the latter, involve more or less uncertainty. The valency of an element is frequently a variable quantity, and the validity of a constitutional formula for a compound will depend upon our attributing to each element the valency which it really possesses in that compound. In the case of organic compounds, however, this source of uncertainty is reduced to a minimum. Carbon is, with one certain and one or two doubtful exceptions, always a tetrad; hydrogen and oxygen are constant in their valency; and the character of nitrogen as a triad or as a pentad is generally easy to determine. The chief source of uncertainty lies in the difficulty of expressing the reactions of a compound by its constitutional formula, great scope being left here for arbitrary interpretation. To this is due the fact, on which the opponents of constitutional formulæ lay so much stress, that in the case of numerous compounds the accepted formulæ have varied from time to time. This could, however, scarcely be otherwise. A formula constructed on the basis of an insufficient number of reactions would have to be altered as soon as new reactions were discovered with which it was not in harmony. And it must be admitted that, in the case of most well-studied compounds, very few changes have been made in the constitutional formulæ since these were constructed on the principles of valency. In the case even of the more complex compounds, the constitutional formulæ show a tendency to become finally settled as soon as sufficient experimental material has been accumulated.

In this light, then, a constitutional formula is to be regarded as a symbolic expression, constructed according to the laws of valency, and embodying in a very condensed form the reactions of a compound. By a knowledge of the rules according to which such a formula is constructed—by a knowledge of chemical precedent, as it were—we ought, from an inspection of the formula, to be able to predict the reactions of the compound; to say beforehand, for example, how many substitution-products of a particular class a given compound ought to yield, and so on. The value of a good working hypothesis lies in the fact that it can predict: if it can predict nothing, it is worth nothing. Now, with regard to the question before us, we find that if we correctly embody in a constitutional formula a certain number of reactions—a number sufficient to warrant its construction—it will correctly predict an enormous number of reactions which were not in the least contemplated during its construction. Let us take the example of acetic acid:—

Starting with methyl iodide, which admits of only one constitutional formula, we convert it into methyl cyanide by heating it with potassium cyanide, $CH_3I + KCN = CH_3(CN) + KI$, thus substituting a monad group, CN, for the monad iodine atom. The constitution of this methyl cyanide is, however, not rendered clear by this reaction: it might be either $CH_3.CN$ or $CH_3.NC$ according as the cyanogen group is united to the carbon of the methyl by means of carbon or by means of the nitrogen. Both these compounds are in fact known. The one formed in the foregoing reaction has the first of these two constitutions, inasmuch as, when heated with acids or alkalies, it parts with its nitrogen in the form of ammonia, yielding acetic acid, $CH_3.CN + 2H_2O = CH_3.COOH + NH_3$. In this *hydrolysis*, or decomposition of the compound with assumption of the elements of water, the nitrogen atom of the cyanogen group is removed, whilst the carbon atom remains in combination; and we therefore conclude that it was by means of this carbon atom, and not by means of the nitrogen atom, that the CN-group was united to the carbon of the methyl group—a conclusion confirmed by the behaviour of the isomeric methyl cyanide, in which the carbon atom of the NC-group can be eliminated, leaving the nitrogen attached to methyl. The only question remaining to be solved is the constitution of the monad group, COOH, which might be

either  From what is known from other sources concerning the mechanism of the process of hydrolysis, the first formula is the more probable; that it is correct is shown by the behaviour of acetic acid towards the trichloride of phosphorus, by which reagent the hydroxyl group (OH) can be removed and replaced by a monad chlorine atom, whilst the resulting acetyl chloride ($CH_3.COCl$) may be reconverted by the action of water into acetic acid ($CH_3.CO.OH$). Acetic acid therefore contains a monad group, OH, exchangeable for chlorine; and the first formula is correct. Uniting this COOH-group (carboxyl) to the methyl group, and expanding these radicles, we have the fully-dissected formula of

acetic acid, 

What does this formula tell us? What does it predict? Of the four hydrogen atoms, three are directly united to carbon, and one is distinguished from the others by being indirectly united to carbon by means of oxygen. We know that hydrogen, when directly united to oxygen (for example, in water) may be displaced by electro-positive elements such as metals; and we find that in acetic acid one hydrogen atom is distinguished from the others by this property. We know that hydrogen atoms in direct union with carbon (as in the hydrocarbons) may be displaced by electro-negative elements such as the halogens. This we find to occur in the case of acetic acid: there are three atoms of hydrogen which may be successively displaced by chlorine and other electro-negative atoms or groups. That these three chlorine atoms are attached to the same atom of carbon, and that therefore the three atoms of hydrogen which they have displaced are also so attached, is shown by the fact that potassium trichloracetate, when warmed with a solution of potassium hydroxide, yields chloroform ($CHCl_3$)—

$$\begin{array}{l} CCl_3 \,\vdots\, CO.OK. \\ \;\;\;\; H \,\vdots\, OK \end{array}$$

The same reaction with ordinary potassium acetate (a higher temperature being, however, required in this case) yields marsh gas (CH_4)—

$$\begin{array}{l} CH_3 \,\vdots\, CO.OK. \\ \;\;\;\; H \,\vdots\, OK \end{array}$$

In both these reactions the molecule is divided at the point of union of the carbon atoms. Apart from this disruption, each carbon atom retains the same atoms in combination with it after the separation which were attached to it before. In the reaction with phosphorus trichloride already referred to, the molecule of acetic acid is divided at the point of union of the hydroxyl group (OH) with the acetyl group ($CH_3.CO$). That such separations are possible without disturbing the atomic arrangement of the separated groups renders the construction of constitutional formulæ possible. But the point to be noted is that all the foregoing reactions and many others—in fact all the reactions of acetic acid—are satisfactorily explained by the constitutional formula, and are, so to speak, embodied in the formula.

A constitutional formula is thus founded on reactions and predicts reactions. In this lies its chief value. A constitutional formula which is not founded on reactions possesses a very slight value indeed. The constitutional formula of a complex mineral silicate, for example, is not an expression of the reactions of that silicate, inasmuch as the silicate has not hitherto been induced to yield any variety of reactions worth mentioning: it is merely the simplest, and perhaps the most symmetrical, way of arranging the component atoms consistently with their valency, and in accordance with certain analogies in the constitution of salts of oxygen-acids. Not even the molecular weight of the silicate is known, and this knowledge is the first step towards the construction of a constitutional formula which shall have any great value. But the beginner, who has not always the genesis of the various formulæ before his eyes, is apt to put all constitutional formulæ into one category, and to view all with equal trust or distrust according as his temperament happens to be sanguine or sceptical.

The chief opponents of constitutional formulæ are to be found among inorganic chemists. Constitutional formulæ are essentially a creation of organic chemistry. We have seen that they mainly originated in the necessity of explaining the phenomena of isomerism. Now isomerism, which is the rule in organic chemistry, is entirely the exception in inorganic chemistry. The constitutional formulæ of inorganic chemistry are thus an artificial growth: they are the result of an attempt to transplant into inorganic chemistry methods and analogies derived from organic chemistry, and it cannot be affirmed that these borrowed growths have altogether flourished in the new soil. Where the organic formulæ have guided the chemist through the labyrinths of the various classes of compounds, predicted reactions, laid down the number of possible isomerides, and shown the way to the synthesis of natural compounds so high in the scale of complexity as alizarin and indigo, the same methods applied to inorganic chemistry have led to no tangible result higher than that of checking a few doubtful formulæ by means of the laws of valency. The reasons of the failure have already been indicated. But the partial failure of constitutional formulæ in inorganic chemistry is hardly an argument against their use in organic chemistry, where they have achieved the most signal success.

Up to this point we have regarded the constitutional formula simply as a symbolic device, by means of which reactions and cases of isomerism may be expressed and predicted. The question now arises: Is it anything beyond this? A constitutional formula is primarily a certain definite arrangement of atomic symbols. Is there anything like this atomic arrangement in the molecule itself, or even anything corresponding with it?

It is in the highest degree improbable that there is anything *like* it in the molecule itself, but quite possibly there is something *corresponding with* it. That the constitutional formula cannot be like the molecule in the sense of being a picture of it is manifest from a variety of considerations. To mention one out of several: a constitutional formula represents the atoms as points connected with one another in a certain definite way by lines of attraction, without reference to any actual positions in space which these atoms may be supposed to occupy; for the sake of convenience they are represented as lying in the plane of the surface on which the formula is drawn. Now the kinetic theory of gases informs us that the atoms within the molecule are not to be conceived of as occupying their positions in a state of rest: each executes some form of vibration or rotation. This view is quite compatible with the existence of definite relations of attraction between given atoms within the molecule. To borrow an illustration from astronomy, we might in the constitutional formula of acetic acid, for instance, regard the two carbon atoms as the two suns of a double star, and the atoms directly attached to the carbon suns as planets—one with a satellite. The parts may execute their respective motions without disturbing the stability of the whole, any more than the stability of the solar system is disturbed by the motions of its parts. Now, it is evident that a constitutional formula which represents the atoms as motionless in a plane cannot be a true image of the molecule—cannot be *like* it.

That the constitutional formula, however, in some way *corresponds with* the molecule, is shown, not only by the chemical evidence which we have already discussed, but, what is more important, by a number of physical considerations. That the physical properties of a substance are dependent on the arrangement of the atoms within the molecule is evident from the fact that in isomeric compounds the melting-point, boiling-point, specific gravity, and other physical properties generally vary for each isomeride. A comparison of the physical properties of similarly-constituted compounds shows that in many cases very definite relations can be traced between constitution and physical properties.

Very important information has been gained in this way by studying the behaviour of organic compounds towards light. Thus a number of these compounds when in the liquid state, or in solution, cause the plane of a ray of polarized light, if passed through them, to turn through a certain angle. It was observed by Le Bel that all such optically active substances contained in their constitutional formulæ at least one *asymmetric* carbon atom—that is, a carbon atom united to four dissimilar atoms or groups; and an ingenious hypothesis has been put forward by Le Bel, and in greater detail by Van't Hoff, to account for this concatenation. The researches of Gladstone and Dale, Landolt, Brühl, and others on the molecular refraction of organic liquids have demonstrated an intimate connexion between the refractive power of a liquid on the one hand and its constitution on the other, so that observations on the refractive power may be employed in ascertaining the constitution of such compounds; and Perkin has recently shown that the "magnetic rotatory power" of organic liquids—the power which such liquids possess, when placed in a strong magnetic field, of turning the plane of the polarized ray—may be utilized in the same manner. Again, the selective absorption which organic liquids exercise on light of different wave-lengths is closely connected with the constitution of these liquids; and the presence of certain organic radicals in the formula of a compound is manifested by certain definite absorption-bands which make their appearance in the photographed spectra of the infra-red (Abney and Festing) and of the ultra-violet (Hartley).

Other remarkable relations between constitution and physical properties are manifested in what is termed the *molecular volume* of organic liquids at their boiling-points—a subject first investigated by Kopp, and later by Thorpe, Ramsay, Lossen, and others. By the *molecular volumes* of compounds are understood the relative volumes which quantities of these compounds taken in the proportion of their molecular weight occupy. Kopp found that the molecular volume of a liquid organic compound at its boiling-point is the sum of the atomic volumes of its elements; and that, whereas the atomic volumes of carbon and hydrogen are constant, the atomic volume of oxygen varies with its mode of combination, having two distinct values: one value for an oxygen atom attached with both its affinities to the same atom of another element, and a second value for an oxygen atom attached to two different atoms.[1] Sulphur exhibits a similar definite variation in atomic volume in accordance with the mode of distribution of its affinities.

[1] Kopp distinguished "intraradical" and "extraradical" oxygen. The above is a re-statement of his views in terms of modern formulæ.

In all the foregoing instances we have a successful correlation of the results of physical chemistry with those obtained by the pure chemist in the deduction of constitutional formulæ. Many who withheld judgment, or even condemned, when the chemist was his own witness, may listen to him more favourably now that he is supported by the independent testimony of the physicist.

