THURSDAY, APRIL 5, 1894.

THE NEW PHARMACOPŒIA OF THE UNITED STATES.

The Pharmacopœia of the United States of America. Seventh decennial revision (1890). (Philadelphia, Pa., 1893.)

THE history of the various editions of the United States Pharmacopœia presents some points of interest. The first Pharmacopœia, published both in Latin and English, appeared in 1820, and so obviously filled a want that a second edition was supplied in 1828. The original intention was to issue a second Pharmacopœia in 1830, but in consequence of serious difference of opinion amongst the delegates to the convention, the design was nearly frustrated. The contending parties were for a time unable to reconcile their differences, and two works were produced, one in New York, and the other in Philadelphia, neither of which received official sanction. However, towards the end of the year, a second national Pharmacopœia was published in New York, and was reissued, in a slightly amended form, in Philadelphia in 1831. Ten years elapsed before any further steps were taken, but in 1842 unanimity prevailed, and the third revision appeared. The Pharmacopœia of 1851 gave such satisfaction that in 1855 it reached a second edition. In 1873 there appeared what is officially known as the fifth revision, which was followed in 1882 by a sixth Pharmacopœia. The present issue is called the seventh decennial revision of 1890, but did not come into force until January 1894.

The mode of obtaining materials for the revision of the United States Pharmacopœia differs somewhat from that employed in this country. To give it the requisite degree of popularity as a national undertaking it is considered desirable that every State should assist in its production. A number of universities, associations, and medical societies are invited to send delegates to a general meeting at Washington, which appoints certain permanent officers and a committee for the revision and publication of the work. It appears that the delegates from the more distant States do not as a rule appear in person, but they are technically represented, and any friction between the often conflicting interests of the East and West is avoided. In the case of the present revision the first meeting was held early in 1890, and the requisite materials being at hand, the work was completed with commendable dispatch. The committee were fortunate in having for their chairman Dr. Horatio C. Wood, of Philadelphia, an accomplished pharmacologist, and the author of a work on the physiological action of drugs, which is a model of lucid reasoning based on scientific research. Before adjourning, the convention made arrangements for publishing a supplement at the end of five years, and for the issue of a complete revision in 1900.

Several matters of considerable importance engaged the attention of the framers of the present edition. First and foremost was the question of establishing a fixed proportion, or possibly of fixing the limits of the active principles in the preparations, of the more active drugs capable of being accurately assayed. The matter was very fully discussed, but after carefully investigating the various processes, which from time to time had been suggested either as general methods of assay or as being applicable to special drugs, the convention came to the conclusion that reliable measures resulting in even approximately uniform results when carried out by different observers were available only in the case of a very small number of drugs. It was considered necessary that particular caution should be exercised in this matter, seeing that pharmacopœial requirements and assay processes are often made the basis of legal proceedings by public inspectors and others entrusted with the duty of enforcing the regulations relating to the adulteration of food and drugs. It was determined to apply the processes of assay to three drugs only, opium, nux vomica, and cinchona, and their preparations, leaving the extension of the system to some future date. The committee were of opinion that there was a fair prospect of being able to add materially to this list at the next revision.

It was deemed undesirable to make the tinctures of uniform strength, for it was feared that more harm would be done by so radical a change than would be compensated for by the advantage of ensuring simplicity and uniformity. It will be seen that the committee were careful not to introduce drastic remedies in matters of policy.

The adoption of the metric system in the directions for making the various preparations is distinctly a move in the right direction, whilst we note with pleasure that the term "official" has superseded the old word "officinal."

Certain minor alterations respecting the spelling, mode of printing, and interpunctuation to be followed in the use of botanical names were adopted in accordance with the suggestions of the Paris Codex of 1867. It was decided that species names should be printed with a small initial letter even if derived from geographical names. Certain exceptions were made to this rule, as when the specific name had itself at any previous time been a genus name—*Datura Stramonium*, to wit—or when the species name is derived from the name of a person, or when it is an undeclinable noun.

The changes which have been made in the body of the work call for detailed notice. In the first place we find that ninety drugs and preparations have been "dismissed," presumably on the ground that they are valueless, or are no longer extensively employed. The majority of them, it must be confessed, will not be missed. It is probable that few physicians in this country, at all events, have any knowledge of the therapeutical properties of azedarach, cydonium, or magnolia. We are surprised, however, to find extract of malt in the list of expurgated remedies. There is probably no drug more extensively employed, and from which greater benefit has been derived in all forms of wasting diseases. We are justified in concluding that it has been omitted not from any want of faith in its medicinal value, but from the difficulty which has always been experienced in accurately defining it. The arguments against introducing it into the last edition of the British Pharmacopœia were purely pharmaceutical, and were in no way connected with any disbelief in its therapeutical properties. The exclusion of Ignatia will be regarded with feelings of regret by many prescribers who have been accustomed to consider it of much value in the treatment of hysteria and other affections incidental to women. It undoubtedly contains active principles identical with those of nux vomica, but therapeutically the two drugs appear not to be interchangeable. Thuja, again, although comparatively little known, has many enthusiastic supporters. The evidence in favour of these drugs, it is true, is purely clinical, and rests on no firm pharmacological basis.

The list of articles added to the Pharmacopœia, some eighty-eight in number, is of importance as indicating the measure of popularity which certain drugs have obtained in the United States. The selection will meet with the approval of the great majority of therapeutists i this country. We note with pleasure that the bromide lactate and iodide of strontium have received official recognition. These salts, thanks to the researches of Paraf-Javal, can now be obtained in a state of absolute purity. The bromide especially is extensively employed, and has, to a great extent, superseded the other bromides in the treatment of epilepsy and other convulsive disorders. It rarely produces a rash on the skin, or any of the other symptoms included under the term "bromism." The lactate is said to be useful in Bright's disease and chronic albuminuria, whilst the iodide is of much value in the treatment of tertiary syphilis. Strophanthus, the pharmacological action of which was so exhaustively worked out by Prof T. R. Fraser, of Edinburgh, very properly receives admission, its value as a substitute for digitalis ensuring its ready acceptance. Convallaria, another member of the digitalis group, is not so generally used, and of late years has lost rather than gained popularity. Its admission may perhaps excite some surprise ; but if there is a difference of opinion respecting the value of any particular drug, it is as well to err on the side of liberality. Rosorcin is another drug which has hardly maintained its early reputation, but it is still extensively employed in Germany, and its admission may fairly be considered justifiable. Lanoline, cocaine, menthol, naphthol, and salol have passed into the category of domestic remedies, and are so largely used that they could not be overlooked. Nitrite of sodium, the introduction of which some years ago excited much controversy, has slowly but surely established itself in public favour, and has now an assured position as a therapeutical agent. We find, with some surprise, that pepsin, the manufacture of which has been carried to an amazing pitch of perfection by American chemists, is now for the first time admitted into their Pharmacopœia. The method of estimating its activity differs materially from that recommended in the British Pharmacopœia, the standard being considerably higher, so that many of our commercial pepsins would hardly pass muster in America. Pancreatin, now so largely employed for predigesting milk and other foods, takes its place beside pepsin. The ever-popular antifebrin is introduced under the name of acetanilidum, but we look in vain for antipyrine, sulphonal, saccharin and many other remedies of undoubted value. The explanation of the absence of some recently introduced remedies may be found in the statement contained in the preface that " in accordance with the positive instructions of the convention those of the new synthetic remedies which cannot be produced otherwise than under patented processes, or which are protected by proprietary rights, are not admitted into the Pharmacopœia." Pure terebene and terpin hydrate, which clearly do not come under the ban, are admitted without question. It is clear that the framers of an official publication, such as a national Pharmacopœia, exercise a wise discretion in refusing to admit drugs the exact composition of which is unknown whilst their mode of manufacture is practically a trade secret.

In conclusion, we must offer our sincere congratulations to the committee and those who have assisted in the work on the admirable manner in which their gigantic task has been accomplished.

TWO BOOKS ON FORESTRY.

No. 2. *Tree Pruning. A Treatise on Pruning Forest and Ornamental Trees.* By A. des Cars. Translated from the seventh French edition by C. S. Sargent, Professor of Arboriculture in Harvard University, U.S.A. (London : Rider, 1893.)

No. 3. *Practical Forestry.* By Angus D. Webster, Wood Manager to the Duke of Bedford. (London : Rider.)

MESSRS. RIDER AND SON are publishing a series of technical handbooks, the first of which dealt with the economical transmission of power, and Nos. 2 and 3 have just been issued. Des Cars' treatise on pruning is in many ways an excellent little book, which has been thoroughly well translated by Prof. Sargent, and it contains sixty plates admirably illustrating the text.

The book is written in a most persuasive style, and no landowner with trees in his hedgerows, or some parcels of woodland, will read it without being tempted to set to work straightway and prune his trees. Des Cars somewhat ambitiously considers pruning as "a means of growing the greatest number of full-grown trees on a given area, and making them attain their greatest value in the shortest time without injury to the underwood beneath them."

The first fifty-six pages of the book deal with the oak, the species usually grown in Britain and in the north of France as standards over coppice ; and from an incidental remark, it may also be considered applicable to the elm and ash, though no distinction is made regarding sycamore or other trees which do not recover readily from pruning.

Only three pages are given to soft-woods, poplars and conifers, and for firs and spruces Des Cars very wisely advises that pruning should be restricted to dead and dying branches, to be cut off close to the trunk, so as to prevent the knots which interfere with their growth, and eventually produce holes in boards and planks. His advice regarding pines is not quite so sound, for though it is quite true that when grown isolated they develop large branches, yet no one wanting pine timber would dream of growing the trees far apart. Pruning off the large branches of isolated pines, which Des Cars says can be safely reduced to half or one-third of their length, provided foliage branches are left above the section to draw up the sap, will not improve the timber of these trees; nor certainly, as Des Cars says, render them fit for masts and spars, which can only be obtained from the densely-planted and slowly-grown pine-forests of Northern Europe.

To return to the treatment proposed for oak trees: Des Cars will not persuade foresters that large living branches can be pruned off without danger to the future quality of the timber, however carefully the operation may be performed. It is safer to restrict pruning, in the case of oak, to dead or dying branches, or to branches still too young to contain any heart-wood, and which therefore heal up speedily. Broillard, one of the best of French foresters, who has recently written an excellent book[1] on forest management in France, praises the hedgerow oaks of England especially because they are left with their natural crowns intact. If oaks are to be trained, it should be done whilst they are young. Having premised the danger of too great enthusiasm for pruning on the part of inexperienced persons, there can be no doubt that it may sometimes be necessary to prune large branches of neglected roadside avenue trees, which, however, should have been done whilst they were still only formed of sap-wood; and in such cases, and in all cases of pruning small branches, Des Cars is an excellent guide, and thoroughly explains how the pruning should be effected, his main ideas being to prune close to the stem, and in merely shortening branches to leave a sap-lifter above the wound, to maintain life in the shortened branch. Finally, all wounds should be dressed with coal-tar. For carrying out the work, De Courval's strong heavy pruning hatchet is recommended, and the use of the saw deprecated, as requiring much practice to use skilfully; but it is better only to employ skilful woodmen to prune trees, and then the saw is generally the better instrument to use.

"Webster's Practical Forestry" is another useful little book, giving the experience of a practical man who has devoted his lifetime to the every-day duties of a forester. It is not, however, by any means an exhaustive treatise, and, curiously enough, not a word is said about pruning; but the author wisely advises that wherever trees are grown for their economic value, they should be kept close with an unbroken leaf-canopy, so that the lower branches may be killed outright for fully one-half the length of the stems.

Nothing is said about coppice or coppice with standards, which are the commonest modes of growing woods in England.

The efficacy of drainage on forest growth is too much insisted on, while the opinion of French foresters on moisture in the soil may be summarised as follows from Broillard's book, already quoted:—

Dry lands will only produce timber under dense growth of shady trees, which keeps the soil somewhat moist in summer.

Soils which in summer never dry below 6–8 inches allow most forest species to thrive. Moist soils, which when pressed in the hand always leave some trace of moisture, are the most fertile, and suit the pedunculate oak, the ash, and the elm.

Wet soils, usually saturated with water, provided the latter is in movement, and therefore aërated, as along the banks of watercourses, suit alders, willows, and poplars.

Marshes are usually unproductive, but they afford moisture to neighbouring lands, and fine trees are found along their borders. Thus drainage is only required where there is not enough fall of the ground for the water to move about, and, provided the water does not stagnate the roots of forest trees are the best drainers of a soil.

Webster gives some useful notes on trees adapted for various soils and for town planting, and ranks the maiden-hair tree (*Ginkgo biloba*) and *Ailanthus glandulosa* next to the plane as trees flourishing in spite of the smoke of large cities. He also gives an excellent list of trees adapted to grow exposed to sea-breezes, of which *Pinus Laricio* is the best among conifers, and Norway maple and sycamore among broad-leaved trees. The larch, it appears, when grown on gravel generally becomes rotten at the core, and Webster's advice to study the relationship of trees and soils is greatly needed in England, where it is frequently the practice to plant alternate lines of spruce, Scotch pine, larch, and beech without any regard to the different demands they make on the soil. His complaint of preferential railway rates to foreign growers, which have rendered osier-beds unremunerative, points to a great obstacle to forestry in the United Kingdom. An Irish land-agent recently said that it was impossible to send wood from the interior to the ports at a profit; and if our railways cannot provide cheap goods carriage, it is time that canal extension on a large scale were proposed for the transport of our heavy country produce, and that existing canals were withdrawn from the control of the railway companies.