These investigations into the physical properties of organic compounds are of relatively recent date. There is little doubt that as they are extended new and important laws will be deduced. Much is to be hoped from thermo-chemistry, incoherent as many of its utterances as yet are. By following the path of physico-chemical research, chemists may even hope to arrive at a dynamical representation of the molecule which shall be as much more powerful as an instrument of research than the present merely statical constitutional formula, as that is more powerful than the empirical formula which preceded it. It is hazardous to try to fix a limit to scientific advance in any direction, but it is probable that the modern constitutional formula represents the limit to what purely chemical research can accomplish in determining the constitution of matter. Much will still have to be done by purely chemical research in working out the details of the existing system: the constitution of the more complex compounds will be ascertained on the lines of our present formulæ; new valuable natural compounds will be synthesized. But mere chemical reactions can probably never settle questions of intramolecular dynamics; in these help must come from physical chemistry. Moreover, the physical methods of research supplement the chemical methods in one important particular. By chemical methods we can never study the molecule as it actually exists. Our synthetical methods give us information concerning the molecule only at the moment of its formation; our analytical methods equally confine themselves to the moment of its destruction. The physical methods supply this want: they enable us to study the existing compound. Of these physical methods, one of the most promising, although one of the most recent, is the optical method, which has yielded results of the utmost importance both in inorganic and in organic chemistry. The ray of light which passes from the fixed star to the earth gives us information concerning the composition of the atmosphere of the fixed star; and it is perhaps not too much to hope that the ray of light which has threaded its way through and between the molecules of a compound, and has been modified by its contact with these, will, if properly interrogated, furnish some information concerning the structure of these molecules. Indeed, in the case of the rotation of the plane of polarized light by organic liquids, of their absorption spectra and their indices of refraction, this information has in a measure been obtained.

To sum up. The constitutional formula is not an ultimate expression of the whole truth as regards molecular structure. But it is certainly a very useful and convenient symbolical expression of certain aspects of the truth. We all hope that it may one day be superseded by some higher and more complete generalization. But it will be absorbed and assimilated, not rejected and contradicted, by that generalization. *Non omnis morietur.*

THE YALE COLLEGE MEASUREMENT OF THE PLEIADES.[1]

THE Messrs. Repsold have established, and for the present seem likely to maintain, a practical monopoly in the construction of heliometers. That completed by them for the Observatory of Yale College in 1882 leaves so little to be desired as to show excellence not to be the exclusive result of competition. In mere size it does not indeed take the highest rank; its aperture is of only 6 inches, while that of the Oxford heliometer is of $7\frac{1}{2}$; but the perfection of the arrangements adapting it to the twofold function of equatorial and micrometer, stamps it as a model not easy to be surpassed. Steel has been almost exclusively used in the mounting. Recommended as the material for the objective-cell by its quality of changing volume under variations of temperature nearly *pari passu* with glass, its employment was extended to the telescope-tube and other portions of the mechanism. The optical part of the work was done by Merz, Alvan Clark having declined the responsibility of dividing the object-lens. Its segments are separable to the extent of 2°, and through the contrivance of cylindrical slides (originally suggested by Bessel) perfect definition is preserved in all positions, giving a range of accurate measurement just six times that with a filar micrometer. (Gill, "Encyc. Brit." vol. xvi. p. 253; Fischer, *Sirius*, vol. xvii. p. 145.)

This beautiful engine of research was in 1883 placed in the already practised and skilful hands of Dr. Elkin. He lost no time in fixing upon a task suited both to test the powers of the new instrument and to employ them to the highest advantage.

The stars of the Pleiades have, from the earliest times, attracted the special notice of observers, whether savage or civilized. Hence, on the one hand, their prominence in stellar mythology all over the world; on the other, their unique interest for purposes of scientific study and comparison. They constitute an undoubted cluster; that is to say, they are really, and not simply in appearance, grouped together in space, so as to fall under the sway of prevailing mutual influences. And since there is, perhaps, no other stellar cluster so near the sun, the chance of perceptible displacements among them in a moderate lapse of time is greater than in any other similar case. Authentic data regarding them, besides, have now been so long garnered that their fruit may confidently be expected at least to begin to ripen.

Dr. Elkin determined, accordingly, to repeat the survey of the Pleiades executed by Bessel at Königsberg during about twelve years previous to 1841. Wolf and Pritchard had, it is true, been beforehand with him; but the wide scattering of the grouped stars puts the filar micrometer at a disadvantage in measuring them, producing minute errors which the arduous conditions of the problem render of serious account. The heliometer, there can be no doubt, is the special instrument for the purpose, and it was, moreover, that employed by Bessel; so that the Königsberg and Yale results are comparable in a stricter sense than any others so far obtained.

One of Bessel's fifty-three stars was omitted by Dr. Elkin as too faint for accurate determination. He added, however, seventeen stars from the Bonn *Durchmusterung*, so that his list comprised sixty-nine, down to 9·2 magnitude. Two independent triangulations were executed by him in 1884-85. For the first, four stars situated near the outskirts of the group, and marking the angles of a quadrilateral by which it was inclosed, were chosen as reference-points. The second rested upon measures of distance and position-angle outward from Alcyone (η Tauri). Thus, two wholly unconnected sets of positions were secured, the close accordance of which testified strongly to the high quality of the entire work. They were combined, with nearly equal weights, in the final results. A fresh reduction of the Königsberg observations, necessitated by recent improvements in the value of some of the corrections employed, was the preliminary to their comparison with those made, after an interval of forty-five years, at Yale College. The conclusions thus laboriously arrived at are not devoid of significance, and appear perfectly secure, so far as they go.

[1] "Determination of the Relative Positions of the Principal Stars in the Group of the Pleiades." By William L. Elkin. Transactions of the Astronomical Observatory of Yale University. Vol. I., Part I. (New Haven: 1887.)

It has been known for some time that the stars of the Pleiades possess a small identical proper motion. Its direction, as ascertained by Newcomb in 1878, is about south-south-east; its amount is somewhat less than six seconds of arc in a century. The double-star 61 Cygni, in fact, is displaced very nearly as much in one year as Alcyone with its train in one hundred. Nor is there much probability that this slow secular shifting is other than apparent: since it pretty accurately reverses the course of the sun's translation through space, it may be presumed that the *backward* current of movement in which the Pleiades seem to float is purely an effect of our own *onward* travelling.

Now the curious fact emerges from Dr. Elkin's inquiries that six of Bessel's stars are exempt from the general drift of the group. They are being progressively left behind. The inference is obvious, that they do not in reality belong to, but are merely accidentally projected upon, it: or, rather, that it is projected upon them; for their apparent immobility (which, in two of the six, may be called absolute) shows them with tolerable certainty to be indefinitely more remote—so remote that the path, moderately estimated at 21,000,000,000 miles in length, traversed by the solar system during the forty-five years elapsed since the Königsberg measures, dwindles into visual insensibility when beheld from them! The brightest of these six far-off stars is just above the eighth (7·9) magnitude; the others range from 8·5 down to below the ninth.

A chart of the relative displacements indicated for Bessel's stars by the differences in their inter-mutual positions as determined at Königsberg and Yale, accompanies the paper before us. Divergences exceeding 0″·40 (taken as the limit of probable error) are regarded as due to real motion; and this is the case with twenty-six stars besides the half-dozen already mentioned as destined deserters from the group. With these last may be associated two stars surmised, for an opposite reason, to stand aloof from it. Instead of tarrying behind, they are hurrying on in front. An excess of the proper movement of their companions belongs to them; and since that movement is presumably an effect of secular parallax, we are justified in inferring their possession of an extra share of it to signify their greater proximity to the sun. Hence, of all the stars in the Pleiades these are the most likely to have a measurable annual parallax. One is a star a little above the seventh magnitude, distinguished as *s* Pleiadum; the other, of about the eighth, is numbered 25 in Bessel's list. Dr. Elkin has not omitted to remark that the conjecture of their disconnexion from the cluster is confirmed by the circumstance that its typical spectrum (as shown on Prof. Pickering's plates) is varied in *s* by the marked character of the K line. The spectrum of its fellow-traveller (No. 25) is still undetermined.

It is improbable, however, that even these nearer stars are practicable subjects for the direct determination of annual parallax. By indirect means, however, we can obtain some idea of their distance. All that we want to know for the purpose is the *rate* of the sun's motion; its *direction* we may consider as given with approximate accuracy by Airy's investigation. Now, spectroscopic measurements of stellar movements of approach and recession will eventually afford ample materials from which to deduce the solar velocity; though they are as yet not accurate or numerous enough to found any definitive conclusion upon. Nevertheless, M. Homann's preliminary result of fifteen miles a second as the speed with which our system travels in its vast orbit, inspires confidence both from the trustworthiness of the determinations (Mr. Seabroke's) serving as its basis, and from its intrinsic probability. Accepting it provisionally, we find the parallax of Alcyone = about 0″·02, implying a distance of 954,000,000,000,000 miles, and a light-journey of 163 years. It is assumed that the whole of its proper motion of 2″·61 in forty-five years is the visual projection of our own movement towards a point in R.A. 261°, Decl. + 25°.

Thus, the parallax of the two stars which we suspect to lie between us and the stars forming the genuine group of the Pleiades, at perhaps two-thirds of their distance, can hardly exceed 0″·03. This is just half that found by Dr. Gill for ζ Toucani, which may be regarded as, up to this, the smallest annual displacement at all satisfactorily determined. And the error of the present estimate is more likely to be on the side of excess than of defect. That is, the stars in question can hardly be much nearer to us than is implied by an annual parallax of 0″·03, and they may be considerably more remote.

Dr. Elkin concludes, from the minuteness of the detected changes of position among the Pleiades, that "the hopes of obtaining any clue to the internal mechanism of this cluster seem not likely to be realized in an immediate future;" remarking further: "The bright stars in especial seem to form an almost rigid system, as for only one is there really much evidence of motion, and in this case the total amount is barely 1″ per century." This one mobile member of the naked-eye group is Electra; and it is noticeable that the apparent direction of its displacement favours the hypothesis of leisurely orbital circulation round the leading star. The larger movements, however, ascribed to some of the fainter associated stars are far from harmonizing with this preconceived notion of what they ought to be. On the contrary, so far as they are known at present, they force upon our minds the idea that the cluster may be undergoing some slow process of disintegration. M. Wolf's impression of incipient centrifugal tendencies among its components certainly derives some confirmation from Dr. Elkin's chart. Divergent movements are the most strongly marked; and the region round Alcyone suggests, at the first glance, rather a very confused area of radiation for a flight of meteors, than the central seat of attraction of a revolving throng of suns.

There are many signs, however, that adjacent stars in the cluster do not pursue independent courses. "Community of drift" is visible in many distinct sets; while there is as yet no perceptible evidence, from orbital motion, of association into subordinate systems. The three eighth-magnitude stars, for instance, arranged in a small isosceles triangle near Alcyone, do not, as might have been expected *a priori*, constitute a real ternary group. They are all apparently travelling directly away from the large star close by them, in straight lines which may of course be the projections of closed curves; but their rates of travel are so different as to involve certain progressive separation. Obviously, the order and method of such movements as are just beginning to develop to our apprehension among the Pleiades will not prove easy to divine.

A. M. CLERKE.

NOTES.

STRENUOUS efforts have been made to secure that the arrangements for the observation of the total solar eclipse of August 19 shall be adequate. "A large number of astronomers," says the *Times* of the 15th inst., "will be distributed along the central line, fully equipped with instruments suited to the particular work they intend to do. The Russians themselves have most energetically organized a very complete set of observations, meteorological and otherwise, at widely-distant stations, viz. Krasnoiarsk in Siberia, Perm in the Ural Mountains, and Viatka in Central Russia; while Prof. Mendeljew goes to Pavlovsk, near St. Petersburg; Prof. Bredichin, of the Moscow Observatory, to Kineshma; and Dr. Podsolnotschnaja will be stationed near Tver. Several foreign astronomers will also visit Russia, and have received very hospitable treatment at the hands of Prof. Struve and the other Russian authorities. From

England, Dr. Copeland, of Lord Crawford's Observatory, and Father Perry, of Stonyhurst, have accepted an invitation from Prof. Bredichin to two members of the Astronomical Society, and have already joined him at Kineshma; and Mr. Turner, from the Greenwich Observatory, will occupy a station selected by Prof. Struve. Prof. Young and Prof. M'Neill, from America, have gone to Tver; and two other American astronomers will also make observations. Prof. Tacchini and Dr. Riccò, from Italy, have gone to Viatka; and two German delegates and one French have also been sent." We may add that there will be an American photographic and spectroscopic station in Japan.

SEVERAL very good speeches were delivered last Saturday in the course of the debate on the Education Estimates. Mr. Mundella did excellent service by insisting, as he had often done before, on the necessity for a higher standard of education in our elementary schools. A great many people seem still to be of opinion that the State discharges all its obligations in this matter if it secures that children shall learn to read and write. But what is the good of teaching children to read and write if they are not also taught how to put the power, when they have acquired it, to a proper use? The chances are that reading and writing, if education goes no further, will soon be forgotten. Long ago this was pointed out by M. Thiers, who showed that children in France who could read and write at the age of eleven ceased to be able to do either before they entered the army as conscripts. If education is to be of real value, it must be carried on to an age when boys and girls are capable of taking an interest in "things of the mind," and they must receive instruction in subjects which they are likely to find attractive. This was urged with much force by Sir John Lubbock, who argued that history and natural science should receive far more attention than is now devoted to them in elementary schools, and that manual instruction ought to be added to the list of the optional class subjects.

FROM the Aiken (South Carolina) *Recorder* of the 19th ult we learn that Dr. Henry William Ravenel died on July 17, after a protracted illness. He was a native of the State in which he died, and early in life botany was his favourite pursuit, and fungi his specialty. Soon after graduating he engaged in cotton planting, and continued it for twenty years. Subsequently he devoted more time to botany, and during the last few years of his life he was Botanist to the South Carolina State Department of Agriculture. The infirmity of deafness prevented him from taking any other post. He published a few short papers, chiefly on the plants of his native State; but he was more widely known from his "Fungi Caroliniani Exsiccati," of which he issued a number of fasciculi; and the "Fungi Americani Exsiccati," which he prepared in conjunction with Dr. M. C. Cooke. He was a member of several scientific Societies, and in 1886 the degree of LL.D. was conferred on him by the University of North Carolina.

THE Curatorship of the Natural History Department of the Science and Art Museum of Dublin is now vacant, owing to the resignation, through ill-health, of Mr. A. G. More. Mr. More has been associated with the Institution for twenty years. He succeeded to the Curatorship six years ago, on the death of Dr. Carte, and the condition of that portion of the Museum over which he presided testifies to-day to his abilities as an administrator, and to the exceptional skill of himself and those who have been associated with him. As a botanist he is best known as joint author with the late Dr. Moore of the "Cybele Hibernica"; as a zoologist his name is honourably associated with British ornithology. Numerous notes and papers, scattered throughout various journals, give evidence of his scientific attainments and activity; and by no means an inconsiderable portion of his experience lies buried in publications on the Irish fauna and flora, for, with characteristic good-nature, he has always been willing to help local naturalists with his experience and critical knowledge. His loss is greatly to be deplored, and we wish the directorate good fortune in the choice of his successor.

THE Autumn Congress of the Sanitary Institute of Great Britain will be held at Bolton on September 20 and following days, under the presidency of Lord Basing. The Council invite papers on subjects included in the programme, and will be very glad to receive the personal co-operation and support of all who are interested in the diffusion of sanitary knowledge.

ON Saturday last, M. Jovis, accompanied by M. Mallet, made a balloon ascent from Paris, hoping that he might reach a height greater than that attained by any previous aëronaut. The balloon began to ascend at 7.15 a.m., and was visible until 8.10, when it disappeared, having reached, as was supposed, a height of between 7000 and 8000 feet. About eleven o'clock it came down in Belgian Luxembourg. The altitude reached was 22,000 feet. This is far below the "record" of Messrs. Glaisher and Coxwell, who rose to a height of 37,000 feet.

THE eighth Bulletin of Miscellaneous Information issued from the Royal Gardens, Kew, has just been published. It contains a series of valuable notes on the Tree Tomato (*Cyphomandra betacea*), the Chocho (*Sechium edule*), the Arracacha (*Arracacia esculenta*), and the Cherimoyer (*Anona Cherimolia*). All these food-plants have been recently introduced from the West Indies to the East Indies. The notes are preceded by the following statement:—"The introduction of the Arracacha was first attempted, at the instance of the Government of India, in 1879, but, after many failures, was only successfully accomplished in 1883. The Chocho was introduced to Ceylon by means of a single plant, which survived the journey direct from Jamaica to Ceylon, in January 1885. The Tree Tomato and Cherimoyer were introduced by seeds, which travel well and are more convenient for distribution than plants. In a few years, no doubt, all these plants will be widely distributed throughout the East, and they will be found useful additions to the vegetable diet of both Europeans and natives. Already the Chocho introduced to Ceylon as recently as 1885 is to be found in the local markets; and the Tree Tomato is mentioned 'as a most valuable acquisition to Southern India.' All the four plants here mentioned are likely to thrive at hill-stations in India and in all districts suitable for coffee and cinchona cultivation. They are sub-tropical rather than tropical in their requirements, and hence no doubt they will be found of service in South Africa, in certain parts of Australia, Northern New Zealand, and in hilly districts generally throughout our tropical possessions. The information here summarized will indicate their usefulness as food-plants, and the sources both in the Old and New World from which future supplies of seeds and plants may conveniently be obtained."

SOME doubt has existed as to whether the Chinese have not one or more kinds of plants in use as ginger that are unknown elsewhere. In the Annual Report on the Botanical and Afforestation Department, Hong Kong, for the year 1886, Mr. Charles Ford, Superintendent, says he has taken steps for cultivating all the kinds of plants generally included by the Chinese as ginger, with the hope that he may be able to study them in such a manner as to secure all possible information in connexion with this subject. While at San Ui he was fortunate in obtaining from cultivated plants good flowering specimens. These he dried, and, together with specimens of the roots (properly rhizomes), forwarded to the Director of Kew Gardens for a study of them to be made there, where they can be compared with other kinds, or with specimens of the same kind from other places. The specimens he procured were, without doubt, *Zingiber officinale*, the species commonly in cultivation in other parts of the world. It is possible that some other plant, which is not a true ginger, may be used in making the celebrated Canton preserved ginger, but all the information Mr. Ford has yet obtained points to the species *Zingiber officinale* as the only kind which the Chinese use for this purpose. The ginger cultivated on the Lo-Fau Mountains has a wide reputation amongst the Chinese as being of unusual efficacy in medicine. This superior quality may be derived from peculiarities of soil or climate which communicate to the plant exceptional properties.

A REMARKABLE relation is shown to exist by Dr. C. Bender (*Ann. der Physik und Chemie*, 1887, 8 B., p. 873) between certain physical constants and chemical valency. In experimenting upon the density, expansion, and electrical resistance of several salt solutions, and mixtures of the same, the curious fact was noticed that a very simple relation existed between the number of gramme-molecules of the various salts required per litre of water at 15° C. to make up solutions the physical constants of which should remain unaltered on mixing. It is a well-known fact that on mixing two chemically-inactive salt solutions the physical constants generally diverge very considerably from the arithmetical mean of those of the constituents. But Dr. Bender finds that it is possible to prepare "corresponding" solutions, which on mixture shall retain their physical constants unchanged, the constants of the mixtures forming the arithmetical means of those of the constituent solutions; and further, the strengths of these "corresponding" solutions expressed in gramme-molecules per litre bear extremely simple relations to each other. For example, with respect to density and expansion, a solution of sodium chloride containing 1 gramme-molecule per litre at 15° corresponds with a solution of potassium chloride also containing a gramme-molecule, or a barium chloride solution containing half a gramme molecule, barium being divalent; corresponding with these are also a solution of ammonium chloride containing $\frac{5}{4}$ gramme-molecule, and a lithium chloride solution in which $\frac{5}{2}$ gramme-molecule is dissolved in a litre of water. With respect to electrical conductivity, the following also correspond:—Solutions of NaCl, LiCl, and $\frac{1}{2}(BaCl_2)$, each containing n gramme-molecules; and of KCl and NH_4Cl, each containing $\frac{3}{4}n$ gramme-molecules per litre. Hence "corresponding solutions" are those whose gramme-molecule contents, respect being had to valency, stand in a simple relation to each other.

THE *American Meteorological Journal* for the months April to July last contains a reprint of a lecture delivered by Prof. Cleveland Abbe, in December last, before the Franklin Institute, on some popular errors in meteorology. We can only draw attention here to a very few of the points taken up. The author first attacks the astro-meteorological predictions made up for a long time in advance, and shows that every effort to demonstrate any appreciable influence of the moon or planets on our atmosphere has signally failed. He refutes the singular belief that animals or birds know more about future weather than man himself, and attributes their migrations and hibernating habits to the results of experience of many past ages, or to natural causes beyond their control; and he shows that what is true of animals is still more clearly true of vegetables, so that nearly all the rules for weather-prediction founded on the behaviour of plants, on the falling of soot in the chimney, &c., relate simply to hygroscopic phenomena, of which a hygrometer will give more accurate indications. The efforts to show that the destruction or growth of forests affects the climate are objected to on the ground that we have not enough observations of rainfall and temperature properly comparable with each other to justify any conclusion whatever. With reference to the fact of less rainfall being caught in gauges high above the ground, the author explains that, although the drops grow as they descend through clouds, they rarely grow after they have nearly reached the ground; the stronger winds to which the gauge is exposed when set high up, carry the drops to one side, and so the higher gauge catches less than the lower one.

THE Monthly Weather Review of the United States for May contains much useful information, and possesses additional interest from the fact of its publication so soon after date. Eleven barometric depressions are traced in the North Atlantic, two of which traversed the ocean from coast to coast. Among the notices of meteors, one of extraordinary size seems to have fallen in a field near Wellsburg, N.Y., making a pit 40 feet wide and 20 feet deep; an effort is to be made to find the meteor. A special feature in these Monthly Reviews is the reports of fogs in the vicinity of the banks of Newfoundland and in the trans-Atlantic routes. Notes on their possible prediction have been published by Sergeant E. B. Garriott in the last three issues of the Review, and ship-masters have been requested to send special reports relative to the fog-banks observed. From the observations already made it is assumed that the differences in the temperature of the air which cause the development of dense fog, are occasioned by the *deflection* of the regular prevailing air-currents by cyclonic areas advancing from the interior of the continent. A knowledge of the movements of these cyclonic areas would, in the opinion of Sergeant Garriott, allow of the prediction of fog in time to send telegraphic warning to ships leaving British ports. Further investigation of the subject by the Signal Office will show whether these hopes are capable of practical realization.

THE Danish Meteorological Institute has published its *Meteorologisk Aarbog* for 1885, with the exception of that portion relating to the colonies, which appears to be one year in arrear of the other parts. The work is divided into three sections. (1) Observations taken in the kingdom of Denmark at 10 principal stations, 102 climatological stations, and 171 for rainfall. At 8 of the principal stations the observations are printed *in extenso*; and there are also monthly and yearly *résumés*. The correction for gravity at lat. 45° is given for the means of the barometric observations, in accordance with the recommendation of the International Meteorological Committee (Paris meeting, 1885). (2) Colonial stations, containing observations in the Faroe Islands, Iceland, Greenland, and one station at Santa Cruz in the West Indies. (3) Observations of air and sea temperature, &c., taken on 21 light-vessels round the Danish coasts. These latter observations are very valuable for determining various questions connected with the range of sea-temperature of the coasts, and the migrations of fish, &c. The Reports of the Meteorological Council show that such observations have been taken for some years in this country, although not regularly published. The Danish observational system dates from 1861, when it was under the charge of the Agricultural Society. The Meteorological Institute has published its year-books since 1873.

AT a recent meeting of the Pekin Oriental Society, Dr. Dudgeon read a paper on "*Kung-fu*, or Taoist Medical Gymnastics." *Kung-fu* means labour, and is applied to the science of movement, including, among other things, massage, shampooing, and other operations on the body practised with the object of preventing and curing disease, and for the comfort and sense of bracing which they confer. One of the thirteen departments in the Chinese great Medical College is that of pressing and rubbing. An early Chinese work on this subject was translated by the Jesuits in 1779, and first drew the attention of Europe to the subject and stimulated inquiry. Ling, a Swede, introduced the movement cure into Europe; but here it rests on definite anatomical knowledge, whereas in

China it can lay claim to no such foundation. The Taoists adopted the practice at a very early period to ward off and cure disease; but in later times charms, incantations, and magic seem to have taken its place. Dr. Dudgeon described the general principles of the art, including active, passive, and breathing movements, and the *rationale* of the Chinese system of medicine on which it is founded. The life of man depends upon the existence of air circulating throughout the system. The vital principle is supposed to reside at a point one inch below the navel; from here the two principles of nature emanate. Thence, according to Chinese notions, proceeds the breath in expiration, and thither it goes in inspiration. The great object of life and also of *Kung-fu* is to nourish this original air, and avoid disease by preventing the admission of depraved air. Dr. Dudgeon gave a description of the various movements prescribed for various diseases. Some of these are complicated, and many ridiculous, but the practice appears to hold its place still in Chinese medicine.

AT a recent meeting of the French Société d'Encouragement, M. Grosfils, of Verviers, described a new method he had hit upon for preserving butter. The principle of it is, to hinder the crystallization of salicylic acid added to the butter, and so maintain its antiseptic power indefinitely. This he effects by means of lactic acid, which is a pretty strong solvent of salicylic acid. The composition he had arrived at consists of 98 parts of water, 2 parts of lactic acid, and $\frac{1}{5000}$ of salicylic acid. This will preserve good butter indefinitely, even at high temperatures and in hot countries. M. Grosfils estimates that the butter, supposing it retains 5 per cent. of its weight of liquid, will retain 1 part of salicylic acid to 100,000. Lactic acid beyond 2 per cent. gives a slightly acidulated taste which might affect the saleability of the butter: this may be removed by simple washing with water, or, better, with skim-milk containing a little bicarbonate of soda. The preparation of a kilogramme of butter by M. Grosfils' process does not cost more than one or two centimes.