W. R. FISHER.

[1] "Le traitement des bois en France," par Ch. Broillard, ancien professeur a l'école forestière. (Paris: Berger Levrault et Cie, 1894.)

RECENT RESEARCHES ON SACCHAROMYCETES.

Micro-Organisms and Fermentation. By Alfred Jörgensen (Copenhagen). Translated from the third edition in German by A. K. Miller and E. A. Lennholm, and revised by the author. (London: F. W. Lyon, 1893.)

THE development of bacteriology is closely linked together with the advances made in our knowledge of fermentation, which was first placed on a truly scientific basis through the far-reaching investigations of Louis Pasteur in his "Études sur la bière." He propounded the doctrine that every fermentation and putrefaction is caused by micro-organisms. This is an accepted theory now, if by fermentation we understand alcoholic fermentation. For there are other processes of fermentation which are produced by unorganised substances, whose chemical nature is as yet undefinable, such as ptyalin, pepsin, trypsin. The part played by micro-organisms as ferments in disease is still shrouded in mystery. At one time it was thought that they produce a specific lesion by means of basic bodies allied to the vegetable alkaloids, but differing from them in chemical composition and reactions, to which the name "ptomaines" was given, and which were carefully investigated by Brieger. When Hankin discovered an albumose amongst the metabolic products of anthrax bacilli, the ptomaines were regarded with suspicion, and toxalbumins in the form of albumoses, peptones, globulins, separated from artificial cultures of pathogenic bacteria, and pronounced to be the true toxins. The fact that in snake venom and some vegetable poisons, such as abrin and ricin, similar toxalbumins were obtained, lent still further interest to the whole question, and our path seemed perfectly clear. Duclaux, of Paris, at all times raised objections of great weight against this conception of toxalbumins, and the recent works of Buchner, Sidney Martin, and others tend to show that the toxins of most pathogenic micro-organisms are ferment-like bodies, not reacting as ordinary albumoses, peptones, globulins, or albumins when the germs are grown in non-albuminous substances.

Dr. Jörgensen's work discusses the phenomena of alcoholic fermentation only and especially as applied to the brewing of beer, and does not give a general account of fermentation in all its aspects, physiological or pathological, as we had hoped from the title of the book. The Danish savant is, however, hardly responsible for the slight disappointment which we experienced on finding that the scope of the book, which numbers over 250 pages, is limited to alcoholic fermentation, for the German word "Gährung" is generally used to signify this special kind of fermentation. Though this book appeals in the first instance to scientific brewers, and none the less to practical ones, it contains much of special interest to the biologist, bacteriologist, and chemist. The greatest merit is the collection and summary of Hansen's work on yeasts, and we must be grateful to the translators for having given us the results of the patient and laborious investigations made at the Carlsberg Laboratory in an English rendering. Hansen cleared the hopeless confusion existing regarding the saccharomycetes by finding methods for obtaining pure cultures and separating and distinguishing various allied forms which, though hitherto included under the same name, were mere impurities. He rendered a great service to botany and biology by giving an accurate description of the sporulation of these organisms, their various forms of spores, and their germination, facts which enabled him to differentiate between various groups of saccharomycetes. Amongst the latter only organisms are found capable of rapidly and vigorously fermenting maltose, and the yeasts for breweries and distilleries must therefore be sought among them, and a suitable species must always be selected for each particular kind of beer. Hansen studied also and discovered groups of wild yeasts which produce diseases in beer, such as bitter taste and turbidity, and he showed that these unwelcome guests are capable of doing harm only when introduced into the wort at the commencement of fermentation. He has also pointed out ways and means to avoid and prevent disease in beer. Dr. Jörgensen carefully describes the various species and varieties of saccharomycetes and torulæ, and a point of special interest is the tendency of many among them to form mycelia or pro-mycelia, a tendency which by Klein and others has also been observed in schizomycetes, such as diphtheria, tubercle, and anthrax bacilli. For industrial purposes absolutely pure and carefully selected yeast cultures should be used for brewing. This is already done by many breweries on the continent and in America. In England, however, we are slow in applying scientific research to industrial pursuits, and though a number of breweries already use Hansen's system, it can hardly be said that it has received the attention it deserves, and chance, tradition, and blind empiricism still govern too much the manufacture of beer in England. As Prof. P. Frankland says: "Scientific accuracy and the certainty of success can only be introduced into the industry of brewing with a due appreciation of these brilliant researches."

Dr. Jörgensen has treated his subject in a thoroughly scientific and withal clear and concise manner, which suffers but little, if at all, from the translation. To brewers and those interested in the mycotic chemistry of brewing, the book will be welcome, and to those who are not able to read the works of Hansen in the language in which they have been written, it will be invaluable. We hope that this work will assist in banishing empiricism from the English systems of beer fermentation. The general application of Hansen's method is merely a question of time.

A. A. Kanthack.

OUR BOOK SHELF.

A Year amongst the Persians. Impressions as to the Life, Character, and Thought of the People of Persia, received during twelve months' residence in that country in the years 1887–8. By Edward G. Browne, M.A., M.B., Lecturer in Persian to the University of Cambridge (London: A. and C. Black, 1893.)

Mr. Browne's studies lie in the realms of metaphysics and linguistics, subjects which appeal readily to the cultured Persians of the cities. Hence he has obtained more insight into the intellectual side of Persian life than falls to the lot of most foreigners visiting the Shah's dominions. His sympathies are wide, and his tact considerable, for he succeeded in winning the confidence of the persecuted Bàbis and down-trodden *Guebres* of Shiraz and Yezd without incurring the enmity of the official classes. The story of these people and their beliefs is admirably told, but from its nature it lies outside the scope of critical consideration in this journal. Amongst the Guebres or Zoroastrians of Yezd Mr. Browne recognised the most perfect representatives of the ancient Persian race, the physical type being kept pure by the unceasing persecution to which the sect has been subjected since the commencement of Mohammedan supremacy. These people are in constant communication with their kinsmen the well-to-do Parsis of Bombay, who occasionally revisit the country of their origin. The glimpses of the habits and customs of Persian life and thought are singularly vivid, and although the author rather avoids mere topographical detail, his brief sketches of the cities in which he sojourned are powerfully drawn and strikingly accurate. The great want of the country appears to be irrigation, which is carried on at present very partially and in a wasteful manner. Near Kashan a stream was found carefully dammed at intervals to cause the water to overflow the bank and trickle into the channel below heavily charged with mud, the reason assigned being that muddy water evaporates less rapidly than clear.

While the book is generally free from error, we note a slip, hardly to be expected of a Cambridge graduate, on p. 463, where he speaks of a hole a yard square, when the obvious meaning is a yard cube. This obscures the point of a very good story in which mathematical and legal reasoning are shown to differ in their results. There are some curious stories of magic which would have repaid fuller investigation.

Nature Pictures for Little People. By W. Mawer, and others. (London: The Sunday School Association.

SOME parts of this book are very good; others impress us much less favourably. In order to test whether the little people for whom the book is intended were interested in its contents, we gave it to a few average boys to read, and found that their verdict was the same as that expressed above. The authors frequently assume that their young readers are familiar with things not commonly seen, and with expressions not usually found in children's reading-books. For instance, one section of the book is headed 'Απτέρυξ and begins with the sentence, "Rara avis in terris indeed!" This is very well in its way, but is out of place in a book of this character. Also, the numerous small witticisms and puns do not add to the interest or value of the descriptions. "You will wonder," we find in an account of whales "notwithstanding all you have read, how the big whale in the picture was drawn out of the sea and placed upon that rock. I have an opinion of my own upon the subject, and will confide it to you: the artist *drew* him up there." The following specimen is also unattractive, if not misleading. "When collecting those tiny shells which you find ready perforated for threading into necklaces, do you wonder *why* they are so perforated? If so, let me tell you. The little creature which lives in the shell is the favourite food of those bigger ones which have been introduced to you as Roaring Buckies—namely, whelks, as well as purples: and to get out the sweet morsel—oh! so sweet—with their tongues (or what you may call their tongues) they file out the little round hole, and then—oh!" There is much brilliant writing of this character, the style being after that in Kingsley's "Water Babies," and a very long way after. In our opinion, however, the best parts are those *not* containing composition of the kind quoted. Several excellent illustrations, and two or three simply-worded and interesting sections, are the book's only redeeming features.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Foundations of Dynamics.

DYNAMICAL investigations are often made to depend upon the following three propositions, viz., *the principle of linear momentum*, *the principle of angular momentum*, and *the principle of energy*. In treatises which are concerned with ordinary mechanical systems, such as rigid bodies, elastic solids and *frictionless* fluids, the word energy is generally employed in the restricted sense of mechanical energy, and is confined to two particular species, viz. kinetic energy arising from such motions of the system as can be controlled by ordinary mechanical agencies, and potential energy arising from the configuration of the system or from its position in space. All other forms of energy, such as molecular kinetic energy arising from the production of heat by friction, and chemical potential energy contained in fuel, explosive compounds, &c., are excluded from consideration. In systems of this kind the sum of the kinetic and potential energies is an invariable quantity, and this proposition may be termed the *principle of the conservation of mechanical energy*.

It is important to recollect that the principle of momentum is a proposition of a wider character than the principle of the conservation of mechanical energy, for the former proposition is true when the system possesses viscosity or internal friction which gives rise to a conversion of mechanical energy into heat. From this fact it follows that the principles of momentum and energy cannot be regarded as axiomatic, but depend upon certain propositions of a more fundamental character, which ought to be capable of explaining why it is that the principle of momentum is true in the case of viscous systems, whilst the principle of the conservation of mechanical energy does not hold good.

In order to examine this question we shall start with Newton's three Laws of Motion, which will be regarded as fundamental axioms, and shall first inquire how far they will carry us; and we shall find that when we consider the motion of masses of matter of finite size, Newton's Laws are not sufficient to enable us to determine the motion unless the matter is in the ideal state of a frictionless or perfect fluid. In all other cases an additional hypothesis is necessary.

To clear the ground, it may be well to point out that the parallelogram of forces is a direct consequence of Newton's second law, and that the parallelogram of couples is a consequence of the parallelogram of forces; whence all the propositions relating to the composition of forces and couples, including the one which enables any system of forces and couples to be compounded into a wrench, are deductions from the second law.

There are two methods of investigating the motion of a mass of matter of finite size. In the first place, we may suppose the matter to consist of very small discrete masses under the influence of molecular forces, together with bodily forces, such as gravity and the like; in the second place, we may regard the mass as a continuous one which may be subdivided into small differential elements of volume. We shall consider the subject from the first point of view.

Let m_1, m_2 be the masses of any two elements (x_1, y_1, z_1), (x_2, y_2, z_2), their co-ordinates referred to *fixed* axes; let R_{12} be the molecular force of m_2 on m_1, R_{21} of m_1 on m_2; also let F_1 be the bodily force acting on m_1.

By Newton's second law, the forces R_{12}, F_1 may be resolved into components f_{12}, g_{12}, h_{12}, and X_1, Y_1, Z_1 parallel to the axes; also by the same law, the equations of motion of the elements are

$$\left.\begin{aligned} m_1\ddot{x}_1 &= X_1 + f_{12} + f_{13} + \dots \\ m_2\ddot{x}_2 &= X_2 + f_{21} + f_{23} + \dots \end{aligned}\right\} \quad . \; . \; . \; . \; . \; . \quad (1)$$

$$. \quad . \quad . \quad . \quad . \quad . \quad . \quad .$$

$$\left.\begin{aligned} m_1\ddot{y}_1 &= Y_1 + g_{12} + g_{13} + \dots \\ m_2\ddot{y}_2 &= Y_2 + g_{21} + g_{23} + \dots \end{aligned}\right\} \quad . \; . \; . \; . \; . \; . \quad (2)$$

$$. \quad . \quad . \quad . \quad . \quad . \quad . \quad .$$

It follows from Newton's third law that the molecular force of m_2 on m_1 is equal in magnitude and opposite in direction to that of m_1 on m_2; whence $f_{12} = -f_{21}$, &c. Accordingly, if we add the system of equations (1) it follows that all the molecular forces disappear, and we obtain

$$\Sigma(m\ddot{x}) = \Sigma(X) \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad (3)$$

Equation (3) is the analytical expression for the principle of linear momentum, and from the above investigation it follows that this principle is a direct consequence of the second and third laws.

Since the equations of motion of a perfect fluid can be deduced from the above principle, it follows that the whole theory of the hydrodynamics of frictionless fluids depends solely on Newton's second and third laws.

We must next consider the principle of angular momentum. From (1) and (2) we obtain

$$\Sigma m(x\ddot{y} - y\ddot{x}) = \Sigma(xY - yX) + g_{12}x_1 + g_{21}x_2 - f_{12}y_1 - f_{21}y_2 + \dots \quad (4)$$

By the third law the last four terms may be written

$$f_{12}(y_2 - y_1) - g_{12}(x_2 - x_1) \quad . \; . \; . \; . \; . \; . \; . \quad (5)$$

which represents one of the components of the couple due to the mutual action of m_1 and m_2.

Now Newton's third law states that the action of m_1 on m_2 is equal and opposite to that of m_2 on m_1; but it makes no assertion to the effect that the mutual action consists of a force *acting along the line joining them*. An assumption of this kind would limit the generality of the law, and would be one of a somewhat doubtful character, for in viscous systems there are grounds for thinking that this mutual action may consist in part of a force perpendicular to the line joining two elements. If in any particular case the mutual force between two elements *did* act along the line joining them, all the expressions of the form (5) would vanish; but the point to which I particularly wish to call attention to is that *the principle of angular momentum cannot be deduced from Newton's laws, but a further hypothesis is necessary.*

We have not yet considered Newton's first law, and if we discard the hypothesis that the mutual action between two elements consists of a force acting along the line joining them, the next step is to inquire whether the first law will assist us. We have already pointed out that all the molecular forces[1] may be compounded into a wrench. Now Newton's first law asserts, in effect, that when the mass is at rest or is moving uniformly in a straight line, this wrench is zero; but the first law is limited to these two cases, and asserts nothing with regard to what happens when the mass possesses *acceleration*, and it is easy to see that when the mass is in either of the states contemplated by Newton's first law, the molecular forces are not the same as when it is in other states. For example, the molecular forces exerted across any section of a pendulum rod, which is oscillating, are not the same as when the rod is held at rest in any of the positions which it assumes during its motion. Newton's first law does not therefore help us. We have, however, proved by Newton's second and third laws that the *force* constituent of the wrench due to molecular forces is zero; and if we assume that the *couple* constituent is also zero, the sum of all such terms as (5) will vanish, and (4) becomes

$$\Sigma m(x\ddot{y} - y\ddot{x}) = \Sigma(xY - yX) \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

which is the analytical expression for the principle of angular momentum.

The latter principle may therefore be deduced from Newton's laws with the aid of one or other of the following additional hypotheses, viz. :—

(*a*) *The molecular action between two elements consists of a force acting along the line joining them.* Or,

(*b*) *The resultant couple due to molecular action is zero, whether the mass of matter be at rest or in motion.*

We must lastly consider the principle of energy.

Assuming that the bodily forces have a potential, we easily deduce from (1) and (2)—

$$\tfrac{1}{2}\frac{d}{dt}\Sigma m(\dot{x}^2 + \dot{y}^2 + \dot{z}^2) + \frac{dV}{dt} = (f_{12} + f_{13} + \ldots)\dot{x}_1$$
$$+ (g_{12} + g_{13} + \ldots)\dot{y}_1 + \ldots + (f_{21} + f_{23} + \ldots)\dot{x}_2 + \ldots \quad . \quad (7)$$

whence if T denote the kinetic energy, and F denote the right-hand side of (7) the equation becomes

$$\frac{dT}{dt} + \frac{dV}{dt} = F. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

The function F is an unknown quantity which it is impossible to determine without making some special hypothesis respecting the constitution of matter or the law of molecular force. We shall presently show that F is zero when the matter is rigid. In the case of a viscous liquid it can be shown by means of the general equations (which depend upon the principles of linear and angular momenta, combined with a certain hypothesis concerning molecular action) that F is the dissipation function; whilst, in the case of an elastic solid it can similarly be shown that $-$ F represents the time variation of the potential energy due to strain. That F is zero when the matter consists of a rigid body can be proved as follows:—Let ω_1, ω_2, ω_3 be its component angular velocities about the axes; then

$$\dot{x}_2 = \dot{x}_1 - (y_2 - y_1)\omega_3 + (z_2 - z_1)\omega_2$$

and the terms in F depending on the mutual action of m_1 and m_2 become

$$(f_{12} + f_{21})\dot{x}_1 - f_{21}(y_2 - y_1)\omega_3 + f_{21}(Z_2 - Z_1)\omega_2$$
$$+ \text{ similar terms in } g \text{ and } h.$$

This may be written—

$$(f_{12} + f_{21})\dot{x}_1 - \omega_3\{f_{21}(y_2 - y_1) - g_{21}(x_2 - x_1)\} - \ldots$$

By the third law $f_{12} + f_{21} = 0$, and also by either of the subsidiary hypotheses (*a*) or (*b*) all the expressions of the form

$$\omega_3\Sigma\{f_{21}(y_2 - y_1) - g_{21}(x_2 - x_1)\}$$

vanish; whence F = 0, and (8) becomes

$$T + V = \text{const.},$$

which is the analytical form of the principle of the conservation of mechanical energy. A. B. Basset.

[1] It seems hardly necessary to suppose that the mutual action between two elements consists of a *couple* as well as a force; for even in the case of magnetized matter, we may regard each element as the limit of a pair of positive and negative ones which are rigidly connected together, and we may deduce the theorem that the mutual action between two magnetic elements consists of a couple by considering the forces between each pair of simple elements.

The Artificial Formation of the Diamond.

With your kind permission I wish to make a few observation on Prof. Joly's interesting letter in your issue of March 22. in which he concludes from a consideration of the curve representing the expansion of diamond by heat that "the diamond is a form of carbon which has been subjected to high pressure when crystallising," and in which he remarks that these theoretical considerations gave rise to experiments which he only laid aside finally upon hearing of M. Moissan's success. He also says: "M. Moissan has shown that the *added condition* of high pressure has rendered a method previously unsuccessful *now for the first time successful.*" (The italics are mine.) Prof. Joly here makes a claim for M. Moissan which I must say, in justice to that gentleman, he has never made for himself.

If Prof. Joly will kindly turn to my paper on the "Artificial Formation of the Diamond," in the *Proceedings* of the Royal Society, No. 204, 1880, he will find that pressure is *not* an "added condition," and that M. Moissan has *not* "rendered a method hitherto unsuccessful for the first time successful."

Further, he will find that his theoretical deductions were practically demonstrated by me fourteen years ago, and I then described experiments showing that carbon, set free by metals under great pressure, was denser and harder the higher the pressure, and my experiments culminated in the preparation of minute quantities of carbon identical in hardness, density, and action on polarised light with natural diamond.

M. Moissan has done no more, but he has devised a process of great ingenuity which does not entail the danger and expense of mine, and which can be repeated with much greater chance of success.

If Prof. Joly will turn to my paper, he will find that, like Moissan, I obtained my diamond in conjunction with a fused mass containing iron, and fused under extreme pressure. Again, in the *Proceedings* of the Royal Society, of June 14, 1888, he will find that the Hon. C. A. Parsons there describes experiments which produced true diamond (thoroughly corroborated since the publication of his paper), and he proved conclusively that pressure is absolutely essential; and as his method is one which lends itself to the treatment of carbon in quantity at the necessary temperature and at any pressure, it is of much greater practical importance than Moissan's method.

I have the highest admiration of Moissan's work, not only with his electric furnace, but in the several fields in which he has distinguished himself; and as he has courteously admitted that I was the first to define the conditions and actually prepare artificial diamond, I feel constrained to point out that both Parsons and I had fully enunciated the conditions which Prof. Joly attributes to Moissan.

I quite agree with Prof. Joly's concluding paragraph, and my researches led me about a year ago to the construction of an apparatus capable of producing pressures up to forty tons on the square inch, in which I have good hopes of being able to melt carbon in quantity and produce diamond by fusion instead of solution.

Carbon, at ordinary pressures, passes directly from the solid to the gaseous state, and only under enormous pressure can it be made to pass through the liquid state.

It would be premature for me to say more at present, but I hope you will kindly allow me to put these facts on record, as they seem to have been forgotten even by those who are working in the field. J. B. Hannay.

Cove Castle, Loch Long, N.B., March 26.

I was in hopes that the limited claim for priority which I made for M. Moissan would have secured me from controversy as to the claims of previous workers. Although well acquainted with the paper to which Mr. Hannay refers me, I had never derived from it the idea that Mr. Hannay attributed his results to the crystallisation of carbon out of a metal.

While I regret having incorrectly inferred Mr. Hannay's claims, readers of the paper to which he refers will, I think, perceive that the error was not without some justification.

Trinity College, Dublin. J. JOLY.

The New Comet.

THE comet discovered here on March 26 was re-observed on the 27th, 28th, 29th, 30th, 31st, and April 1st, 2nd, and 3rd, and its places on four nights were determined as follows :—

1894	G.M.T. h. m.	R.A. h. m. s.	Decl. ° ′
March 26	9 30	9 54 37	+32 13
27	10 30	9 58 32	+31 38
30	9 50	10 9 12	+30 1
31	11 15	10 12 48	+29 27

The motion is becoming slower, whence it may be inferred that the perihelion passage occurred some time ago.

The comet is small and faint, with a stellar nucleus of about 12th magnitude and a short fan-shaped tail. It was discovered with a 10 inch reflector and comet eyepiece magnifying thirty times. To my eye the comet is now decidedly more obvious than it was when first seen, but this may either be due to more favourable atmosphere, or to the fact that greater familiarity with an object is apt to render it plainer.

Bristol, April 4. W. F. DENNING.

Sun-spot Phenomena and Thunderstorms.

A SMALL portion of that most interesting field of research again dealt with in NATURE (vol. xlix. p. 503), perhaps requires to be trodden with caution. Of course all *a priori* reasoning as to probabilities of a connection between solar physics and the occurrence of thunderstorms may be laid aside, and it does not seem that writers on the subject have fallen into that kind of anti-scientific error. At the same time, we readily admit that a connection between solar activity and thunderstorm phenomena exists. But having devoted a little time to the consideration of the question, I may be permitted to make a remark. In the first place, so far as our observations at present extend, it is quite impossible to find a distinct relation of time between prevalence of thunderstorms over our planet and solar periodicities. In the second place, thunderstorms have been classified, and much require further classification (to which, by the way, I am just about to contribute a few results of study). Artificial or conventional classification would by no means be an object of pursuit to Dr. Veeder. Natural classification does not seem to bring us now at all near to the connection which we might anticipate. In fact, it seems to me that in reference to the thunderstorms mentioned in NATURE for March 29, 1894, natural classification leads us away from the connection.

April 2. W. CLEMENT LEY.

A Lecture Experiment.

THE following experiment, to illustrate the anomalous contraction and expansion of water due to decrease of temperature, I have found to be very striking :—

A large test tube is fitted with a cork, through which a glass tube passes just far enough to allow a rubber tube to be attached. The rubber tube should be long enough to reach to the bottom of the test tube. Close the lower end of the rubber tube, and fill it and the glass tube with mercury up to a little above the top of the cork. Fill the test tube with water, insert the rubber tube, and cork and press the latter firmly in place, taking care that no air-bubbles are imprisoned between it and the water. The pressure of the cork against the surface of the water will cause the mercury to rise in the glass tube. Place the apparatus thus prepared into a freezing mixture of ice and salt. The mercury will fall slowly in the tube until the water has attained its maximum density, remain stationary for a moment, then rise on the further cooling of the water, and at the instant of freezing will make a rapid movement upward.

Armour Institute, Chicago, U.S.A. J. C. FOYE.

Centipedes and their Young.

THE members of the Trinidad Field Naturalists' Club will be glad if any of your correspondents can throw additional light upon the following facts in the history of centipedes, which have recently come under their notice :—

On September 17, 1892, Mr. Charles Libert, of this town, sent to Mr. R. R. Mole a centipede (*Scolopendra prasina*) which enclosed in a circle formed of the fore part of its body a circular mass of young centipedes about the size of a half-penny, and about quarter of an inch thick. The young ones were quite white. The old centipede was very vicious. The centipede and the young ones were exhibited at a conversazione of the Victoria Institute the same evening. The old centipede did not alter her position at all, and on the 21st was packed up for transmission to the Gardens of the Zoological Society, London. Dr. Sclater wrote, on October 27, to Mr. Mole stating that the centipede was dead on arrival, and only one young one could be found in the box. Mr. Libert informs me that he has once or twice found young centipedes clinging to various parts of the body of an adult. Mr. T. D. A. Cockerell (late of Jamaica), of whom inquiries were made, said this habit was new to him.

At a meeting of the Trinidad Field Naturalists' Club on July 7, 1893, the President (Mr. Caracciolo) exhibited a sketch of a centipede carrying its young between the legs of the anterior twelve segments of its body. He stated that he received the centipede, from which the sketch was made, from Mr. Guiseppi on June 20. The creature protected her young in this manner until June 25, when she altered her position, and lay flat over them. On June 30 she left them, "but kept an eye on them." When undisturbed the young centipedes formed a heap, in which they remained for four days. They then gradually began wandering away from the heap, one by one, in search of food. There were about 140 young ones altogether.

At the meeting of the Club on February 2, 1894, Mr. Potter said he had been told by Mr. S. W. Knaggs that he had recently found a centipede coiled up spirally on itself. On attempting to uncoil it a number of pellets of small size fell from its under-surface. These bore the appearance of eggs. He subsequently found others clasped by the numerous legs against the creature's under-surface. The pellets, or eggs, were situated all along the under-surface of the body, and dropped from it on its being uncoiled.

Several text-books and works on natural history have been consulted with the view of finding out more about this interesting habit, but without success; and in most books it is stated that centipedes lay their eggs under dead leaves, or in a dark corner, and manifest no further concern about them.

F. W. URICH.

Port of Spain, Trinidad, B.W.I., March 6.

PROF. IRA REMSEN ON CHEMICAL LABORATORIES.[1]

ON January 1 the Kent Chemical Laboratory was dedicated with appropriate exercises. The beautiful building was thrown open to inspection, and many passed through its rooms expressing admiration. Its plans were explained and a general account was given of the uses to which it is to be put. Honour, "as is most justly due," was paid to the generous donor, whose name from this day forth will be intimately associated with progress in chemistry in this country. The exercises of yesterday have led by an easy step to those of to-day, and a chemist is called upon to give the Convocation address. What theme more natural to him, or more appropriate, than "The Chemical Laboratory?" It is to this theme that I ask your attention. My purpose is to treat the chemical laboratory, not from the material point of view, but in its broader aspects, as far as I may find this possible. I shall attempt to answer briefly three questions, and these are :—

(1) When and how did chemical laboratories come to be established in universities?

(2) What part have chemical laboratories played in the advancement of knowledge?