IT appears that, after some years' experiment, M. Jovis, Director of the Aëronautic Union of France, has found a satisfactory varnish for textile materials. It is of great flexibility, contains no oleaginous base, and, while adding little to weight, confers great impermeability. A piece of calico coated with it will retain hydrogen several days, and is not only not disaggregated by the matters applied, but even by use increases their dynamometric force; a matter of great importance for marine cordage, sails, tents, &c. The varnish is also suitable for paintings, wainscoting, &c., and it is exempt from mouldiness. It can be exposed to very varied temperatures without alteration. Lastly, the sub-products can be utilized for coating walls, railway-sleepers, &c. Such is the account presented to the Société d'Encouragement, to which the Aëronautic Union has applied for help to give this new industrial branch a worthy development.

WE have received the Transactions of the Norfolk and Norwich Naturalists' Society for 1886-87. This is the eighteenth annual volume issued by this flourishing Society. The papers are numerous and varied, beginning with the presidential address of Sir Peter Eade, which is devoted to the subject of germ life, more particularly as it affects human and animal life. Mr. Seebohm follows with two papers on the birds of the Lena Delta and of the extreme north of Alaska, and Mr. Harvie-Brown contributes a paper on the birds of Priest's Island. Sir Peter Eade gives an account of two land tortoises (*Testudo græca*) in confinement; and there are two papers on new or rare Norfolk plants. Mr. J. W. Gurney, Jun., has a paper "On the Periodic Movements of Gulls on the Norfolk Coast," and the Rev. H. A. Macpherson writes on "Hybrid Finches." Mr. Francis Day gives descriptions of some remarkable forms of eels found in Saham Mere, Norfolk; and Mr. Southwell has a paper on the "Smelt Fishery in Norfolk," as well as his annual report on the herring fishery from the ports of Yarmouth and Lowestoft. Mr. A. W. Preston continues his meteorological notes. Two papers of more than local interest are contributed by Lieut.-Colonel Feilden and Mr. Herbert Geldart, the former on zoological, the latter on botanical, researches carried on during a voyage to Hudson's Bay on board the *Alert*, which, in the summer of 1886, visited and relieved the various meteorological stations in that locality. There are some interesting communications in the form of "Miscellaneous Notes and Observations"; and last, but by no means least, is Part II of the "Fauna and Flora of Norfolk," being Section II. of a list of the birds observed in the county by Messrs. Gurney and Southwell.

THE journal *Caucase* states that the Imperial Society of the "friends of natural science, ethnography, and anthropology" are devoting particular attention to the zoology of the Caucasus. In 1885 the Society sent a mission to study the fauna of Erivan and of the coast of the Black Sea, and this year it has sent out two expeditions, one to study the fauna of the coast of the Caspian, the other that of the environs of Tiflis and the Lakes Gotchka, Paleoston, and others.

THE death is announced of Dr. Johann Krejci, Professor of Geology at the University of Prague and a member of the Bohemian Parliament.

THE Imperial Leopold-Caroline Academy of Naturalists, at Halle, celebrated its two-hundredth anniversary on August 7.

A VOLCANIC eruption lately occurred in the Island of Galita, on the Algerian coast. The streams of lava were numerous, and the light of the fire was visible for forty miles around.

ON July 26 a severe shock of earthquake was felt at Obernzell, Wegscheidt Messnerschlag, in Lower Bavaria.

A SEVERE earthquake was noticed in Ecuador on August 2, at 6.29 p.m. Great damage was done in many cities, but Cuenca suffered most, many of the houses falling in, and others being seriously damaged. Shocks of earthquake were also felt in several places in Indiana, Kentucky, Tennessee, and on the eastern banks of the Missouri.

THE additions to the Zoological Society's Gardens during the past week include a Red and Blue Macaw (*Ara macao*) from Central America, presented by Dr. and Mrs. T. W. Allright; a Carrion Crow (*Corvus corone*), European, presented by Mr. George Nicholson; a Fieldfare (*Turdus pilaris*), presented by Colonel Verner; a Hive of Bees, presented by Mr. T. Bates Blow; four Geckos, four Frogs from Italy; two Lineated Chalcis (*Chalcides lineatus*) from the South of France; two Dark-green Snakes (*Zamenis atrovirens*), two Natterjack Toads (*Bufo calamita*) from Germany, purchased; a Bennett's Wallaby (*Halmaturus bennetti*), two Viscachas (*Logostomus trichodactylus*), three Wood Hares (*Lepus sylvaticus*), born in the Gardens; a Bronze-spotted Dove (*Chalcopelia chalcospilos*), two Hybrid Spotted Zenaida Doves (between *Zenaida maculata* ♂ and *Z. auriculata* ♀), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

NEW VARIABLE OF THE ALGOL TYPE.—Mr. E. Sawyer announces in No. 159 of *Gould's Astronomical Journal* his discovery that the star 155 (*Uran. Argent.*) Canis Majoris is a variable of the Algol type. A diminution in the light of the star was first observed on March 26; the star was then observed again on March 29 and 30, and April 6, 7, 9, and 10, and appeared on each occasion to be of about its normal brightness. On April 11 at 8h. 15m. it was again found to be faint, but had recovered brightness by 9h. On April 19 another minimum was observed and the recovery of light successfully watched. The next night seemed to show the commencement of another minimum, but the star was low at the time of observation. The epoch would appear therefore to be some aliquot part of eight days; if the observation of April 20 is accepted, it will be about 1d. 3h. It is uncertain, as yet, whether the star has been observed at actual minimum; but the diminution of light remarked has amounted to about half a magnitude. As the star is the first certainly variable star in the constellation, it will probably be called R Canis Majoris. The place of the variable for 1875·0 is R.A. 7h. 13m. 49s., Decl. 16° 9′·7 S.

Mr. Sawyer gives in the same number of the *Astronomical Journal* some observations of Y Cygni, the new Algol-type variable discovered by Mr. Chandler last December. They give a general confirmation of the period, viz. 2d. 23h. 56m., deduced by Mr. Chandler from his own observations.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 *AUGUST* 21-27.

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

At Greenwich on August 21

Sun rises, 4h. 56m.; souths, 12h. 3m. 1·1s.; sets, 19h. 10m.; decl. on meridian, 12° 9′ N.: Sidereal Time at Sunset, 17h. 9m.

Moon (at First Quarter August 25, 20h.) rises, 7h. 37m.; souths, 14h. 10m.; sets, 20h. 30m.; decl. on meridian, 2° 55′ N.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Decl. on meridian. ° ′
Mercury	3 15	10 54	18 33	17 49 N.
Venus	8 39	14 10	19 41	6 18 S.
Mars	1 51	9 56	18 1	21 49 N.
Jupiter	10 49	15 57	21 5	10 46 S.
Saturn	2 18	10 13	18 8	20 16 N.

Occultations of Stars by the Moon (visible at Greenwich).

August.	Star.	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image. ° °
22	65 Virginis	6	20 34	21 26	92 307
27	B.A.C. 6081	6	17 59	19 14	51 277

August.	h.	
21	14	Venus in conjunction with and 9° 13′ south of the Moon.
22	0	Venus at greatest distance from the Sun.
23	13	Jupiter in conjunction with and 4° 12′ south of the Moon.
25	2	Mercury at least distance from the Sun.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.
U Cephei	0 52·3	81 16 N.	Aug. 21,	20 8 *m*
			26,	19 47 *m*
Algol	3 0·8	40 31 N.	,, 22,	0 37 *m*
			,, 24,	21 25 *m*
δ Libræ	14 54·9	8 4 S.	,, 26,	21 6 *m*
U Coronæ	15 13·6	32 4 N.	,, 22,	22 36 *m*
U Ophiuchi	17 10·8	1 20 N.	,, 21,	3 14 *m*
		and at intervals of		20 8
X Sagittarii	17 40·5	27 47 S.	Aug. 24,	22 0 *m*
W Sagittarii	17 57·8	29 35 S.	,, 24,	20 8 *m*
U Sagittarii	18 25·2	19 12 S.	,, 21,	0 0 *M*
β Lyræ	18 45·9	33 14 N.	,, 23,	21 0 *m*
			,, 27,	2 0 *M*
δ Cephei	22 25·0	57 50 N.	,, 27,	0 0 *M*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A.	Decl.	
From Pisces	60°	11° N.	Swift.
Near κ Cygni	291	60 N.	Slow, brilliant trained meteors.

GEOGRAPHICAL NOTES.

THE *Bollettino della Società Geografica Italiana* for June contains a valuable contribution to the study of the ethnical relations in the Ogoway and Lower Congo basins, by the Cavaliere A. Pecile, who was associated for three years with Count Giacomo di Brazzà in his exploration of the new French protectorate in the equatorial region north of the Congo. All the multifarious tribes of this extensive region, which stretches from the coast inland to the Ubangi affluent of the Congo, are divided into two essentially distinct groups, that is to say (1) the original settled populations, either aborigines in the strict sense of the term, or such as have occupied their present homes from prehistoric times; and (2) those that have made their appearance in comparatively recent times on the Ogoway and Lower Congo continually pressing forward from the interior towards the coast. To the former group belong the Batekes, Adumas, Avumbos, Mbocos, Ondumbos, Mboshi, and many others; to the latter the Bakales, Pauens (Fans), Okandas, and Obambas of the Ogoway, and the Apfurus, Bayanzi, and others of the Congo and its northern affluents. One of the most important results of the author's researches is the light that he throws on this mysterious forward movement of the inland tribes, which is not confined to the equatorial regions, but extends almost uninterruptedly northwards to Upper Guinea and Senegambia. Here the chief aggressive populations are the Toucouleurs (mixed Berbers), Fulahs, and Mandingans, all now Mohammedans; in the Ogoway and Congo basins the Bakales, Fans, and Bayanzi, all still pagans, and mostly cannibals. These have already reached the coast at many points, pressing forward from a vast and almost impenetrable forest zone, which stretches from the seaboard eastward probably to the Niam-Niam country in the heart of the continent. But the author believes that he has discovered the very cradle of the fierce Bakale and Fan peoples about the head waters of the Ivindo (2° 30′ N.), where the old settlements still exist whence the first waves of migration flowed westwards. This general westward movement is described as taking place unconsciously, or through a sort of vague instinct attracting the over-crowded inland populations towards the centres of trade on the coast. Their interests naturally impel them in the direction whence come the European commodities so much coveted by all the inland populations. The Bakales appear to have preceded the Fans by many years, their migrations being chiefly directed towards the lagoons of the Lower Ogoway, where they are now settled between the local Galoa and Inenga tribes. The Bayanzi, who have acquired the ascendency along the right bank of the Lower Congo, seem to have come originally from the same regions as the Fans, whom they resemble in physical appearance, character, language, and usages. But while the latter are "land-lubbers," displaying absolute horror of the water, the Bayanzi have always been great fluvial navigators, so that their original home may have been the Upper Ubangi, slowly advancing down this great artery to its junction with the Congo. In general the settled aborigines are of blacker complexion and more decided Negro type; the intruders much fairer, taller, with more regular features, less woolly hair, more animated and intelligent expression. At the same time they are also more ferocious and very decided cannibals. This point, about which some doubts had been expressed, was confirmed in a startling way by the fate of three Aduma boatmen belonging to the Expedition, who happened to be left behind near a Fan village on the banks of the Ogoway, and whose skeletons were afterwards found carefully picked (*diligentemente scarnati*) by the villagers. The Fans are continually on the look-out for captives to supply their cannibal feasts, whereas the somewhat more pacific Batekes are anthropophagists rather through the necessity of procuring a flesh diet in their present territory, which is nearly destitute of large game. A chief source of their supplies are the unfortunate slaves, or the humbler members of the tribe, who are denounced by the medicine-men as the cause of any calamity, such as the sickness or death of a chief, and who are always sacrificed and eaten to propitiate the evil spirits, and at the same time to satisfy the craving for human flesh.

THE BRITISH ASSOCIATION.

THE Manchester meeting of the British Association promises to be brilliantly successful. It will probably be attended by a larger number of persons than have been present at any former meeting; and, as we have repeatedly noted, ample preparations are being made for the hospitable reception of visitors. The meeting will be rendered especially interesting by the foreign men of science who will take part in the proceedings. To the lists, already printed, of these distinguished visitors we may now add the names of the American chemist Dr. Alfred Springer, and Dr. H. F. Weber, of Zürich. Dr. Sterry Hunt, F.R.S., of Montreal, has also expressed his intention of being present.