[1] Address delivered by Prof. Ira Remsen on January 2, 1894, in connection with the opening of the Kent Chemical Laboratory of the University of Chicago, U.S.A.

(3) What are the legitimate uses of the chemical laboratory of a university at the present time in this country?

The first laboratory ever erected for the teaching of chemistry—indeed, the first laboratory for teaching any branch—was that of the University of Giessen, Germany, which owed its existence to the enthusiasm of Liebig. The story is an interesting one, and especially instructive on an occasion such as this. Liebig was born in the year 1803. According to his own account, he had a hard time of it in the schools. He says: "My position at school was very deplorable; I had no ear-memory, and retained nothing or very little of what is learned through this sense. I found myself in the most uncomfortable position in which a boy could possibly be; languages and everything that is acquired by their means, that gains praise and honour in the school, were out of my reach; and when the venerable rector of the gymnasium, on one occasion of his examination of my class, came to me and made a most cutting remonstrance with me for my want of diligence—how I was the plague of my teacher and the sorrow of my parents, and what did I think was to become of me—and I answered him that I would be a chemist, the whole school and the good old man himself broke into an uncontrollable fit of laughter, for no one at that time had any idea that chemistry was a thing that could be studied."

This was truly an unpropitious beginning, yet this butt of his school was soon contributing more to the development of chemistry than any one ever had before or than any one ever has since. Filled with the determination to study chemical things and phenomena, he left the school where he had been such a failure, and entered an apothecary shop, but at the end of ten months the proprietor was so tired of him that he sent him back to his father. As Liebig said, he wanted to be a chemist, not a druggist. He must have been about fifteen years of age when, in spite of his inadequate preparation in languages, he was received as a student in the University of Bonn, and from here a little later he went to Erlangen. But he appears not to have been much better satisfied at the university than he was in the apothecary shop. He speaks almost with contempt of the teachers under whom he studied. "It was then a very wretched time for chemistry in Germany," he says. "At most of the universities there was no special chair of chemistry; it was generally handed over to the Professor of Medicine, who taught it, as much as he knew of it—and that was little enough—along with the branches of toxicology, pharmacology, materia medica, practical medicine, and pharmacy." Referring to the equipment of the universities for the teaching of chemistry, he says: "I remember, at a much later period, Prof. Wurzer, who had the chair of chemistry at Marburg, showing me a wooden table-drawer, which had the property of producing quicksilver every three months. He possessed an apparatus which mainly consisted of a long clay pipe-stem, with which he converted oxygen into nitrogen by making the porous pipe-stem red-hot in charcoal, and passing oxygen through it. Chemical laboratories, in which instruction in chemical analysis was imparted, existed nowhere at that time. What passed by that name were more like kitchens fitted with all sorts of furnaces and utensils for the carrying out of metallurgical or pharmaceutical processes. No one really understood how to teach it."

After a comparatively short sojourn in Erlangen, Liebig returned home fully persuaded that he could not attain his ends in Germany. Some of the young men of that time had gone to Stockholm to study chemistry, attracted thither by the fame of the great Berzelius. But Liebig decided in favour of Paris. He was then seventeen and a half years old, and, as we have seen, he could not have been well prepared in chemistry, yet in a short time after his arrival, he made such an impression on Alexander von Humboldt that he was admitted to the laboratory of one of the most brilliant chemists of the day, Gay-Lussac. He had previously begun an investigation on certain fulminating compounds to which his attention was first directed in a curious way at his home in Darmstadt.

Let me again use his own words: "In the market at Darmstadt I watched how a peripatetic dealer in odds and ends made fulminating silver for his pea-crackers. I observed the red vapours which were formed when he dissolved his silver, and that he added to it nitric acid, and then a liquid which smelt of brandy, and with which he cleaned dirty collars for the people." Gay-Lussac gladly joined him in the investigation, and he gratefully refers to this opportunity. He acknowledges that the foundation of all his later work was laid in Gay-Lussac's laboratory.

And now to the main point. When Liebig was in his twenty-first year he received an appointment to a professorship of chemistry at Giessen through the influence of von Humboldt. His opportunity had come. He determined to have a laboratory for teaching. The great advantages he had reaped from his contact with Gay-Lussac showed him clearly that if students were to study chemistry at all it must be in a well-equipped laboratory in contact with a teacher. And so the first laboratory was built, and became one of the great forces of the world. Soon students flocked to the little university from all parts of the civilised world, and the most flourishing and powerful school of chemistry that has ever existed was rapidly developed. One of the most brilliant pupils of this school, the late Prof. Hofmann, of Berlin, in speaking of its influence, says: "The foundation of this school forms an epoch in the history of chemical science. It was here that experimental instruction such as now prevails in our laboratories received its earliest form and fashion; and if, at the present moment, we are proud of the magnificent temples raised to chemical science in all our schools and universities, let it never be forgotten that they all owe their origin to the prototype set up by Liebig." The foundation of this school marked an epoch not only in the history of chemical science but in the history of science. The great success of this laboratory led naturally to the building of others, and in a comparatively few years a chemical laboratory, at least, came to be regarded as essential to every university. At first these were of necessity modest affairs. One of the earliest was that at Tübingen, in regard to which a curious fact may be mentioned. It appears that the ground available for Liebig's laboratory in Giessen was not altogether well adapted to its purpose, and in consequence, one of the larger working-rooms received light from only one side. When the laboratory of Tübingen was built later, that at Giessen was copied in every detail even to the dark room, notwithstanding the fact that there were no buildings in the immediate neighbourhood, and light in abundance was available.

As time passed, the era of the palatial laboratory was introduced. Probably we shall be very near the truth if we fix the responsibility of this era upon Bonn. Hofmann was called to Bonn from England, whither he had gone under the most flattering conditions, and, before accepting the new call, he had, no doubt, received promises with reference to a laboratory. At all events, a building was erected, much finer than anything in the way of a laboratory that had ever appeared. As is customary in Germany, the professor's dwelling-rooms were in the building, and so beautiful were all the arrangements, that when the King of Prussia passed through at the time of the formal opening, he is said to have remarked, "I should like to live here myself." Soon after this Hofmann built the laboratory at Berlin, and again magnificence was the order of the day. Statues and carvings, and tiles and frescoes, took their place in the laboratory, and since then in Germany and France and Austria and Switzerland immense sums have been expended in the erection not only of chemical but of physical, and physiological, and petrographical, and anatomical, and pharmacological, and geological laboratories. While of late years there has perhaps been a reaction, and a tendency to somewhat simpler buildings than those that at one time were the fashion, it is still true that the laboratories are semi-palatial, and a strict economist might find ground for complaint, claiming that results as good might have been obtained at smaller cost. It would hardly be profitable to discuss this point here. In this country we cannot be said in general to have been extravagant in building laboratories; certainly not, if we keep the European standard in mind. Most of the larger laboratories in this country are modest in their fittings, and the strictest economist could hardly find fault.

If we had the power to estimate the value of the work that has been done for the world by the scientific laboratories, it is certain that the money spent for them, however great the sum may be, would appear to us ridiculously small. The scientific method, as it is called, has been spread among men, and has changed the whole aspect of things. The influence of the laboratory is felt in every branch of knowledge. The methods of investigation have changed, and everywhere the scientific method has been adopted. Who can tell what an enormous influence this has already had upon the thoughts and actions of men, and what still greater influence is to be exerted? The laboratory has impressed upon the world the truth that in order to learn about anything it will not suffice to stand aloof and speculate, and that it is necessary to come into as close contact with that thing as possible. When the old philosopher wished to solve a problem, his method was to sit down and think about it. He relied upon the workings of his brain to frame a theory, and beautiful theories were undoubtedly framed, and many of these, probably all of those which had reference to natural phenomena, were far in advance of facts known, and often directly opposed to facts discovered later. Minds were not hampered by facts, and theories grew apace. The age was one of mental operations. A beautiful thought was evidently regarded as something much superior to knowledge. We have not learned to think less of beautiful thoughts or of mental processes, but we have learned to think more of facts, and to let our beautiful thoughts be guided by them.

And how did this come about? It is curious that the scientific method of work, which is altogether the simplest, should be the last to be adopted by the world as it is by individuals. It would be impossible to determine all the causes that have led to this result, but one of the immediate causes is undoubtedly to be found in the fact that, at an early period in the history of the world, those who worked with their hands came to be looked upon as inferior to those who worked with their heads alone. This operated powerfully to keep those who were best fitted to advance knowledge, from adopting the simplest method, viz. that of studying things. One who engaged in experiment did it surreptitiously, or lost caste.

Probably the most powerful force that first led men to experiment systematically was the conception of the philosopher's stone, and out of the labours of the alchemists sprang experimental science. Strange as it may seem, it was the love of gold that led to the development of scientific methods of investigation. In some way, probably through superficial observations, men came early to think it possible that the ordinary or base metals could be transformed into gold, and with this idea came the desire to experiment on the subject, and the experiments on this subject have been kept up until the present century. So that in one sense, certainly, it is not true that "the love of money is the root of all evil." While much folly was committed in the name of alchemy—as much folly is committed to-day in the name of chemistry, and of medicine, and of other lines of work—it is clear that the true alchemist was as ardent a worker as the world has perhaps ever seen; he was engaged in experimenting. He was teaching the world that the way to a correct knowledge of nature lies not in philosophy alone but through coming in contact with the things of nature, and becoming personally acquainted with them. Paracelsus speaks of the alchemists of his time thus: "They are not given to idleness, nor go in a proud habit, or plush or velvet garments, often showing their rings upon their fingers, or wearing swords with silver hilts by their sides, or fine and gay gloves upon their hands, but diligently follow their labours, sweating whole days and nights by their furnaces. They do not spend their time abroad for recreation, but take delight in their laboratory. They wear leather garments with a pouch, and an apron wherewith they wipe their hands. They put their fingers among coals, and into clay, not into gold rings. They are sooty and black like smiths and colliers, and do not pride themselves upon clean and beautiful faces."

This is certainly the picture of a hard worker, and as such we must look upon the alchemist. The work done by the alchemists was chemical work. It was allied very closely to the work done by chemists now-a-days. They hoped to find the philosopher's stone among chemical substances, and the transformation they hoped for was to be accomplished by a chemical method. They consequently devoted themselves to careful study of all known chemical substances, and in further studying the action of these substances upon one another they came into possession of new facts. There can be no doubt that we owe to the alchemists not only the foundation of chemistry, but the foundation of experimental science. In our superior way we smile at their futile labours to discover the philosopher's stone, but the tremendous results reached by them must not be lost sight of. The theory of the philosopher's stone was shown to be a false theory; but what of that? Probably many of the theories now held are false, but they are none the less valuable. An idea is of value if it leads to active work. Working hypotheses are the stepping-stones of intellectual progress. The philosopher's stone was more than a stepping-stone—it was a magnificent bridge. "Any idea," says Liebig, "which stimulates men to work, excites the perceptive faculty, and brings perseverance, is a gain for science, for it is work that leads to discoveries. The most lively imagination, the most profound wisdom, is not capable of suggesting a thought which could have acted more powerfully and lastingly upon the mind and powers of man than did the idea of the philosopher's stone. Without this idea chemistry could not exist to-day in its present perfection."

Let us now turn from the past to the present, and inquire, What is the province of a chemical laboratory in a university in this country? The first chemical laboratories had for their sole object the training of chemists, and consequently, the methods adopted in them were adapted to this end alone. Afterwards, and indeed only quite recently, the importance of laboratory training in chemistry for those looking forward to the study of medicine came to be recognised; and, still later, the idea that such training might be made a valuable part of a general education appeared. At present, then, a chemical laboratory is called upon to furnish opportunities (1) for the general student who does not expect to become either a technical chemist or a teacher of chemistry; (2) for the medical student; (3) for him who expects to devote himself to the practice of chemistry, either in a chemical factory or in an analytical laboratory ; and (4) for him who is to devote his life to teaching and investigation. In addition to furnishing these opportunities, it should also be a place in which investigation is constantly carried on by the teachers and advanced students.

As regards the teaching of chemistry to general students much might be said, but it will be possible to touch upon only a few points on this occasion. Most of the teaching is of this kind, and the subject is under active discussion. There can be no question that much of the work done in schools and colleges is highly unsatisfactory, many of the courses which are called scientific are most unscientific, and the student is often more harmed than benefited by his work. If a course in a science, whatever that science may be, does not tend in some degree to develop a scientific habit of mind in the student, it is not serving its legitimate purpose. If the experience of twenty-one years in teaching in college and university in this country is worth anything, your speaker, who has during that time had to deal with many students from all parts of the country, is justified in asserting that the minds of students who enter college are very far from being scientific, and the same can be said of most of those fresh from the colleges. By a scientific mind is meant one that tends to deal with questions objectively, to judge things on their merits, and that does not tend to prejudge every question by the aid of ideas formed independently of the things themselves. Perhaps an anecdote, though trivial, will make this clearer. In a book used by my classes for a number of years, there was one error that served as a simple test of the condition of the students' minds. In the directions for performing a certain experiment, the statement was made that a blue solution would result at one stage. As a matter of fact, the solution referred to was always a bright green. Each student being required to write out an accurate description of what he had seen, each one in turn for a series of years described the green solution as blue, disregarding the evidence of his senses, and accepting the evidence of the printed word as more reliable. Occasionally one would appear whose conscience was troubled by the discrepancy, and who would boldly assert that the book must be wrong, but the number of these exceptions was insignificant. Surely this tendency to disregard the evidence of the senses is one that in the great majority of cases can be overcome. It would be better if it did not exist at all, and it probably would not exist if our educational methods were what they should be. We need teachers properly trained for carrying on scientific courses in our schools and colleges, and one of the most important branches of work in a university is the training of such teachers. Many of the courses in the schools and colleges are at present too ambitious. The attempt is made in them to do in a small way just what is done in a large way in the most advanced courses in universities. Instead of being what they should be, school courses and college courses, they are reduced university courses. Young men who have had the advantages of advanced courses feel so plainly the benefits they have received, that they naturally wish their own students in turn, whatever their ages may be, to get the same benefits. But time will not permit further discussion of this topic, and the main object in referring to it at all is to make it clear that the university laboratory has a great field of work in connection with the improvement of methods of teaching chemistry.