From an article in the *Times* of the 15th inst. we reprint the following account of the work which is expected to be done in most of the Sections:—

"Coming down to the Sections, we find the Presidential Chair of Section A (Mathematics and Physics) occupied by the Astronomer-Royal of Ireland, Sir Robert S. Ball, who is not only among the most eloquent of scientific orators, but one of the two great recognized wits of the Association, the other being a brother Irishman, Dr. Haughton. We may therefore expect something unusual in the way of presidential address from Sir Robert. The subject of the address will, we believe, be that part of the science of theoretical mechanics known as 'The Theory of Screws.' Its treatment will be peculiar and somewhat imaginary; it will indeed be 'a dynamical parable,' and contain a little more humour than is usually met with in such addresses. The general proceedings of the Section are likely to be of considerable interest. The report on the very important subject of electrolysis may possibly lead to a lengthy discussion, in which some of the more distinguished foreign visitors may be expected to take part. There may also be a discussion on the report of the Committee on Electrical Standards. Sir William Thomson will most likely exhibit his milliampere balances and read a paper on their application. Some interesting electrolytic results may be expected from Owens College, and Mr. Haldane Gee will exhibit a comparison-magnetometer. Electricity will ocupy a prominent place in the Section. Mr. W. H. Preece will probably read a couple of papers. More results of Profs. Thorpe and Rücker's new magnetic survey may be communicated. Prof. Hull will treat of the effect of continents in altering sea-level. The Ben Nevis Observatory will have another word to say on high-level meteorology, and some papers on heat will come from the Glasgow University laboratory.

"The Geological Section will be presided over by that able palæontologist, Dr. Henry Woodward, of the British Museum. Dr. Woodward, in his address, may be expected to touch on some of the more important topics that have been recently engaging the attention of geologists—the progress of the geological survey, the relations which exist between palæontology and biology, and recent special researches in various directions. There will, we believe, be a discussion by a combined meeting of this Section with the Section of Economic Science, on the question of gold and silver, in which the geologists will mainly deal with the subject of supply. Another important discussion will be on the burning topic of the arrangement of museum collections—whether palæontologists should arrange their finds to suit themselves, or whether the fact of their extinction should be ignored and these specimens be mixed up with their extant fellows.

"The Geographical Section will this year have the honour of being presided over by the chief of the Metropolitan Police, Sir Charles Warren, himself an experienced practical geographer. He will probably in his address deal with one branch of the leading geographical topic of the day—the uses of the study of geography to the practical statesman. In this, the popular Section of the Association, there will be not a few papers of popular interest. The King of the Belgians is sending over two representatives to speak on the Congo Free State, while Capt. Coquilhat, an old Congo official, will read a paper on his own account. Mr. A. Colquhoun, who is in England on short leave, has promised a paper on Burmah and another on Formosa. Mr. John Forrest, the Surveyer of Western Australia, will read a paper on that colony. Mr. Steains, a young engineer just returned from the Botocudo country in South America, will have something racy to tell of an almost unknown people. Dr. L. Wolf, of Leipzig, who has done so much important work on the southern tributaries of the Congo, will give to the Section the results of his journeys. One of the most important papers will be on the new survey of Siam, on which Mr. M'Carthy, the official surveyor, has been engaged for seven years, and the beautiful maps of which he has brought home with him. Various aspects of geographical education will be brought forward by Mr. H. T. Mackinnon, Mr. E. G. Ravensten, and others, while the subject of Antarctic exploration may receive some attention.

"With Dr. Giffen as President of Section F (Economic Science) we may expect an address which will be worth listening to by all interested in our national progress. The subject will be 'The Recent Rate of Material Progress in England,' and the lessons to be adduced will doubtless come home to all in their suggestiveness, so far as holding our own with other nations is concerned. The papers which are promised for the Economic Section are likely to be of unusual interest. The bimetallist movement has a very strong hold in Manchester, and it is expected that Prof. J. S. Nicholson, of Edinburgh, will be present to advocate this cause. Very valuable light will be thrown on the subject by Mr. E. Atkinson, of Boston, who has been commissioned by the United States Government to inquire into European feeling on this important issue. M. Walrus and Mr. Dana Horton will also contribute papers on monetary matters. The status and working of limited liability companies is another subject of special interest in Lancashire; this will be dealt with by Mr. G. Auldjo Jamieson, of Edinburgh. There will also be an important discussion on a topic which is attracting attention all over the country—the depression in the value of land, and the reasons which have brought it about. Dr. Arthur Ransom will contribute an interesting statistical investigation on phthisis areas in Manchester and Salford. Another day will be devoted to a group of papers on subjects connected with foreign trade. Mr. F. Hardcastle, M.P., will read on the classification of the exports of cotton piece goods in Board of Trade returns; Mr. A. E. Bateman, of the Board of Trade, will have a paper on the statistics of our foreign trade, and what they tell us; Mr. Marshall Stevens will write on freights; and Mr. W. Westgarth and Prof. Leone Levi will deal with Australian and American protectionism.

"The economists will also give a day to education, especially in its technical aspects. With this Mr. W. Mather will deal, while Sir Philip Magnus will read a paper on schools of commerce. An interesting paper on farthing dinners in elementary schools will be contributed by Mr. Sargant, of Birmingham, who has made careful and minute observations on the working of the system. Two reports will also be presented to this Section—on the monetary standard, and on the lists by which wages are regulated in the cotton trade. The latter is an elaborate document, and will in all probability give rise to much interesting discussion.

"From Prof. Osborne Reynolds, as President of the Section of Mechanical Science, we are sure to have an address that will be of as much interest to the student of pure science as to those who deal only with its applications. As might be expected, the Manchester Ship Canal is sure to receive considerable attention in this Section, and we may expect a lively discussion on the papers by Mr. W. Shelford on 'Improvements of Access to the Mersey Docks,' Prof. O. Reynolds on 'The Tides in the Mersey,' and Mr. E. Leader Williams on 'The Manchester Ship Canal.' Another paper of the same class will be that by Mr. T. A. Walker on the Severn Tunnel, which is likely to be of special interest. Other papers likely to be of more than average interest will be those of Mr. Gisbert Kapp on the maximum work of dynamos, Mr. H. White on improved railway sleepers, Mr. A. S. Biggart on the Forth Bridge works, Mr. Arthur Rigg on a revolving engine, and Mr. Henry Davey on expansive working in directing pumping-engines.

"Prof. Sayce, as President of the Anthropological Section, is sure to give an address of real human interest. The science of anthropology is young, but it embraces many lines of inquiry. Prof. Sayce will very wisely confine himself to his own line—to the study of language and the evidence we may derive from it as to the history and development of mankind. He may broach some theories that will surprise orthodox anthropologists, and will have a good deal to say upon the Celts. We believe Canon Isaac Taylor is writing a paper on a subject kindred to that discussed by Mr. Sayce, and is expected to occupy the whole of Friday morning. Mr. Stuart Glennie will also contribute a paper on the same subject, and Mr. Akin Kàroly promises some contributions to the remote history of mankind. Mr. Flinders Petrie's collection of Egyptian squeezes and photographs will form the subject of a paper by the Rev. H. G. Tomkins. The report of the Egyptian Photographs Committee, and that on the North American Indians, will both be of considerable interest.

To this statement it is only necessary to add that Dr. E. Schunck will preside over Section B (Chemistry), and Prof. A. Newton over Section D (Biology).

THE JAPAN EARTHQUAKE OF JANUARY 15, 1887.[1]

SOON after the occurrence of the earthquake of January 15 last, which caused considerable damage to property in and near Yokohama, the authorities of the Imperial University directed the writer to visit the places which had been affected by the shock, and to make a full report of all the circumstances. The results thus arrived at form the subject of the present paper. Before proceeding with this, however, it seems desirable to give some particulars respecting the principal shocks which have been felt in the Empire since 1879.

The earthquake of February 22, 1880, is the severest that has been experienced in the Plain of Musashi during the last ten years. The damage done to buildings was very much greater than on the recent occasion. Its origin was in the Bay of Tōkyō.

On October 25, 1881, Nemuro, in Yezo, was visited by a somewhat destructive shock. Fissures were opened in the ground, and the damage to property was not inconsiderable.

The well-known Atami Spa and its neighbourhood were convulsed on the morning of September 29, 1882, by a sudden and severe movement, which damaged embankments, destroyed an historical monument, and did sundry other mischiefs.

The earthquake of October 15, 1884, originated in the Bay of Tōkyō, and affected the Plain of Musashi. It overturned a considerable number of chimneys, cracked walls, and broke articles in museums and elsewhere. In Tōkyō, the greatest horizontal movement, in a soft ground, was 42 mm., or double the amount observed on January 15 last. However, the total damage, taking the whole affected area into account, was smaller.

The seismic waves in the disturbance of October 30, 1885, extended over the whole of Northern Japan and part of Yezo, shaking a land area of 34,738 square miles. But, though of great extent, they fortunately did little harm.

On July 23, 1886, quite a destructive earthquake visited Shinano and the neighbouring provinces, overthrowing several houses, and forming fissures in roads and hill-sides. The shock also stopped the flow of a hot spring at Nozawa. The part most severely shaken was a mountainous district some 2000 feet above the sea, including the famous active volcano of Asama, and many extinct craters. This case was an unusual one, as most of the larger earthquakes in Japan extend along the sea-shore.

Next in the list comes the severe shock of last January.

It thus appears that this Empire is visited by a more or less destructive earthquake *almost once a year*, and that the Plain of Musashi is affected in like manner *at intervals of a few years*.

The shock of last January was of most unusual violence. It originated near the coast, about 35 miles south-west of Tōkyō, and the seismic waves propagated nearly 200 miles to the west and north-east along the Pacific seaboard. On the north-west they approached but do not quite reach the shore of the Japan Sea. They shook, in all, about 32,000 square miles of land area.

In Tōkyō the disturbance began at 6h. 51m. 59s. p.m., with slight tremors. After thirty seconds from the commencement, the greatest horizontal motion (21 mm.) was recorded. The time taken to complete one to-and-fro motion of the ground was 2·5 seconds. The maximum vertical motion was only 1·8 mm., being, as usual, very small compared with the horizontal movement. The principal motion continued for more than two minutes, during which time no less than *sixty distinct shocks* occurred. The maximum velocity and maximum acceleration, which measure the overthrowing and shattering power of earthquakes, have been calculated from the above numbers, and found to be respectively 26 mm. and 66 mm. per second. These numbers, considering the range of motion, are small; or, in other words, the oscillations of the ground were comparatively gentle and slow, which serves to explain the fact that but little harm was done to property in the capital. In Yokohama, Hipp's seismograph registered a horizontal motion of 35 mm.

The origin of the shock was in a narrow band of country running from west to east in the province of Sagami, parallel to the coast, at a distance from it of about seven miles. It emanates from the western or mountainous parts of the province, passes through the southern foot of Oyama (4125 feet above the sea-level), and reaches the Bay of Yokohama in a total distance of about 30 miles. I believe the most probable cause of the shock to have been faulting or dislocation of the earth's crust along the band above named. This inference is supported by the fact that the parts of the country through which the western half of the band passes consists of rocks of different geological formations, interwoven in such a way that their junctions present lines of weakness favourable to earth-snaps. The topographical features of the district—high mountains on the north, and comparative low plateau and sea-shore on the south—also lend strength to this conclusion. Unequal distribution of loads on the earth's surface tends to facilitate bending and folding of the rocks.

It is along the above-named axis or band that the effects were most striking. They were mainly confined, however, to a small breadth on either side of it, so that places as little as two or three miles to the north or south experienced a well-marked diminution of seismic energy. This is not the first instance in the history of the severer shocks in which the destructive effects have been practically limited to a small area near the origin.

More especially on the hilly or western portion of the origin, land-slips and cracks were numerous. The cracks mostly took place in banks, hill-sides, or other situations favourable for their formation. The writer counted no fewer than seventy-two in a distance of seven miles, the largest measuring a foot wide and five hundred feet long, and all of them running parallel to the axis of origin, which is also parallel to the general contour of the country. Several wells became turbid. In some of artesian character the water permanently decreased; in others it increased. There is a ferry across the large river Banyū where it is crossed by the axial band; but the water was so agitated by the shock that for some time afterwards the boat could not be used. The water in one of the rivulets on the west became muddy. The shock was severely felt on board of vessels in Yokohama harbour, the people in many of them rushing on deck under the impression that they had been run into. The effects upon these vessels were doubtless caused partly by motion communicated through the cables, and partly by agitation of the water due to movements of the sea-bottom. The earthquake was preceded by the usual warning roar or rumbling, as of distant cannon, emanating apparently from the western part of the origin-band. In that district, too, the after-shocks on the same night were five in number, while in Tōkyō there was only one. There were four tremors near the origin during the night of the 16th.

Dwelling-houses in country towns and villages are always built of wood. Their frame-work is of timbers from four to seven inches square, crossing one another at right angles. The uprights are placed about three feet apart, and stand on rows of squared stones or boulders, the intervening spaces being filled with bamboo-laths, on which is laid the mud-plaster that forms the walls. Tiles and straw are principally used for the roof-covering. In the district near the origin these wooden houses shook with great violence. Several of them were more or less twisted, cracked, or unroofed. Sliding doors, covered with paper or of wood, which serve as shutters, partitions, and windows in Japanese houses, broke and were shot out of their grooves. The joints between the frames were in some cases badly loosened. Although there are thousands of wrecked houses, in the district of origin, on the verge of falling down, and looking as if a strong breeze would be enough to blow them over, the buildings of this class nevertheless withstood the violence of the earth movements so far as to escape actual demolition. The writer saw only two small rotten hovels which had

[1] Paper by S. Sekiya, Professor of Seismology, Imperial University, Japan. Reprinted from the Journal of the College of Science, Imperial University, Japan, vol. i. part iii. The earthquake, the distribution and effects of which are described in this paper, is the shock which formed the subject of an article in NATURE for June 2 (p. 107), in which one of the autographic records obtained by the author with Prof. Ewing's seismographs was reproduced in *facsimile*. The diagram in question, which showed a greatest horizontal movement of 7½ millimetres, was one of those referred to near the end of this paper as having been obtained on the stiff elevated soil where the University is built, and where the amplitude of the motion was little more than one-third of the motion shown by seismographs of the same construction on the lower alluvial soil.

been thrown down. This circumstance shows the tenacity of wooden framed structures. Prof. T. Mendenhall, in a report [1] on the recent catastrophe at Charleston, says:—"As was to be expected, buildings constructed of wood suffered much less than those of brick. The interior of wooden buildings, however, would often exhibit a scene of total destruction, furniture, book-cases, &c., having evidently moved with great violence."

Fire-proof stores, or *Kura*, suffered severely as to their walls. These buildings have wooden frames, strongly joined by horizontal and vertical pieces, and closely covered with laths, the whole making up a compact box-like structure. The roof is tiled, and carefully plastered with a mud which has a slight cementing property, to the thickness of from three to nine inches. This plaster is put on in several layers, each layer being added after the preceding one has dried. The whole process is an expensive one. The walls, on account of their great thickness and the poor tenacity of the mud, are easily cracked or stripped. As many as sixty or seventy per cent. of the *Kura* suffered from the recent shock. It is evident that these thick-walled structures should be replaced by brick buildings, which are equally fire-proof and much stronger.

It may be mentioned, however, that the frameworks of *Kura*, after having been entirely stripped, have withstood the most violent earthquake on record.

In Yokohama, houses are built of different types and with a variety of materials, so that they afford a fair field for the comparison of seismic effects. It is very fortunate that, judging from the effects wrought by the recent earthquake on both land and buildings, the seismic intensity in this town was less than one-third of that in the western or hilly parts of the origin-band. But for this, the results would have been highly disastrous.

The houses which suffered most were the composite structures of wood and stone. They are built of wooden frames encased with stone blocks, each of the latter measuring 2 feet 9 inches long, 9 inches wide, and 6 inches thick, and being clamped to the wooden planks inside by three iron nails. The nail, called *Kasugai*, is 5 inches long and $\frac{7}{16}$ inch square, and bent at right angles at its two ends. The stone is soft and brittle, being volcanic rock of the worst quality. In time the iron nails get rusty, and the stones are so acted on by rain and frost as to be easily cracked, or detached from the wooden frames, even by moderate shakings. These buildings, erroneously called European houses, already exist in abundance, and unfortunately increase each year in number. They are generally constructed with bad materials and on faulty principles; the object of the builders being to attain fair protection from fire, along with the appearance of a stone building, at the least practicable cost.

Two brick structures received serious damage, cracks having been formed, as usual, at the corners of the buildings and over the windows. The seismic vibrations, however, left no traces on the Town Hall, the Custom House, Prefectural Office, and other well-built structures of brick or stone.

In Yokohama, wooden houses sustained no damage worth mentioning. Joints were more or less loosened and tiles occasionally fell down from the roofs. The tiles that are fastened to the framework of wooden houses, to form walls, were in some cases detached in large quantities. There are decidedly many improvements which might be made in the present wooden buildings, both of Japanese and so-called European styles, especially in the arrangements of their joints, the scientific distribution of materials, &c. If these and other defects were properly remedied, such dwellings might be made pretty safe as against earthquakes. In sites little liable to danger from fire, one may find, in this country, wooden houses built three and even four centuries ago. Wood, no doubt, will continue for a long time to be the chief building material in this country.

In Japan, however, fire is a more constant and even more dread enemy than earthquakes, while terrible conflagrations are often brought about by destructive shocks. Hence, brick and stone should, and probably will in time come to be largely employed for building, especially in towns. The question, then, is to select certain types of brick or stone houses which are best calculated to resist earthquake shocks. Sheet and bar iron houses, as used in Australia, would make very efficient earthquake-proof buildings, although they are not free from several objections.

After the terrible catastrophe of 1883 in the Island of Ischia, the Italian Government appointed a Commission [1] to consider the reconstruction of the buildings in that island. The Commission, after investigating the different modes of construction most suitable for earthquake countries, submitted models of houses in wood, and in combinations of wood and masonry, which were adopted. The Commission recommended that buildings should be chiefly constructed with an iron or wooden framework, carefully joined together by diagonal ties, horizontally and vertically, the spaces between the framework being filled in with masonry of a light character. Not more than two stories above ground were to be allowed, &c., &c.

In Italy, brick houses are joined by iron tie-rods; and similar devices are now, to a certain extent, used in this country. Concerning the erection of brick or stone houses in Japan, much valuable information is to be obtained from the Italians, who, like ourselves, have lived for centuries amidst terrible shakings, and who, no doubt, have gained much experience in the constructive arts suitable to the conditions of our existence here.

A prominent feature in the effects of the recent earthquake was the overthrowing of brick chimneys in Yokohama, especially on the Bluff. Soon after the shock, circulars were sent round to the principal residents, asking for information as to the effects of the shock on the buildings occupied by them. More than fifty answers were received, and the facts embodied in them have been of great value in preparing this paper. The writer takes this opportunity of expressing his warmest thanks for the kind assistance thus rendered to him. From these answers, from the Police Reports, and from actual observations, fifty-three chimneys appear to have been destroyed. In one instance a heavily-coped chimney fell in a large mass through the roof, and severing a strong beam of 1 foot by 8 inches on the second story, penetrated to the ground floor.

About one-half of the chimneys thrown down during the shock were cut in two at their junction with the roof; while some dislodged the tiling and did sundry other damage to the buildings at their points of contact. Evidently the chimneys and the houses moved with unequal range and with different vibrational periods. Prof. Milne has more than once recommended that chimneys should be built thick and squat, without heavy ornamental mouldings or copings; and be, if possible, disconnected from the roofs. Those houses in which his suggestions had been adopted suffered no damage on January 15.

Generally, the relations of the seismic effects to the geological, topographical, and other features of the various localities were found to corroborate previous experience. That the seismic vibrations in hard ground are very much less than in soft soil was well illustrated on the recent occasion. At the University, where the ground is hard and firm, the seismograph recorded only 8 mm. horizontal motion, as compared with 21 mm. registered by a similar instrument placed on soft soil a mile distant. Totsuka is a small town, with a single long street running along the foot of a hill; one side of the street, however, is built on made-up ground. Most serious damage was done on that side, while the opposite houses suffered very much less, though not more than twenty feet distant. Houses built on cliffs and hill-brows received more damage than those situated at the base or on the flat summits of the same hill. To observe the effects of marginal vibration, the writer recently placed one seismograph at the steep edge of a loamy hill thirty-eight feet in height, and another similar instrument at its foot. The motions, thus far measured, at those two levels are found to be in the ratio of 2 to 1. A third instrument will shortly be set up on the flat summit of the same hill. Observations of a similar nature, on different rocks and at various heights, will form the subject of a further paper. It is probably owing to marginal vibration that houses on the Bluff of Yokohama are always heavy sufferers from earthquakes.

The extensive and rapidly increasing use of kerosene lamps in Japan constitutes a grave danger in severe shocks. The lamps now in common use are of very brittle materials, contain the most combustible of oils, and are usually poised on ill-balanced stands. In the great earthquake of 1855, at a time when kerosene was unknown in this country, fire broke out in Yedo at more than thirty points, setting a very large part of the city in a blaze. In the event of another such shock, the mischief which would be produced from this cause alone is awful to contem-

[1] The *Monthly Weather Review*, U.S. Signal Service, August, 1886.

[1] Proceedings of the Institution of Civil Engineers, vol. lxxxiii., Session 1885-86, part i.

plate. Great credit will be due to any one who can invent a convenient earthquake safety-lamp, which, it is to be observed, will also constitute a valuable safeguard in ordinary daily life. It is true, so-called safety-lamps are sold in Tōkyō, but they are very ineffective and miserable affairs. The use of metallic oil-holders would doubtless greatly lessen the danger.

During his inquiry the writer was shown sixteen lamps that had been broken in the recent earthquake. In one instance the kerosene caught fire, and it was with great difficulty that the residents extinguished it by the aid of wet mats.

MINERALS AT THE AMERICAN EXHIBITION.

ONE of the most conspicuous features of the American Exhibition is the remarkable collection of minerals brought over and exhibited by Mr. A. E. Foote, of Philadelphia. Many of the specimens, which are extremely fine, have been obtained during collecting-expeditions undertaken by Mr. Foote himself, and several new species and varieties have been made known to science through his indefatigable labours.

The central feature is a hexagonal pavilion covered with mica, and surmounted by a model of a snow crystal. Each side of the pavilion is devoted to a separate mineral region of the North American continent—except the first, which is filled with a collection of gems and ornamental stones. Here are rough and cut specimens of a precious ruby, topaz, opal, williamsite, with examples of malachite and azurite beautifully banded and taking a fine polish.

A lapidary who has had several years' experience in making rock-sections for the British Museum is constantly employed close by.

Minerals from the region near the Pacific coast come next. Wulfenite, a rare species, some the finest specimens ever seen, is here exhibited in large groups of orange-red crystals; also brilliantly red vanadinites and large bright crystals of chessylite or azurite associated with velvet tufts of malachite. All these are from the marvellous country that Humboldt called New Spain. The deep-red garnets from Alaska in their sombre settings of gray mica-schist are especially noteworthy. Among the minerals of the Rocky Mountain region are wonderful crystals of the green Amazon-stone; ore from the famous Bridal Chamber at Lake Valley, New Mexico, so rich that the heat of a match will cause it to melt and fall in drops of nearly pure silver. A space the size of a moderate-sized room produced about £100,000. The precious turquoise comes from Los Cerrilloz, New Mexico, where Montezuma got his chalchuhuitls that he valued above gold and silver. The Indians still make long pilgrimages for the sacred stone.

Most striking among the minerals of the Mississippi Valley and Lake region are the blendes and galenas from South-West Missouri, a district that now produces over one-half of all the zinc mined in the world. It was formerly so abundant that farmers built their fences with it. Masses of the lead-ore weighing ten tons were found within 12 feet of the surface. Here Indians formerly procured the lead for their bullets, placing the ore in hollow stumps and building a fire over it.

From Arkansas come fine rock-crystals or hot-spring diamonds, with powerful lodestones, arkansites, and hydrotitanites.

From the Lake Superior region come copper, chlorastrolites, and zonochlorite, a remarkable gem-like mineral.

In the case devoted to the North Atlantic coast region is rhodonite, so much used by the Russians in their ornamental work, in fine crystals. The mines at Franklin, N.J., produce also many minerals found nowhere else in the world, such as franklinite, named after the illustrious philosopher; anomolite, a new species recently described by Prof. G. A. König, of the University of Pennsylvania; troostite, jeffersonite, blood-red zincite, &c., &c. Cacoclasite, a new species in fine crystals, associated with pink titanite, comes from the same region, as do the remarkable crystals of apatite. These are among the finest specimens ever seen, and associated with them are the brilliant twin-zircons. From the apatite are manufactured hypophosphites to stimulate the appetite, and superphosphates to grow wheat and corn.