The teaching of chemistry to medical students suggests a number of thoughts, but they are rather of a special character, and this branch of our subject may be passed over with the remark that there is practical agreement as to this point, that what the medical student most needs at first is good scientific training, and that a course in general chemistry is well suited to this purpose. The most recently established medical schools require training in chemistry as one of the conditions of matriculation, and it is distinctly understood that it is chemistry, and not medical chemistry nor physiological chemistry, that is wanted.

The relation of the science of chemistry to the chemical industries is suggested by the next division of the subject. Here a most instructive object lesson was afforded during the past summer by a visit to the chemical exhibits in Jackson Park, where for the time being the products of the earth were concentrated. If you had had an intelligent chemical guide he would have pointed out many an interesting product from England, France, Russia, Italy, and this country, but his enthusiasm would have been reserved for the exhibit of the German chemical industries. He would have pointed out a great variety of beautiful and valuable products, and you would, I am sure, have carried away with you the conviction that the Germans excel the world in this line of work. The reason is not hard to find. It has often been discussed, but it would not be right to let this opportunity pass without again calling attention to it. Those who are familiar with the subject do not hesitate to acknowledge that the reason why the chemical industries have reached such a flourishing condition in Germany is that the pure science has been so assiduously cultivated. The value of pure science in the industries has long been recognised there, much more clearly than in any other country, and the scientific method has become established in the factories much to their advantage. Men deeply versed in pure chemistry, whose minds have been clarified by training in the university laboratories, are eagerly sought for in the factories. So thoroughly convinced are the Germans of the value of pure science for the industries that in the polytechnic schools, the plan of instruction in chemistry is essentially the same as in the universities, and some of the best purely scientific work is done in the laboratories of these polytechnic schools. We, in this country, have yet to learn the importance of this relation between science and industry, though undoubtedly some progress has been made in this line. We still endeavour to make iron and steel chemists, and soap chemists, and sugar chemists, and turn out hosts of raw products that are not worth their salt. Training along such narrow lines is a positive injury to the students. They are the victims of false pretences Let the training be as broad as possible and as thorough as possible, and the student will at least not be crippled when he ought to be strengthened.

Finally, a few words in regard to what is commonly and properly spoken of as the highest work of the university laboratory—the training of teachers and investigators. Here, again, we find that Germany leads the world, and to her we must look for guidance ; and, as is well known, to her we have looked for guidance for many years past. Just as Liebig betook himself to Paris, and Wöhler to Stockholm, so in turn Americans have betaken themselves to Germany to work with the great masters. This movement began soon after the establishment of the Giessen laboratory, and many an American obtained his inspiration in that laboratory. There are living to-day a number of American chemists who sat at Liebig's feet ; a still larger number look back with pride to the time spent in the Göttingen laboratory, where Wöhler's was for many years the master mind. Bunsen and Hofmann attracted large numbers in their best days ; and now Bayer in Munich, Ostwald in Leipsic, Victor Meyer in Heidelberg, and Fischer in Berlin, appear to exert the strongest influence upon American students. Most of the chemists holding prominent places in this country have had more or less prolonged training in German universities, and it is not to be wondered at, therefore, that German methods have found their way into our laboratories. Indeed, there are some who appear to hold that, unless a method has a German tag on it, it is not worth considering. These hold, also, that the goal to strive for is the development of a laboratory like the best in Germany.

For many years Americans have been returning to this country after having enjoyed the best opportunities afforded abro d. Each annual crop have at least one thought in common, and that is, that chemistry in this country is in a deplorable condition, and that their labours are needed to bring about a reform. These young reformers are, of course, quite out of joint with the country, and often render themselves incapable of bringing about the results they desire, by refusing to recognise what is good and endeavouring to build upon that. The true and efficient reformer is a believer in continuity. Progress has always been by easy stages. The history of chemistry in this country shows that there has been a slow and steady advancement, and there is much promise in the present.

We owe to Germany very largely the investigating tendency which is showing itself more and more every year, and while even now the amount of original work done, as compared with that done abroad, is small, it is quite natural that it should be so.

A large part of the experimental work in Germany is done by advanced students and young chemists who are waiting for positions. It is by the aid of the former class especially that the professors work out their problems. Now, the number of advanced students of chemistry in this country is much smaller than in Germany, and the same is true even to a still greater degree of young chemists waiting for positions. Increase the number of these two classes here, and the amount of investigating work will be increased accordingly. But such increase must be determined largely by the demand, and the demand for thoroughly trained chemists is by no means as large as in Germany. The most important reason for this has already been spoken of. The value of these thoroughly trained chemists in the industries has not yet been generally recognised. Indeed, those particular industries in which the aid of scientific chemists is specially needed do not exist to any great extent, so that there is very little demand for such men. Most of the advanced students are looking forward to teaching, and the graduate departments in our universities must for years to come look to these men for re-enforcement. Plainly, the number of such students must be comparatively limited, or the supply will exceed the demand. After completing their regular courses these students must secure occupation. The "bread and butter question" is involved. But the number of places to be filled is limited, and every year young men well fitted to take good places are left, at least for a time, without means of support, and all their efforts must go to securing positions; and, further, when they secure their places, the conditions are for the most part unfavourable to the carrying on of higher work, and although many of them struggle manfully for a time to keep up their enthusiasm, it gradually dies out for want of nourishment.

All this is discouraging, of course, to the advanced students of chemistry, and to those who wish to study chemistry, and thus the number is necessarily kept down. It is a fair question whether the number of graduates now studying chemistry is not unnaturally large. However this may be, it is clear that, as the amount of investigating work depends upon the number of advanced students, the amount of this work must of necessity be comparatively small. More could be done, no doubt, by teachers in colleges throughout the land, and the amount done by these teachers is increasing year by year, but it is difficult for them to secure co-workers, and, with unaided hands, the amount of chemical work that can be done by an individual is small.

Some of the most active workers in Germany are, as has been remarked, the young chemists, who are waiting for positions. These form a comparatively large class of picked men—men who have a strong tendency to investigation, and in some way see their way clear to at least a sufficient income to "keep body and soul together." Most of them have a hard struggle, though, on the other hand, some are men of means, whose ambition is not destroyed by the fact that they have fortunes. These men, of course, are desirous of securing advancement, and they know that their only chance lies in doing good work. It is the tremendous competition among these men that leads to the results for which Germany is famed.

Very well, you will say, if that is the secret, let us have that system here. But that is the very thing we cannot get. We may be able to secure a few able professors, a number of bright advanced students, good laboratories, and supplies, but this intermediate class of active workers cannot be secured, save under conditions that do not exist here, and are not likely to exist here for many years to come. Abroad the university career is one of the most attractive open to men; a professor is a very much respected member of the community, and his life is an unusually pleasant one. Without entering into a detailed comparison between the university career in this country and abroad, we may accept the general statement that this career exerts a much stronger attraction upon students there than here. Then, too, the opportunities in other fields are more limited there, so that these two forces working together, lead a number of the ablest young men to choose the university career, and to face the great difficulties which they know they will have to overcome before they attain success. The first condition of that success is good work done. There is absolutely no chance for one who does not carry on investigation, nor for one who is lukewarm in his work. The school is a merciless one, but the results probably justify the means.

What possibility is there of introducing this system in this country? Let the experiment be tried. Offer young men of ability the privilege of teaching in a university and nothing else, and how many, think you, will avail themselves of it? Or if some few exceptional men under most exceptional conditions should do so, how long will they remain in the position? To keep them it will be necessary to pay them at least enough to live on, and then the very soul of the German system is destroyed. In short, we have our own problems to work out under conditions that we cannot control, and while we may be inclined to regret that we cannot have all that we should like to have; while we in this generation at least must necessarily be content to do with less scientific work than those who have breathed the German atmosphere have been accustomed to, there is pleasure in working out new educational problems, and there is satisfaction in causing the tree of knowledge to grow where before it languished. We have a great field to cultivate. It is fertile. Labour expended upon it will yield rich harvests. So let us to work. Those who have been in the chemical field for years welcome the new workers, and especially such a body of workers as has been brought together in this University. May the great activity in chemical work which has characterised this University during its short life continue unabated. The Kent Chemical Laboratory is already known of all the world, even before its doors are open. May its fame increase year by year.

THE TEACHING UNIVERSITY.

AT the ensuing meeting of Convocation of the University of London (on April 10 next), the rejection of the Gresham Commission scheme will be the subject of the first motion. It is intended (if possible) to propose an amendment which will, in effect, be a declaration that Convocation generally approves of the scheme as enabling the University to make extended provision for teaching, and for the advancement of learning, and for original research in London in accordance with, and in furtherance of, the principles already sanctioned by the several charters of the University. The following special, among other reasons, in general support of the Gresham Commission proposals, are now submitted to the consideration of your readers and the members of Convocation interested in the welfare of their University:—

(1) The original London University was intended to be both a teaching and a degree-conferring body.

(2) The University of the "30's" was open to collegiate candidates only, and was governed by a strictly professorial body, consisting of the examiners, who formed the senate of the University.

(3) Under the charter of 1858 the non-collegiate student was admitted to the examinations, but the older system has never been abolished, nor has the principle thereof ever been abrogated.

(4) In the existing charter (Sec. 2) the object is declared to be "*to hold forth . . . an encouragement for pursuing a liberal and regular course of education.*"

In Sec. 34 a long list of affiliated colleges is given, in the next section power is conferred to "alter, vary, and amend" such list, and in Sec. 36 non-collegiate students are made admissible (except in medicine) "on such conditions" as the Senate may prescribe.

(5) Under Sections 18–38, and following, the Senate is empowered to examine for, and confer degrees on such conditions as it may think fit (subject to general law and the charter) to confer *ad eundem* degrees, and grant certificates of proficiency.

(6) It is, therefore, clear that the University is still essentially what it was originally—a collegiate University, with the added faculty of admitting non-collegiate students "upon conditions." The chief fault found with the collegiate system in 1858 was, in effect, that it was imperfectly established and insufficiently administered. It could have been reformed, and its maintenance was supported by 531 graduates against 38 who advocated the admission of the non-collegiate, as well as of the collegiate, student.

(7) It is equally clear that nothing in the existing charters prevents the University from establishing special examinations (if need be, which is very doubtful) for collegiate and non-collegiate students respectively, Professorships, Boards of Studies, Faculties, and even (probably) an Academic Council or its equivalent, such as provided by the Gresham Commission scheme, which, running counter to no principle sanctioned by any former or by the present charters, mainly restores and extends the University, methodises and regulates its educational machinery, and enables it to exercise such direct control over teaching as any well-wisher to academical education must surely desire to see it endowed with.

(8) The non-collegiate student, in whose favour alone does the Gresham scheme depart from the original principle of the University, cannot but gain by having his studies directed by the whole teaching force of the metropolis. At present only two professors actually engaged in teaching, representing only one out of the numerous subjects comprised within the faculties of Art, Science, Medicine, and Laws (exclusive of clinical medicine, which is well represented), sit upon the councils of the University. Even Convocation, during its whole existence, appears to have elected only two professors. Such a divorce of testing from teaching has been long regretted by most teachers of eminence, metropolitan or provincial, and by most, if not all, of the Examiners of the University.

(9) Lastly, as measuring the comparative academical success of collegiate and non-collegiate courses of study, the figures which I give in a note are not uninstructive[1]:—

If conclusions may be drawn from these figures, the academical success of the graduates who were largely non-collegiate, would appear to be one-half of that of the graduates who were largely collegiate, and one-fourth of that of the graduates who have always been wholly collegiate.

(10) As collegiate and non-collegiate candidates are certainly of equal intrinsic quality, it would seem that the difference is to be ascribed to the superiority of collegiate over non-collegiate courses of study.

(11) Hence the collegiate principle, the original principle of the University, which it has never abrogated, would appear to be the principle most likely to repay extension—and this is precisely what the Gresham Commission scheme proposes to do—and there is nothing to show that its extension need in the slightest degree interfere with the interests of the non-collegiate student. On the contrary, it would facilitate the increase of his opportunities for regular instruction of the highest character.

(12) In conclusion, the assumption underlying the foregoing remarks is that the chief object of a University is the advancement of learning and research, and not the mere granting of degrees, which are but a means to an end. The eloquent appeal of Lord Reay, appended to the Gresham Report, should be carefully studied by all interested in the University questions.

F. VICTOR DICKINS.

WILLIAM PENGELLY.

THE death of William Pengelly, at the ripe age of eighty-two, deserves more than a passing notice, because he was one of the last survivors of a scientific type represented by Sedgwick, Lyell, Phillips, Murchison, and the other old heroes who laid the foundation of geological science. He belongs to the heroic age of geology—to that group of men who found British Geology almost a *terra incognita*, and left it so completely explored that there is little left for their successors but to correct mistakes and fill in minute details.