The last case devoted to the South Atlantic coast region contains amethysts, sapphires, aquamarines, tantalite, gummite, and uranolite, huge sheets of mica, &c., &c.

Next to the wall opposite is a very extensive collection illustrating the mineralogy of Pennsylvania, which, besides the well-known coal, iron, and other ores that have made the State famous, includes very extraordinary specimens of the rare mineral brucite, from which the medicine, Epsom salts, may be made; diaspore in fine crystals, corundum for polishing purposes, chromite for producing brilliant yellows, &c., &c.

Adjoining, in cases and drawers, are the college and educational collections indispensable for the studies of mineralogy, geology, and chemistry.

The collection of American Geological Surveys and other scientific works is very extensive, over fifty volumes from Pennsylvania alone being shown. We have devoted so much space to the description of the extensive exhibit made by Mr. A. E. Foote, of Philadelphia, that we can only refer to the minerals shown by Kansas and other States, by the Denver and Rio Grande and C. B. and Q. Railroads, and by various mining companies.

THE FOLK-LORE OF CEYLON BIRDS.

A CORRESPONDENT of the *Ceylon Observer* of Colombo, referring to the interest excited by Mr. Swainson's new book on "The Folk-Lore and Provincial Names of British Birds," notes some points in the folk-lore of the birds of Ceylon, obtained largely in conversation with natives. The devil-bird (*Syrnium indrani*) stands *facile princeps* for his evil reputation; his cry heard in the neighbourhood of villages is a sure harbinger of death, and the superstitious natives are thrown into great consternation by its demoniac screech. The legend about the bird is as follows:—A jealous and morose husband doubting the fidelity of his wife killed her infant son during her absence and had it cooked, and on her return set it before her. She unwittingly partook of it, but soon discovered that it was the body of her child by a finger which she found in the dish. In a frenzy she fled to the forest, and was transformed into a *ulania*, or devil-bird, whose appalling screams represent the agonized cries of the bereaved mother when she left her husband's house. The hooting of owls in the neighbourhood of houses is believed to bring misfortune on the inmates. The magpie robin, though one of the finest of the song-birds of Ceylon, is similarly tabooed; it has a harsh grating screech towards evening, which is considered ominous. The quack of the pond heron flying over a house is a sign of the death of one of the inmates, or of a death in the neighbourhood. If the green pigeon (*Nila kobocya*) should happen to fly through a house, as it frequently does on account of its rapid and headlong flight, a calamity is impending over that house. Similarly with the crow. But sparrows are believed to bring luck, and are encouraged to build in the neighbourhood of houses, and are daily fed. The fly-catcher bird of Paradise is called "cotton thief," because in ancient times it was a freebooter, and plundered the cloth merchants. As a penalty for its sins it was transformed into a bird and doomed to carry a white cotton attached to its tail. The red wattle lapwing, the alarm bird of sportsmen, has the following legend connected with it:—It is said to represent a woman who committed suicide on finding herself robbed of all her money, amounting to thirty silver pieces, by her son-in-law. The cry of the bird is likened to her lament: "Give the silver, give the silver, my thirty pieces of silver." Its call is heard at all hours, and the stillness of night is broken with startling abruptness by its shrill cry. Another story about it is that when lying in its nest in a paddy field, or a dry spot in a marsh, it lies on its back with its legs in the air, being in continual fear that the heavens will fall and crush its offspring. The story current about the blue-black swallow-tailed fly-catcher (*Kawudu panikkia*) and its mortal enemy, the crow, is that the former, like Prometheus of old, brought down fire from heaven for the benefit of man. The crow, jealous of the honour, dipped its wings in water and shook the drippings over the flame, quenching it. Since that time there has been deadly enmity between the birds. The Indian ground thrush (*Pitta coronata*) is said to have once possessed the peacock's plumes, but one day when bathing the peacock stole its dress; ever since the *Pitta* has gone about the jungle crying out for its lost garments. According to another legend, the bird was formerly a prince who was deeply in love with a beautiful princess. His father sent him to travel for some years, and on his return the princess was dead. He still wanders disconsolately about calling her name. It is also said that the peacock, being a bird of sober plumage, borrowed the brilliant coat of the *Pitta* to attend a wedding, and did not return it. The disconsolate *Pitta* wanders through the jungle calling on the peacock to restore its dress—hence the cry, *ayittam, ayittam* (my dress, my dress). The cry of the hornbill (*Kandetta*) is inauspicious and a sure sign of drought. The bird is doomed to suffer intolerable thirst; not being able to drink from any stream or rill, it has the power only to catch the rain-drops in its bill to quench its thirst, and keeps continually crying for rain.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE following is the list of candidates successful in the competition for the Whitworth Scholarships, 1887:—James Whitaker, 21, engineer student, Burnley, £200; John Calder, 20, mechanical engineer, Glasgow, £150; John Smith, 22, carpenter, Belfast, £150; Nicholas K. Turnbull, 21, mechanical engineer, Glasgow, £150; James C. Talbot, 23, engineer, Southampton, £150; Arthur F. Horne, 25, mechanical engineer, Moreton-in-Marsh (formerly of Glasgow), £150; Edward J. Duff, 23, engineer, Glasgow, £150; Robert N. Blackburn, 20, engineer apprentice, Liverpool, £150; William Thomson, 20, engineer apprentice, Glasgow, £150; William W. F. Pullen, 20, engineer apprentice, Cardiff, £100; Edwin Griffith, 20, engineer apprentice, Glasgow, £100; Frederick C. Tipler, 23, assistant chemist, Crewe, £100; Thomas H. M. Bonell, 24, analytical chemist, Swindon, £100; Richard J. Redding, 22, metallurgist, Plumstead (Woolwich), and Arthur W. Sisson, 25, mechanical draughtsman, Lincoln (equal), £100 each; Arthur H. Abbott, 22, engineer, Great Yarmouth, £100; George Hough, 23, engineer, Wolverton, £100; Harry G. Christ, 19, engineer apprentice, London, £100; Harry D. Griffiths, 21, engineer apprentice, Cardiff, £100; Denholm Young, 24, engineer apprentice, Edinburgh, £100; Benjamin G. Oxford, 20, engineer apprentice, Liverpool, £100; Bernard H. Crookes, 21, engineer student, Liverpool, £100; George J. Wells, 23, engineer, London, £100; John Eustice, 23, engine fitter, Camborne, £100; Augustus H. H. Bratt, 24, engineer, Plumstead (Woolwich), £100.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, August 3.—Dr. D. Sharp, President, in the chair.—Mr. J. W. Peers and Mr. R. G. Lynam were elected Fellows.—Jonkeer May, the Dutch Consul-General, exhibited a pupa and two imagos of *Cecidomyia destructor* (Hessian fly) which had been submitted to him by the Agricultural Department.—Mr. W. White exhibited, and made remarks on, a specimen of *Philampelus satellitia*, Linn., from Florida, with supposed fungoid excrescences from the eyes. Mr. Stainton said he was of opinion that the supposed fungoid growth might be the pollinia of an Orchis. Mr. Poulton expressed a similar opinion, and the discussion was continued by Mr. Pascoe and Dr. Sharp.—Mr. White also exhibited a specimen of *Catephia alchymista*, bred from a pupa collected last autumn on the south coast.—Mr. McLachlan sent for exhibition a number of oak-leaves infested by *Phylloxera punctata*, Lichtenstein, which he had received from Dr. Maxwell Masters, F.R.S.—Mr. Champion exhibited two rare species of *Curculionidæ* from the Isle of Wight—viz. one specimen of *Baridius analis*, and a series of *Cathormiocerus socius*. He remarked that *C. maritimus*, Rye, had been placed in recent European Catalogues as a synonym of the last-named species, but that this was an error. He also exhibited a series of *Cicindela germanica*, from Blackgang.—M. A. Wailly exhibited, and made remarks on, a number of living larvæ of *Antheræa pernyi*, *A. mylitta*, *Telea polyphemus*, *Platysamia cecropia*, *Attacus cynthia*, *Callosamia promethea*, and other silk-producing species. He also exhibited imagos of the above species, imagos of *Antheræa yama-mai*, and a number of species of Diurni from Sarawak.—Mr. Poulton exhibited crystals of formate of lead obtained by collecting the secretion of the larva of *Dicranura vinula* on 283 occasions. The secretion had been mixed with distilled water in which oxide of lead was suspended. The latter dissolved, and the acid of the secretion being in excess the normal formate was produced. Prof. Meldola promised to subject the crystals to combustion, so that their constitution would be proved by the final test.

EDINBURGH.

Royal Society, July 15.—Special Meeting.—Dr. J. Murray, Vice-President, in the chair.—Prof. Tait submitted a communication by Sir W. Thomson on the stability of the steady motion of a viscous fluid between two parallel planes.—Sir W. Turner communicated a note by Mr. George Brook on the epiblastic origin of the segmental duct in teleostean fishes, and birds.—Prof. T. R. Fraser read a preliminary note on the chemistry of strophanthin.—Mr. J. J. Coleman described a new diffusimeter and other apparatus for the study of liquid diffusion.—A paper by Mr. Frank E. Beddard was communicated by Prof. Sir W. Turner.—Dr. Murray read a paper on the mean height of the land of the globe. The lower limit he gives is, in round numbers, 1900 feet. The higher limit, which he believes to be more nearly correct, is about 2100 feet.—Mr. J. T. Cunningham, of the Scottish Marine Station, read a paper on the *Chætopoda sedentaria* of the Firth of Forth.

July 18.—Sheriff Forbes Irvine, Vice-President, in the chair.—The Chairman intimated the foundation by Dr. Gunning of the Victoria Jubilee Prize, and the conditions of award which have been approved by the donor. The first award of the prize was made to Sir W. Thomson, for a remarkable series of papers on hydrokinetics which he has communicated to the Society.—Mr. W. Durham read the second part of his paper on the laws of solution.—Prof. Tait communicated a paper by Prof. W. Burnside on the partition of energy between the translatory and rotational motions of a set of non-homogeneous elastic spheres. The rotational energy is equal to two times the translational energy.—Dr. H. R. Mill submitted a paper on the salinity, temperature, &c., of the Firth of Forth.—Prof. Tait communicated a paper by Mr. Albert Campbell on the direct measurement of the Peltier effect. Mr. Campbell has experimented with three pairs of metals. His results agree in every case with Prof. Tait's thermo-electric diagram. The agreement in the case of iron and nickel is of special importance.—Dr. Alex. Scott communicated a paper on vapour-densities at high temperatures.—Prof. Tait read a paper by Dr. G. Plarr on the determination of the curve, on one of the co-ordinate planes, which forms the outer limit of the positions of the point of contact of an ellipsoid which always touches the three planes of reference.—Mr. Buchan read a paper by Mr. A. Rankin on the mean temperatures of the various winds at Ben Nevis Observatory.—Prof. Crum Brown read a paper on ferric ferricyanide as a reagent for detecting traces of reducing gases. This reagent gives a test depending on the production of colour, which is a more delicate test than one which depends on its disappearance.—Prof. Tait communicated some results on the compressibility of water, of mercury, and of glass. The average compressibility of a 20 per cent. aqueous solution of common salt per atmosphere for the first 100 atmospheres is 0·0000316. It diminishes rapidly with the percentage of salt in solution. The compressibility of common lead glass is 0·0000027 at a temperature of 19° C.—Prof. Berry Haycraft submitted a description of experiments to show the truth of Sir J. Lister's theory of coagulation.—Dr. Murray communicated a paper by Mr. Adam Dickie on the chemical analyses of sea-water from the Clyde sea-area.—The Chairman mentioned the number of papers read during the session, classifying them under various heads. He also read the Jubilee address which had been presented to Her Majesty by the Secretary of State on behalf of the Society.

PARIS.