Pengelly was born in 1812, at East Looe, in Cornwall, of a Quaker stock, and lived all his life in the west country. Like Prof. Dana, he took to the sea and served before the mast. Having, however, a decided taste for mathematics and geology, he gave up seafaring and

[1] During the last five years the annual number of B.A.'s (largely non collegiate) has sunk from 238 in 1889, to 156 in 1893, a diminution of 34 per cent. From 1858 to 1893, the annual number of B.A.'s has increased from 70 to 156, of B.Sc.'s from 5 to 80 (in 1892—for some reason or other—the number dwindled to 65 in 1893), of M.B.'s from 20 to 89, and of M.D.'s from 16 to 59.

[The science candidates are mainly collegiate, the medical candidates have always been wholly collegiate.]

During the last three years, 1891–2–3,

Of 639 B.A.'s, 38 took 1st Class Honours, about 5 per cent.
Of 250 B.Sc.'s, 28 ,, ,, ,, ,, 11 ,,
Of 249 M.B.'s, 55 ,, ,, ,, ,, 22 ,,

Of some 500 graduates in Honours at the B.Sc. examination (since the institution of the degree in 1861 to 1892), 470 were collegiate students, and only 30 were non-collegiate.

During the same period, of some 1080 B.A. Honours men, only 260 were wholly non-collegiate, the remainder, 720, were collegiate students. Of the 260 non-collegiates, 42 obtained a 1st Class in Honours, chiefly in modern languages; the remaining 218 were largely placed in the 3rd Class.

settled down as a teacher in Torquay. Here for some sixty years he threw himself into the work of higher education, and more especially in the direction of natural science. In 1837, through his energy, the Torquay Mechanics Institute, which had fallen on evil days, was reorganised and put on a satisfactory working basis. Seven years later he founded the Torquay Natural History Society, and in 1863 he extended the range of his personal influence by establishing the Devonshire Association that took root and flourished exceedingly, and has been of great service in the West of England. It is impossible to read any one of the many volumes published by the Association without realising how great has been his influence in bringing natural knowledge within reach of the people. The museum at Torquay is also an enduring monument to his energy, which will continue to teach when his name is forgotten.

Pengelly was, however, beyond all other things, a geologist, devoted to the study of Devonshire. The collection of Devonian fossils in the Oxford Museum is spoil of his hammer. He collected also the materials for the "Monograph on the Lignite Formation of Bovey Tracey," a joint publication with Dr. Heer, that has thrown so much light on the Miocene forests which clothed the slopes around the Lake of Bovey. During the second quarter of the present century, the question of the antiquity of man was steadily coming to the front. In 1847 Boucher de Perthes published his discovery of flint implements along with the extinct mammalia in the river-gravels of Amiens and Abbeville. Similar discoveries in Kent's Hole by Mr. M'Enery, made some time between 1825 and 1839, had been verified by Godwin-Austen in 1840, and the Torquay Natural History Society in 1846. So strong, however, were the prejudices against the antiquity of man, that the matter was not thought worthy of further investigation, until the year 1858. Then it was determined that a new cave at Brixham, near Torquay, should be explored by a joint committee of the Royal and Geological Societies, consisting, among others, of Lyell, Falconer, Ramsay, Prestwich, Owen, and Godwin-Austen, with Pengelly as the superintendent of the work. The result of the exploration established beyond all doubt the existence of palæolithic man in the Pleistocene age, and caused the whole of the scientific world to awake to the fact of the vast antiquity of the human race. From this time Pengelly's energies were mainly directed towards cave exploration. In 1865 he undertook the superintendence of the exploration of Kent's Hole by a committee of the British Association. It was at this time that I first became associated with him in cave-digging, and as we came to know one another, I learnt to admire his method, and his patient and accurate work. Day by day, excepting when the work was stopped, he visited the cave and recorded on maps and plans the exact spot where each specimen was found, for no less than sixteen years. The vast collection of palæolithic implements and fossil bones, each of which bears traces of his handiwork, is represented in most of the museums in this country, and the annual reports, listened to with so much pleasure by crowds at the meetings of the British Association, are the most complete that have ever been published. It may be objected that the accumulation of so much evidence of the existence of man in the Pleistocene age, in the south of England, was unnecessary. It was, however, necessary to sweep away the mass of prejudice, and this could best be done by repeating the evidence. Had this not been done, early man would not occupy the recognised position which he now holds in the annals of geology. The rest of Pengelly's life was mainly given up to the researches in other caves in Devonshire. In estimating his scientific work, it must not be forgotten that it was done in addition to the daily task of bread-winning.

There remains one other side of Pengelly's many-sided character which deserves remark. He was a fluent and genial speaker and lecturer. For many years he was a leading figure at the meetings of the British Association, and there are but few large centres where he was not known as a lecturer and not welcomed as a friend. Some of his *jeux d'esprit*, such as, for example, his saying in treating of the thorny question of man's antiquity, "that you may be as naughty as you like," will long be remembered. He has died full of years, and with his services honourably recognised by his private friends and by the scientific world. He has left behind an example of what one man can do in advancing knowledge by energy and perseverance.

W. BOYD DAWKINS.

THE LATE CAPTAIN CAMERON.

CAPTAIN VERNEY LOVETT CAMERON, C.B., R.N., died very suddenly, in his fiftieth year, on March 26, in consequence of being thrown from his horse while returning from a day's stag-hunting. His name is associated with the most stirring period of modern inland exploration in Africa. In 1871 Mr. H. M. Stanley met and relieved Livingstone at Ujiji, and on returning to the east coast met the Livingstone relief expedition of the Royal Geographical Society, the leader of which, believing his work to be forestalled, declined to proceed, and broke up his caravan. Lieutenant Cameron had for some time been anxious to explore Africa, and had been one of the unsuccessful applicants for the command of the abortive expedition. On its collapse he submitted proposals for the exploration of the Victoria Nyanza and of east equatorial Africa to the Royal Geographical Society, and in 1872 he was entrusted with a new Livingstone relief expedition, which was to proceed from the east coast, while another expedition, under Lieutenant Grandy, pushed its way up the Congo.

Leaving Bagamoyo early in 1873, Lieutenant Cameron started on his march inland, but was met by the melancholy little group of Livingstone's black servants carrying the body of their master. Although the main aim of the expedition was thus frustrated, and all the Europeans of the party were suffering severely from the climate, Cameron determined to push on alone, and not return until he had accomplished some new geographical work. Early in 1874 he reached Lake Tanganyika, surveyed its southern half, and settled the existence of an outflow by the Lukuga; then turning north-eastward, he reached the Lualaba in the Manyema country, and attempted to descend the river. He could not, however, overcome the difficulties in the way, and turning southwards again, made his way by slow stages suffering greatly in health, to the west coast at Benguela. Here he arrived in November 1875, at the very time when Stanley, more fortunate, was on his march westward from Uganda to finally solve the great problem of the Congo. In 1877 Cameron published his book, "Across Africa," and received various marks of public approval for his services, including his promotion to the rank of Commander, a C.B., the degree of D.C.L. from Oxford, and the gold medal of the Royal Geographical Society. In 1882 he visited the Gold Coast, in company with Sir Richard Burton, on a commercial mission, and during his later years he became more and more deeply interested in various trading companies engaged in the exploitation of Africa. Captain Cameron was respected as an authority on Central African affairs, and took a prominent place, both in this country and in France, in promoting new enterprises.

NOTES.

A FAMOUS physician and physiologist has just passed away. We allude to Dr. Brown-Séquard, of the Paris Academy of Sciences, whose death occurred on Sunday night. Dr. Séquard was born at Port Louis, Mauritius, in 1817, and was, therefore, seventy-seven years of age at the time of his death.

WE regret to record the death of M. H. C. G. Pouchet, Professor of Comparative Anatomy at the Paris Museum of Natural History, at the age of sixty-one. He became assistant-naturalist and head of the anatomical department of the museum thirty years ago, and in 1870 was appointed to the chair he occupied up to his death. He was the author of numerous works of scientific value, among which may be mentioned his "Traité d'Ostéologie Comparée," published in 1889.

PROF. ROBERTSON SMITH has also passed away at the early age of forty-eight.

THE following deaths have recently occurred abroad:—Dr. W. H. Delffs, Professor of Chemistry in Heidelberg University, Dr. G. A. Weiss, Professor of Botany at Prague, and Dr. F. Ulrich, Professor of Mineralogy and Geology in Hanover Polytechnic.

THE Royal Meteorological Society's fourteenth exhibition o instruments, which will open on Tuesday next in the rooms of the Institution of Civil Engineers, 25 Great George-street, Westminster, will be devoted mostly to instruments, drawings, and photographs relating to the representation and measurement of clouds. The exhibition promises to be a very interesting one, and will include original cloud sketches by Luke Howard, as well as photographs of clouds by the highest authorities in various parts of the world. The exhibition will remain open till the 20th inst.

THE eleventh International Medical Congress was formally opened by the King of Italy on March 29. It is said that the congress includes more than six thousand members. The President, Prof. Baccelli, delivered the inaugural address in Latin, and dwelt on the importance of the "great and solemn festivals of science." Prof. Virchow, speaking as the President of the tenth International Congress, held at Berlin in 1890, expressed the thanks of the members of the eleventh congress for the warmth of the welcome extended to them by the city of Rome and by Italy. The *British Medical Journal*, to whom we are indebted for this information, contains a number of portraits of some of the officers of the congress and readers of addresses, among them being an excellent one of Prof. Michael Foster. Members of the Congress were invited to a garden party in the Quirinal Gardens on Monday, and in this and other ways the King of Italy and the Italian Government have shown their interest in the meeting. Foreign visitors must marvel at the different way things are managed here, where the Royal Family and Government generally ignore them.

INFORMATION has been received, through Reuter's agency, that the members of the International Sanitary Conference met on April 2, at the Ministry for Foreign Affairs in Paris, as a private committee, to collate the different copies of the text of the convention. The instrument was to have been signed on Tuesday by the plenipotentiaries of all the Powers, except the representatives of Turkey. A very complete scheme has been formulated in order to diminish to the utmost any chance of the cholera being conveyed to Europe by means of the Indian pilgrimages to the Hedjaz, and also to improve the unsatisfactory conditions to which pilgrims are exposed in the Red Sea and Arabia, both on the outward and homeward journeys. These changes will involve a complete reorganisation of the sanitary stations now controlled, and the creation of a number of hospitals and refuges at Jedda, Mecca, and elsewhere. With the exception of Turkey, all the countries represented at the congress, including Persia, are unanimous in their decisions.

DR. G. S. TURPIN, of the Storey Institute, Lancaster, has been appointed principal of the Huddersfield Technical School.

PROF. O. MATTIROLO has been appointed Extraordinary Professor of Botany and Director of the Botanic Garden at the University of Bologna.

WE learn from the *Journal of Botany* that the first volume of the *Conspectus Floræ Africæ*, by M. Durand and Dr. Schinz, will shortly appear.

PROF. GUIDO CORA, of the Royal University of Turin, is representing the Société d' Anthropologie de Paris at the International Medical Congress, now being held in Rome.

DR. H. KAYSER, who, with Prof. Runge, has carried out some important spectroscopic researches, has been appointed Professor of Physics at Bonn University, in succession to the late Prof. Hertz.

IT has been decided by the Veterinary Section of the Wurtemberg Academy of Medicine to establish a laboratory for the preparation of vaccines by Pasteur methods. The laboratory will bear Pasteur's name.

THE Rouen Académie des Sciences, Belles-lettres, et Arts, offers a prize of five hundred francs to the author of the best work on a new method of accurately measuring high temperatures, or for the improvement of one of the methods already known.

THE Liverpool Library Science and Arts Committee have received an anonymous offer of £5000 towards the cost of erecting central buildings for the School of Science, Technology, and Arts, on condition that the Corporation subscribe a like amount.

MR. J. JENNER WEIR, the well-known entomologist, died on March 23, in his seventy-second year. He became a Fellow of the Entomological Society fifty years ago, and was also a Fellow of the Linnean, the Zoological, and other Societies. His first paper was contributed to the *Zoologist* in 1845; his last appears in the April number of the *Entomologist*. As an enthusiastic worker, and an acute observer, he was esteemed by all, and by his death natural history suffers a severe loss.

MR. GEORGE PYCROFT died at Torquay a few days ago. He was one of the founders of the Devonshire Association for the Advancement of Science and Art.

MESSRS. BALY AND CHORLEY have devised a high temperature thermometer, the novelty of which consists in the replacement of mercury by the singular liquid alloy of potassium and sodium. The boiling point of this alloy lies somewhere in the neighbourhood of 700°, and its solidifying point is −8°, so that between these limits the liquid is particularly suitable for thermometric use. In order not to inconveniently lengthen the thermometer, the graduations are caused to commence at 200°, the bore for this purpose being widened just above the bulb. The space above the alloy is filled with pure nitrogen at such a pressure that when the glass begins to glow, and therefore soften, the interior pressure shall be equal to the atmospheric, and thus any tendency to alteration of volume avoided. The alloy exerts a slight action upon the glass at a red heat, causing a browning, but after the first heating during the preparation of the instrument the action ceases, the stained interior surface resisting further action. It is only necessary to heat the bulb and a small portion of the stem, for the coefficient of expansion of the alloy increases with the temperature in such a manner as to compensate for the error due to the portion not heated. The graduations are thus equidistant, and various points in them are determined by immersion of the lower portion of the instrument in the vapour of high boiling substances whose temperatures of ebullition have been well ascertained. The instrument should be a very useful one for the determination of high boiling points.

THE "Hand-Guide to the Royal Botanic Gardens, Péradeniya," prepared by Mr. Henry Trimen, F.R.S., the Director, contains some interesting information. The gardens were opened in 1821, six years after the final occupation of the Kandyan Kingdom by the English. A plan for a proper botanical garden in Ceylon was drawn up by Sir Joseph Banks as far back as 1810, the site chosen being Slave Island, Colombo. Mr. W. Kerr took charge of this establishment in 1812, but he died two years later, and was succeeded by Mr. Alexander Moon. It was during Moon's rule that the gardens were moved to the present site at Péradeniya. Moon was a diligent student of the flora of Ceylon, and published a valuable work upon it, but after his death, in 1825, a succession of more or less unqualified persons were placed in charge. With the appointment in 1844, however, of Mr. George Gardner, the gardens started on the active, independent, and useful existence which they have since maintained. Mr. Gardner died in 1849, and was succeeded by Dr. Thwaites, who kept Péradeniya in a high state of efficiency for more than thirty years, and died at Kandy in 1882, having never left the island since his arrival. The present director has held his position since 1880.

A PAMPHLET has been published by the observatory of Villa Colon, near Montevideo, containing the results of rainfall observations for the ten years 1883-1892, computed by the Rev. L. Morandi. The mean annual fall is 35·3 inches; the maximum and minimum values for each month show that they varied from 11·7 inches in January 1889 to 0·0 inch in August 1886, whereas the normal values for these months are 3·4 inches and 3·5 inches respectively. The greatest fall in one day was 3·15 inches, on January 26, 1889, while on the 6th of the same month 1·9 inch fell in 2¼ hours. The number of days on which rain fell in the year varied from 68 to 109. The greatest number of consecutive rainy days was 9, and of dry days 38; the greater quantity falls in the early morning. Other tables show the relation between the rainfall, atmospheric pressure, and wind.

AN extremely brilliant aurora borealis was observed on March 30. The Hon. Rollo Russell saw the display from Haslemere. In a letter to us, he says:—"A bluish-white illumination, like late twilight, was first noticed in the north-west, and this continued with little variation for about fifteen minutes, namely, from 10.15 to 10.30 p.m. A red streamer then shot up towards the zenith, and was for about half a minute rather well-defined, but afterwards gradually became fainter and broader. A considerable amount of pale white light remained in the north-west at 10.40. When the phenomenon was at its brightest, the stars in its direction ceased to be visible." The following particulars, received from Mr. C. E. Stromeyer, of Glasgow, are of interest:—"Luminous (white) rays were seen to converge from all parts of the horizon towards a common centre, which, as nearly as I could gauge, shifted its position as follows:—At 10.30 p.m., 11h. 30m. N. 50°; at 11 p.m., 10h., N. 40°; at 11.30 p.m. the centre was not well defined, and few rays showed themselves." Mr. Stromeyer remarks that at first the centre was occupied by luminous clouds of an irregular streaky nature, which sometimes took the form of spirals. Occasionally waves of light were also seen passing rapidly along the rays *toward* the centre. Mr. Preece, writing to the *Times*, says the aurora was accompanied, as usual, by very strong earth currents on all telegraph lines. At 10·20, a peculiar noise was heard upon a telephone inserted upon a long Irish wire at Llanfairpwll in Anglesey, and at 2 a.m. on Saturday, March 31, "twangs" were heard, as if a stretched wire had been struck.

WE are informed that the fund established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, "for the advancement and prosecution of scientific research in its broadest sense," now amounts to $26,000. As accumulated income will be available in June next, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from this fund, in order to receive consideration, must be accompanied by full information, especially in regard to the following points: (1) Precise amount required; (2) exact nature of the investigation proposed; (3) conditions under which the research is to be prosecuted; (4) manner in which the appropriation asked for is to be expended. All applications should reach the Secretary of the Board of Trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A., before June 1. The following grants have been made, in addition to those contained in the list previously noted in these columns (NATURE, vol. xlv. p. 91): $300 to Prof. E. Wiedemann, Erlangen, for researches on luminous electric discharges; $200 to Prof. S. Exner, Vienna, for experiments with carrier pigeons; $100 to Prof. K. Kobert, Dorpat, for researches on sphacelinic acid and cornutine; $200 to Prof. A. Béchamp, Paris, for researches on the composition of milk; $200 to Prof. E. Drechsel, Leipzig, for researches on bases derived from albumens.

AN ordinary general meeting of the Institution of Mechanical Engineers will be held on Thursday and Friday, April 19 and 20. Prof. A. B. W. Kennedy, F.R.S., will deliver his inaugural address on the former date, after which papers will be read and discussed.

AT the twenty-fifth annual meeting of the Norfolk and Norwich Naturalists' Society, held on March 27, Prof. Robert Collett, of Christiania, and Mr. E. T. Newton, F.R.S., were elected honorary members, and Dr. Charles Plowright was appointed president, in succession to Mr. T. Southwell. It was resolved by the meeting that the society be enrolled as a corresponding society of the British Association.

THE Worthing correspondent of the *Daily Chronicle* says that an unfavourable report upon the results of the trial of M. Hermite's system of treating sewage matter with electrolysed sea-water (see p. 469) has been prepared by Dr. C. Kelly, medical officer of health of the borough and of the combined sanitary district of West Sussex. The report contains the results of chemical and bacteriological analyses made respectively by Dr. Dupré and Dr. Klein. The results of the various tests are set out in detail, and Dr. Kelly concludes:—"Since there is no instantaneous decomposition of fæcal matter and no sterilisation of sewage, I am of opinion that the process, so far as the late trials have gone, has therefore failed to produce the results which are claimed for it by its inventor." This is the first time M. Hermite's system has been publicly tested in England.

Dr. H. R. Mill and Mr. E. Heawood have made a careful bathymetrical survey of Haweswater, thus completing the soundings necessary for the construction of contoured maps of all the larger lake-basins in England. The greatest depth found was 103 feet, rather less than one-third of the depth which local tradition assigned to the lake. Haweswater presents an interesting example of a long narrow lake which has been nearly separated into two sheets of water by the large delta of a mountain torrent, illustrating a stage in the history of such severed lakes as Buttermere and Crummock, or Derwentwater and Bassenthwaite. The temperature of the mass of water in the lake was, on March 26, 39°·7 F. with a surface temperature of 41°·5 in the deep, and 43° in the shallow parts of the lake.

We have received from the Deutsche Seewarte, part vi. of *Deutsche ueberseeische meteorologische Beobachtungen*, containing observations made at six places in Labrador, one at Walfisch Bay, one at Apia (Samoa), four on the east coast of Africa, and one at Chemulpo (Corea). The stations in Labrador were first established in 1882, and furnished a very important addition to the international polar observations made in that year, as they formed a link between the stations in Canada and West Greenland. The establishment of the other stations is mostly due to the efforts made by Germany to extend her colonial possessions, and to the praiseworthy desire of having scientific observations made wherever her countrymen gain a footing. The result is the publication of a valuable series of observations in remote places, made with good instruments, and upon a uniform plan. The readings are made three times daily, while the state of the weather, &c. is represented by international symbols. We think it would add to the value of the work if each part contained the key to these symbols, as they are probably unknown to many persons into whose hands the volumes fall.

In the last Report of the Meteorological Society of Scotland it was stated that an inquiry had been completed into the diurnal variation of the barometer on Ben Nevis during the days of clear weather on the one hand, and days of fog or mist on the other. The results gave two sets of curves essentially different from each other; and as these suggested important applications to other meteorological inquiries, it was resolved to submit the barometric observations at the Fort-William Observatory to a similar discussion. The same days were selected that were used in the discussion for the top of Ben Nevis. At the general meeting of the Society on March 29, the Council reported that the discussion has been completed, with the highly important result that, just as happens at the top, the hourly diurnal curves for clear and foggy weather respectively are essentially different from each other. The result, broadly stated, is that for clear weather, the diurnal curves are strongly pronounced forms of the curves for dry continental climates about the latitude of Fort-William; and those for foggy or misty days strongly pronounced forms of the curves for wet climates on the coasts In similar latitudes. Further, the combination of these curves for widely different types of weather is identical with the curves calculated from all the observations. This resolution of the Fort-William diurnal barometric curve is new to the science and is of the highest importance.

Mr. A. F. Miller has made a spectroscopic examination of the light emitted by the small luminous beetle, *Photinus corruscus* (*Transactions* of the Astronomical and Physical Society of Toronto). The light emitted appears to be of two different kinds. From the lower part of the insect's abdomen a glow of a pale greenish tint, like that of phosphorus or a phosphorescent substance, was pretty constantly visible. This light gave a faint spectrum consisting of a wide green band situated between λ 5160 and λ 5805 approximately. The second kind of light was emitted in flashes lasting generally about a quarter of a second, though sometimes the insect emitted several in quick succession. The source of this light is in the same region of the abdomen, but the luminous intensity is much greater than in the former case. The flash has a pale green colour, and its spectrum is perfectly continuous through the region it occupies, that is, from about λ 5000 to about λ 6605. The specimens examined did not seem to give any emission of blue or violet light, though there might have been faint radiations in this region imperceptible to the eye through the sudden character of the flash, and the overpowering preponderance of the less refrangible waves. It would be of interest to test the action of both kinds of luminosity upon a photographic plate. Mr. Miller's observations go to show that the whole energy devoted by the insects to light-production is expended in originating those rays which powerfully affect the visual organs. They thus support the conclusion of Prof. S. P. Langley, that nature produces the most economic kind of light.

At a recent meeting of the Académie des Sciences (Paris) M. Lippmann presented a paper by M. N. Piltchikoff, on a new method of studying the electric discharge. This method consists in joining one pole of a Voss electric machine to a metallic point which is held over a layer of castor oil contained in a copper dish, connected to the other pole of [the machine. If the point is positively charged a large depression is formed, at the centre of which a secondary depression is seen if the distance between the point and the oil is diminished. If a small screen is placed between the point and the oil, an elevation is produced at the centre of the depression; the shape of this elevation being the same as that of the shadow that would be formed if the electrified point were luminous. The level inside this shadow is the same as that of the unaffected liquid, so that it appears that the screen stops the action and produced an electric shadow. This curious effect is shown in a very striking manner by the employment of mica screens cut into various geometrical forms; in every case the "shadow" formed on the depression was an exact reproduction of the screen. One cannot help being struck with the resemblance of the above experiment to some of those of Prof. Crookes. The same phenomena are produced with the negative discharge. The discharge acts in a very powerful manner, and the phenomena show themselves even when a strong blast of air is caused to play between the point and the oil. Using different gases the author finds that at the ordinary atmospheric pressure the electric shadows are in all cases the same; the only differences obtained were in the secondary depressions which appear when the electrified point is very near the surface of the oil. With very low pressures, however, the shadows are not formed. The author has succeeded in photographing the depressions and the shadows, and has obtained sharp and well-defined negatives with an exposure of about twenty seconds, showing that, at any rate for this length of time, the phenomenon does not change appreciably.

The current number of the *Istituto d'Igiene sperimentale di Roma* contains an exhaustive and very important memoir "Sul veleno del Tetano," by Dr. Fermi and Dr. Pernossi. It covers close upon sixty pages, and records numerous experiments on the behaviour of the toxic soluble products of tetanus cultures under various conditions. Amongst these the action of heat was investigated, and it was ascertained that the tetanus-filtrate diluted with water was deprived of all pathogenic properties when exposed for one hour to 55° C., but when completely desiccated it was still toxic after being exposed for one hour to 120° C. The action of an electric current on its pathogenic properties was also examined, and they were found to be destroyed after exposure for about two hours to a current of about 0·5 amperes. Numerous chemical substances were also investigated. Amongst the gases experimented with, it was found that oxygen, carbonic anhydride and hydrogen produced no appreciable effect even after from ten to fifteen hours' contact.

MESSRS. SAXON AND CO. have published a useful little book, entitled "Everybody's Guide to Gardening," by Mr. H. H. Warner.

DR. THOMAS LYNN'S "Health Resorts of Europe" (Bristol: John Wright and Co.), being a guide to the mineral springs, climates, mountain and sea-side stations of Europe, has reached a second edition.

THE Calendar of the Royal University of Ireland, for the year 1894, has just been published. The papers set at the examinations in 1893 are published in a separate volume, forming a supplement to the Calendar.

THE Botanical Exchange Club of Vienna has issued an extensive list of specimens of rare plants, which it is ready to exchange or sell. Several new species are also described. The list may be obtained from Herr J. Dörfler, of I. Burgring 7, Vienna.

DR. J. W. MOLL, the Director of the Botanic Garden at Gröningen, publishes (in French) a list of forty-two species of Papaveraceæ grown in the Garden, three of which are probably hybrids. Seeds of a large number of the species are offered to other horticulturists.

WE have received the number of the *Journal of the Royal Horticultural Society* for January. Besides extracts from the *Proceedings* of the Society and its committees, it contains reports on the growth of a number of garden plants and vegetables at Chiswick, and papers by specialists on various subjects interesting to horticulturists.

Dr. C. V. RILEY, of Washington, has sent us a paper on "Parasitic and Predaceous Insects in applied Entomology," and one entitled "Further Notes on Yucca Insects and Yucca Pollination." The pollination of *Yucca Whipplei* by *Pronuba maculata* is described in detail. In another paper he describes two new species of *Megastismus*, a genus of Chalcididæ which is essentially parasitic, chiefly on gall-making Cynipidæ.

MR. A. E. MUNBY has prepared a pamphlet entitled "Notes on Polarised Light, for Students of Mineralogy," and published by Messrs. Reid, Sons, and Co., Newcastle-on-Tyne. In the twenty-eight pages, of which the pamphlet consists, an elementary description is given of the optical principles utilised in the construction of the polariscope, and of phenomena observable with that instrument used as an adjunct to the microscope. The notes should be of use to elementary students of mineralogy, for they contain clear explanations of the various points connected with the classification of crystals according to their optical symmetry.