Academy of Sciences, August 8.—M. Janssen in the chair.—Observations of the minor planets, made with the great meridian instrument of the Paris Observatory during the first quarter of the year 1887, communicated by M. Mouchez. The right ascensions and polar distances are given of Leto, Sophrosyne, Undine, Hebe, and nine other minor planets at various dates with Paris mean time, all comparisons being referred to the ephemerides published by the Berlin *Jahrbuch*, except those of Undine, which are referred to those published in No. 288 of the circulars of the Berlin *Jahrbuch*. The observations were made by M. O. Callandreau.—Fresh documents on the relations existing between the chemical and mechanical work of the muscular tissue, by M. A. Chauveau, with the co-operation of M. Kaufmann. In order to complete his series of preparatory determinations on the mechanical work of the muscular tissue, the author has attempted to determine the quantity of heat produced by the muscles which function effectively in the physiological conditions of the normal state. By the methods and new processes here described he claims to have overcome the great difficulties inherent to studies of this nature. His experiments show once more that a large amount of heat is generated while the muscle operates, and of this only a small quantity is absorbed by the work performed. Repeated experiments will be needed accurately to determine this quantity. From the experiments already made, he infers that it mostly ranges from one-seventh to one-eighth of the total, the coefficient of the latter being 0·000323 calories, and that of the heat transformed into work generally from 0·000041 to 0·000034 calories.—New fluorescences with well-defined spectral rays, by M. Lecoq de Boisbaudran. Here the author studies alumina with the earth $Z\alpha_2O_3$; but as this earth has not yet been obtained in a pure state, he has been compelled to employ a substance still mixed with some other rare earths, notably $Z\beta_2O_3$; $Z\alpha$, however, being greatly in excess of $Z\beta$. Alumina containing 1/1200 of $Z\alpha_2O_3$ impure, heated with sulphuric acid and moderately calcined to a red (between the fusions of silver and copper), yields a greenish-yellow fluorescence, faint and without measurable spectrum. With 1/50 of $Z\alpha_2O_3$ in the alumina, a green fluorescence is obtained, slightly yellow and dull. The spectrum consists chiefly of the bands of $Z\beta$, which apparently differ but little from those obtained by reversion with a solution of $Z\beta Cl_6$. The presence of $Z\alpha$ is indicated to the right of the two yellow and blue bands; but the green band of $Z\beta$ is the strongest in the spectrum, having two nebulous maximums, of which that to the right is the most intense. The author also announced that he had obtained some very fine fluorescences by highly calcining alumina containing a little didymium or praseodymium.—The partial lunar eclipse of August 3, observed at the Observatory of Bordeaux, by M. G. Rayet. Under a three-prismed spectroscope, mounted on the great equatorial (0·38 metre) the transition from the adumbrated to the luminous part of the disk appeared very abrupt. While the spectrum of the former was limited by the lines D and F, with a maximum of intensity towards E, that of the part in transition extended abruptly towards the red as far as Ångström's atmospheric group α. But the spectrum of the moon especially near the eclipsed part, was too pale to permit the use of a slit narrow enough to show the atmospheric lines. The α group and the very numerous lines near D were alone distinctly visible under the form of bands.—On the tides of the Tunisian coast, by M. Héraud. The observations made during the hydrographic survey of this coast have enabled the author to study the tidal movement, the existence of which in the Gulf of Gabes and on the adjacent seaboard has long been demonstrated. These tides appear to be the most important and regular in the whole Mediterranean basin; but they are perceptible only on the section of the coast to the south of Mehediah. They continually increase in magnitude as far as Gabes, where they acquire a maximum of 2 metres at the mean spring-tides, thence decreasing to 1 metre at Zarzis and on the Tripoli frontier. The tidal wave appears to come from the east, the mean period being apparently about 24 hours. All the observed circumstances would seem to show that the relation of the lunar to the solar wave is less than that of the absolute actions of the sun and moon.—A comparative study of the old, eruptive and sedimentary rocks of Corsica and the Eastern Pyrenees, by M. Ch. Depéret. During a recent trip to Corsica the author had an opportunity of determining some very close analogies between these two geological systems. Thus the central part of the granitoid mass at Ajaccio is formed of a porphyroid granite disseminated with black mica, passing thence on either side insensibly to a granulitic granite, a true transitional formation between the granulite type and granite. Analogous formations occur in the Eastern Pyrenees, as, for instance, in the granitoid mass stretching east and west between the valleys of the Aude, Têt, and Boulsane. Here also the central part, extending from the forest of Salvanère to Belesta, consists of a porphyroid granite passing on both sides imperceptibly over to a granite with two micas and granulitic texture. A comparative study of the eruptive and sedimentary rocks in both regions reveals similar resemblances. In Corsica the Cambrian limestone everywhere worked as marble is absolutely identical with that of the Pyrenees.

BERLIN.

Physiological Society, July 1.—Prof. du Bois Reymond, President, in the chair.—Dr. Martius communicated the results of his researches, by the graphic method, on the movements of the heart. When a sound is passed into the œsophagus, and connected with a Marey drum, cardiopneumatic curves are obtained whose interpretation is still a matter of controversy. In order to arrive at an experimental decision on this point, Dr. Martius has recorded simultaneously on the same individual the cardiopneumatic curves from the œsophagus and the curve of impulse of the ventricular apex as obtained from the wall of the thorax. It appeared from this that the curve of ventricular impulse is of doubtful interpretation; its shape was always the same; but it was impossible to determine with any certainty which part of the curve corresponds to the systole, and which part to the diastole. Dr. Martius has therefore registered the occurrence of the heart-sounds by auscultation and making signals which were recorded on a rotating drum on which the curves of cardiac impulse were being registered, having first ascertained that his personal equation was without influence on the results. In this way he was able to show that the first sound of the heart, corresponding to the closing of the auriculo-ventricular valves, coincides with the first rise of the curve from the base-line, while the second sound, or closing of the semilunar valves, coincides with the second smaller rise of the curve. The *first* rise and fall of the curve corresponds therefore to the cardiac systole. The speaker explained the shape of the *whole* curve as follows:—At the commencement of the systole the auriculo-ventricular valves are shut, as also are the semilunar valves since the aortic blood-pressure has not yet been overcome. During this period the contracting cardiac muscles alter the shape of the heart, the apex moves forward, and so the curve rises. As soon as the pressure in the ventricle is greater than that in the aorta, the semilunar valves open and the blood begins to pour out of the ventricle; as the result of this the apex of the heart moves back, and the curve falls till it reaches the base-line at the conclusion of the systole and commencement of the diastole. At this instant the semilunar valves close and the shock thus produced is communicated to the heart, and makes itself evident on the curve as the second or valvular rise. Thus finally the first rise of the curve of cardiac impulse corresponds to that period of systole during which all the valves are closed; the first apex of the curve marks the instant at which the semilunar valves open; the first fall of the curve indicates that portion of the systole during which blood is flowing out of the ventricle; the systole ends with the commencement of the second or smaller rise in the curve. Dr. Martius has been able to strengthen this analysis of the cardiac movements, so important both physiologically and pathologically, by observing that the duration of the rise and fall of the curve of systole varies in different individuals: thus he finds, conformably with the explanation given above, that in patients with low aortic blood-pressure, the rising portion of the curve of cardiac impulse is very short, while the falling part is considerably lengthened, resulting from the low aortic pressure allowing the semilunar valves to open sooner. On the other hand, in a case of arterial sclerosis, he found the rising part of the curve considerably lengthened, since the aortic blood-pressure was greater, and was only overcome at a later period of the systole.—Dr. Goldschneider presented and explained plates illustrating the topography of the sense of temperature. The sense of heat and cold was determined for the whole surface of the body, and arranged in a series corresponding to twelve degrees of intensity. As a general result, it was found that the sense of cold is more extended than that of heat; that both senses are more developed on the trunk than on the extremities; that the sense of temperature is less acute in the median line of the body; that the distribution of this sense over the surface of the body is quite different from that of the sense of touch; and that the points of exit of the nerves possess little or no sense of temperature.

July 15.—Prof. Munk, President, in the chair.—Dr. Jacobsen gave an account of some acoustical experiments which he has carried out with a view to determining the law according to which the amplitude of vibration of a tuning-fork diminishes as it gradually comes to rest. According to theory, the diminution in the amplitude of vibration takes place in geometrical progression; Hensen had, however, found that the logarithmic decrement at first diminishes, and then, when the vibrations have become extremely small, increases again. The speaker has made experiments with tuning-forks, recording the vibrations of the arms by means of brushes writing on a rotating drum; in another series of experiments, which are not yet concluded, he has photographed the vibrations at equal intervals of time. The result of his work is that the vibrations diminish in geometrical progression, thus according with theory. —Dr. Wertheim gave an account of his experiments to determine the number of visual units in the central portions of the retina. In continuation of the experiments of Dr. Claude du Bois-Reymond, who has determined the number of visual units in the fovea centralis and found them equal in number to the cones, Dr. Wertheim, employing the same method, has determined the number of visual units to a distance of 2·5 millimetres from the centre. A sheet of tinfoil pierced with uniform holes was illuminated from behind, and then the distances were measured at which the holes began to be just visible as separate objects, as their image was made to fall on parts of the retina *successively* further and further towards the periphery. After having found in the fovea centralis the same number of visual units as had Dr. du Dois-Reymond, he then observed that their number decreases rapidly towards the periphery up to a distance of 1·5 millimetres, then remains constant for a short space, then diminishes again rapidly, and then gradually as far as the limits of the retinal area which he investigated. The speaker found that the first rapid decrease extends as far as the limits of the macula lutea. The anatomical statements respecting the limits of the yellow-spot and the number of cones outside this area did not permit of his drawing any conclusion, other than the above, from the optical experiments. The same numbers were obtained when red and green light was used.—Dr. Goldschneider has carried out a series of experiments to test Leyden's theory that ataxy, when not of central origin, is caused by injuries to centripetal nerves. By passing strong electric currents through the first phalanx of one finger he anæsthetized the second and third phalanx, and then found that the movements of flexion and extension of the finger no longer gave a regular curve of rise and fall as traced by the tip of the finger: the movements executed by the finger were irregular, sometimes going beyond and sometimes falling short of the desired extent. The sensation of passive movement was also considerably lessened. The speaker hence concluded that the ataxic movements are caused by the interference with the sensations arising from passive movements of the limbs. He added to this an hypothesis as to the nature of ataxy and the seat of the muscular sense in the limbs.

July 27.—Prof. Munk, President, in the chair.—Dr. Sandmann spoke on respiratory reflexes originating in the nasal mucous membrane. In order to study the possible connexion between asthma and diseases of the nose, which has been so often supposed to exist, the speaker has made experiments on the respiration in rabbits and cats whose nasal openings had been completely occluded. In addition to confirming the phenomena which had been already described by earlier observers, he found that the changes in volume of the thorax were the same as in normal animals, whereas the intra-thoracic pressure was considerably increased when breathing was carried on entirely by the mouth; similarly the respiratory undulations of the blood-pressure tracing were increased in amplitude. He next investigated more closely the respiratory reflexes which originate in the nasal mucous membrane; of these three are known—namely, inhibition of respiration, sneezing, and coughing, as a result of stimulation of the nose. Inhibition of respiration was observed to occur, according to the strength of the stimulation, either in the phase of expiration, or of inspiration, or merely as a more pronounced expiration. Sneezing was brought about by tickling the nasal mucous membrane, and was found to consist of a deep inspiration with simultaneous closing up of the pharynx and mouth by the application of the tongue to the palate, followed by an explosive expiration. When the stimulation is slight, only the deep inspiration is produced; if the stimulation is strong, the deep inspiration is followed by a somewhat lengthy inhibition of the same, which is frequently accompanied by slight expiratory movements; when the stimulation is of moderate strength an ordinary sneeze is the result. After section of the phrenic nerves the deep inspirations were no longer observed. Dr. Sandmann, by section and removal of the mucous membrane in rabbits, has further examined the various regional areas of the same, and found that sneezing can only be produced by tickling a limited area of the mucous membrane. On the rabbit this area is found in the entrance to the nose on the anterior surface of the lowest nasal muscle; but in addition to this place, the same reflexes may be produced by stimulation of the front part of the septum and roof of the nasal cavity. Sneezing cannot be produced by stimulation of any other portion of the nasal mucous membrane. In man the region of the posterior nasal openings is also connected with the reflexes involved in sneezing in addition to the regions mentioned above. An anatomical investigation of the areas whose stimulation leads to sneezing showed that they are supplied entirely by the ethmoid nerve. Stimulation of this nerve in the orbit was followed regularly by sneezing, which could therefore be produced to a certainty by stimulating the trunk of the nerve. The third kind of respiratory reflex—namely, coughing as a result of nasal stimulation—could not be experimentally produced in the cats and rabbits used in these experiments.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

The Distribution of Rain over the British Isles, 1886: G. J. Symons (Stanford).—First Lessons in Science: Dr. J. W. Colenso (Ridgway).—A Treatise on the Principle of Sufficient Reason: Mrs. P. F. Fitzgerald (Laurie).—Prolegomeni di Filosofia Elementare, Terza Edizione (Torino). —Bulletin de l'Académie Royale des Sciences de Belgique, No. 6, 1887 (Bruxelles).—Journal of the Royal Microscopical Society, August (Williams and Norgate).—Bulletin of the California Academy of Sciences, vol. ii. No. 6.—Boletin de la Academia Nacional de Ciencias en Cordoba, Junio 1886 (Buenos Aires).—Journal of the Anthropological Institute, May and August 1887 (Trübner).

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