SOME years ago Liebig wrote to the Royal Agricultural and Commercial Society of British Guiana: "There cannot be a more beautiful and striking exemplification of the genuine British spirit than the disposition shown by the most distinguished and best-informed men in the remotest parts of the great empire to form themselves into Societies, which have for their object the extension, promotion and application, for the public good, of scientific principles." On March 18, the Society to which these words were addressed attained its jubilee, and in view of this fact a short account of its establishment and work is given in the current number of its excellent journal, *Timehri*. In addition to this description, the journal contains a long paper, in which Mr. Edward F. im Thurn details the incidents of one of his journeys into the far interior of Guiana.

WHEN the Natural History Society of Rugby School was founded in 1867 it was laid down that the objects for which it was established were (1) to work out the natural history of Rugby; (2) to keep an annual register of all facts connected with natural history observed there; (3) to assist in the formation of a museum for reference; (4) to hold meetings for the reading and discussion of papers on scientific subjects. The report just issued by the Society shows that most of the original objects were faithfully carried out during 1893. The members of the botanical section have worked well, and, thanks to their exertions, have prepared a useful list of Rugby mosses. In the entomological section, also, good work was done. The report includes an observation list of Rugby Lepidoptera, containing 293 species, of which six are new to the district, and Mr. F. D. Morice contributes some additions to his list of Hymenoptera. Up to December of last year he had found upwards of 140 species of Aculeates in the Rugby neighbourhood. Other sections of the Society concern themselves with zoology, archæology, geology, photography, and meteorology. The report not only contains the proceedings of these sections, but also a brief statement of the observations made at the Rugby Observatory, and several papers read at the meetings. We have also received the last report of the Epsom College Natural History Society. Such societies deserve the greatest encouragement, and the only matter for regret is that their work is not found interesting to a larger proportion of the schools to which they belong, instead of being left to a few enthusiasts.

A DETAILED account of his investigations concerning the gaseous fluorides of the simpler organic radicles is contributed by M. Meslans to the March number of the *Annales de Chimie et de Physique*. The fluorides of methyl and ethyl have already been fully described by M. Moissan and other workers, and the fluorides now described are those of the radicles propyl, isopropyl, allyl, and acetyl, together with the interesting analogue of chloroform, fluoroform. Propyl fluoride may be obtained by reacting with the corresponding chloride, bromide, or iodide upon anhydrous fluoride of silver. The iodide is most convenient as it reacts at the ordinary temperature, while propyl bromide requires heating to the neighbourhood of 100°, and the chloride to a still higher temperature. The reaction between propyl iodide and silver fluoride may be best carried out in a copper tube immersed in tepid water. The propyl iodide is admitted to the tube already containing the silver fluoride from a dropping funnel, and the gaseous product of the reaction passes upwards through a leaden condensing worm, cooled by iced water, and subsequently through three U-tubes containing fragments of silver fluoride, and finally through a delivery tube to the mercury trough over which the gas is to be collected. The reaction does not simply result in the formation of propyl fluoride and silver iodide. A third substance is produced, a red solid substance which is found to be an iodo-fluoride of silver of the composition Ag_2FI. The amounts of propyl fluoride and of the latter substance obtained correspond to the equation

$$C_3H_7I + 2AgF = C_3H_7F + Ag_2FI.$$

Propyl fluoride is a colourless gas possessing an odour similar to that of the analogous chloride. It burns with a brilliantly luminous flame forming aqueous vapour, carbon dioxide, and hydrofluoric acid. It liquefies at -3° at the ordinary pressure to a colourless mobile liquid which is without action upon glass. The difference of boiling point between this liquid and propyl chloride ($+45^\circ$) is 48°, about the same as that between ethyl fluoride and chloride, and almost twice as great as that between the chlorides and bromides of the two radicles. The gas is decomposed by melted sodium, with sudden and brilliant incandescence accompanied by deposition of carbon. It is soluble in water to the extent of one and a half times the volume of the latter. Isopropyl fluoride and allyl fluoride are prepared in a similar manner from the corresponding iodides. They are both gaseous substances capable of condensation to liquids by reduction of temperature or augmentation of pressure. A mixture of allyl-fluoride with four times its volume of oxygen explodes with great violence under the agency of an electric spark, or when brought in contact with a flame.

Fluoroform, CHF_3, has been prepared in the pure state by M. Meslans only after repeated unsuccessful attempts. When free fluorine from the platinum delivery tube of the electrolysis apparatus is allowed to escape into chloroform an energetic reaction occurs, chlorine is liberated, and in a few moments an explosion is produced, with copious formation of carbon tetrafluoride and fluoroform. If the fluorine is caused to enter a vessel containing air charged with vapour of chloroform an immediate explosion is produced. When finely-powdered silver fluoride and iodoform are mixed a vigorous reaction also occurs, usually with incandescence, and the fluoroform produced is contaminated with other gaseous products. The reaction may be modified, however, by adding chloroform and cooling with ice, and the gas may be purified from chloroform by passing through alcoholic potash, which is without action upon fluoroform, from carbonic oxide, which is usually present in small quantity, by means of a solution of cuprous chloride in hydrochloric acid, followed by desiccation over fused potash, and finally from last traces of impurities by passage over silver fluoride heated to 150°. The gas thus treated is pure fluoroform, a gas which liquefies at 0° under a pressure of twenty atmospheres. It is incombustible, but imparts a bluish-green colour to a Bunsen flame when injected into it. It is insoluble in water, and possesses an odour similar to but feebler than that of fluoroform. The action of free fluorine upon it is interesting. A flame is produced at the end of the platinum tube delivering fluorine, and the one atom of hydrogen contained in the fluoroform is extracted and converted into hydrofluoric acid without any deposition of carbon, the latter element being at the same time entirely converted to the gaseous tetra-fluoride.

The additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*) from India, presented by Mr. W. Chrystal; a Squirrel Monkey (*Chrysothrix sciurea*) from Brazil, presented by Mrs. E. M. Parkinson; two —— Bears (*Ursus* sp. inc.) from the Caucasus Mountains, presented by Mr. Arnold Pike; a Striped Hyæna (*Hyæna striata*) from North-west Africa, presented by Señor Don. D. M. Macleod; a Kinkajou (*Cercoleptes caudivolvulus*) from South America, presented by Mr. A. Murray; a Hairy Armadillo (*Dasypus villosus*); a Common Teguixin (*Tupinambis teguixin*) from h America, presented by Captain W. Clift; an American Turkey (*Meleagris gallo-pavo*) from North America, presented by Mr. Blayney Percival; two Pink-footed Geese (*Anser brachyrhynchus*), British, presented by Colonel W. H. Feilden; a Greek Tortoise (*Testudo græca*), European, presented by Mr. George Hollis; a Green Tree Frog (*Hyla arborea*), European, presented by Mr. Thomas Plowman; two —— Pittas (*Pitta* sp. inc.) from Australia, purchased.

OUR ASTRONOMICAL COLUMN.

The Reckoning of the Astronomical Day.—The Canadian Institute, in co-operation with the Astronomical and Physical Society of Toronto, have for some time had under consideration the subject of astronomical time reckoning, and last May the joint committee appointed sent out a circular-letter for the purpose of obtaining the views of scientific men interested in the matter. Answers were invited to the following question:

"Is it desirable, all interests considered, that on and after the first day of January 1901, the Astronomical Day should everywhere begin at mean midnight?" At the present time, as all astronomers know, the astronomical day is reckoned from mean noon to mean noon, and is 12 hours behind the civil day. Hence, if the proposed change were adopted, the only difference between astronomical and civil times would be that the former would have a twenty-four hour, and the latter a twelve-hour notation. The astronomical day would therefore be identical with the universal day, reckoning from 0 to 24 hours, and commencing at midnight. From the fourth annual report of the Toronto Physical and Astronomical Society, it appears that 170 answers to the question had been received. Of these, 107 were in the affirmative, and 63 in the negative. Twenty-one astronomers in the British Islands thought the change desirable, and four were against it. In the United States, twenty-eight astronomers favoured the departure from present custom, and ten opposed it. German astronomers are strongly against the suggested change, as many as thirty-one replying in the negative, while only seven sent affirmative answers. In fact, Germany was the only country which furnished a majority of negative answers. Most of the replies received were simply in the affirmative or in the negative, but many were qualified in some respect. All the categorical replies were in English, and of the answers received from foreign countries, with notes written in English, five were from Germany, four from Italy, four from Austria, and one each from Russia, France, Norway, Holland, and Colombia. As Miss A. A. Gray, who compiled the answers, points out, this shows that the English language is rapidly becoming an international medium for the communication of scientific information.

The Height of an Aurora.—Among the many interesting communications to the Astronomical and Physical Society of Toronto during the year 1893, and contained in the volume of the *Transactions* just received, is one by Mr. Arthur Harvey, on the widely observed aurora of July 15. During the display, an arch of auroral light rolled up out of the north, and passed the zenith of Toronto, spanning the sky from east to west. Its width was fairly uniform, being from 5° to 7°. After lasting for several minutes, its continuity broke up in the east, it wavered at the zenith, and soon vanished. Fortunately, Mr. G. E. Lumsden saw the arch break up and vanish in the same manner. He was at Bala, 110 miles north of Toronto, and saw the arch projected across the constellation Aquilla, at a point some five degrees north of the celestial equator, or 40° south of the zenith. At Toronto, Mr. Harvey saw the same arch at the same time lying across Lyra, at a point about 10° south of the zenith. From these observations the perpendicular height of the arch was found to be 166 miles, and its breadth about 15 miles. If the arch maintained an equal height above the earth, its ends were 1150 miles away, so that the magnificent sight was presented of an auroral belt in the sky with 2300 miles between its two extremities.

An Annular Eclipse of the Sun.—There will be an annular eclipse of the sun to-morrow, which, however, will not be visible in this country. It will be seen as a partial eclipse in Norway and Sweden, Eastern Europe, and Asia; and as a central one along a line starting from a point in the Indian Ocean, crossing India a little north of Madras, passing through Calcutta, Upper Burmah, China, and Eastern Siberia. The central eclipse begins at 2.24 a.m. Greenwich mean time, in longitude $53^\circ 48'$ east, latitude $6^\circ 51'$ north, and ends at 5.23 a.m. in longitude $157^\circ 38'$ west, latitude $62^\circ 48'$ north. The greatest duration of annularity will be about 32 seconds. An eclipse of this kind excites but little scientific interest, the chief observations of value being those of the times of the four contacts.

THE SATELLITE OF NEPTUNE.

THE planet Neptune is now in the constellation Taurus, a little to the north-east of Aldebaran; so the following free translation of a paper on its satellite, read by M. Tisserand to the Société Astronomique de France in February, and reprinted in the March number of *L'Astronomie*, is of interest at the present time.

Less than a month after Galle discovered Neptune[1] in the place assigned to it by Le Verrier, Lassell suspected the existence of a small satellite, and confirmed his suspicion in 1847. This body is very faint, being of the fourteenth magnitude, and a large telescope is required in order to see it. According to Pickering's photometric observations, its size is about the same as that of our moon, but it is 12,000 times further removed from us, and hence the light we receive from it is very dim.

It is well known that the satellite is in retrograde motion round Neptune, in the same way as the satellites of Uranus. In this respect these two planets on the borders of the solar system strikingly differ from the others. Comparing Neptune with other planets, it would be expected that he would possess more than one satellite, but though many scrutinies have been made with powerful telescopes, particularly that at Washington, no one has found a new attendant.

Neptune's moon is not troubled by the motions of companion satellites, so it ought to present a movement of great simplicity, rigorously realising the geometrical movement considered by Kepler. In fact, some astronomers have proposed to use the satellite as a means of testing the uniformity of certain movements in the planetary system. The body would constitute a clock of marvellous precision, and with nothing apparently to put it out of order. Accumulated observations have, however, brought to light a singular fact with regard to the satellite's orbit. Five or six years ago, Mr. Marth pointed out that observations made from 1852 to 1883 showed that the orbit was being slowly displaced in a certain direction, its inclination to the plane of Neptune's orbit during this period of thirty-one years having increased by about five degrees—an amount too great to be ascribed to errors of observation. What is more, the observations made by H. Struve with the great refractor at Pulkova, during the last ten years, confirm this variation, both as regards its direction and amount. This being so, the question arises as to the cause of the disturbance.

There can be no hesitation in attributing the change to the oblateness of the planet. The amount of polar compression has not yet been determined by direct measurement, and it will doubtless escape detection for some time to come. This is because the disc of Neptune only subtends to us the small angle of about two seconds of arc, and if the oblateness were, say, 1/100, the ellipticity of the disc would be beyond our perception.

But in order to account for the changes established by observation, it is necessary to take other matters into consideration. If the plane of the orbit of the satellite coincided with the equator of the planet, there would be no reason why this coincidence should not be maintained indefinitely. It seems, however, that the two planes are inclined at a certain angle, and it can be demonstrated that in this case the orbital plane must be displaced with respect to the equatorial one, while the angle between the two remains constant.

If the poles of these two planes are supposed to be projected upon the celestial sphere, the former will move uniformly round the latter in a circle, and by the accumulation of observations for two or three centuries, the position of this circle could be very accurately determined. The centre of the circle would be above the north pole of the planet; so by this means it becomes possible to determine the direction of the polar axis—a datum which, as we have seen, cannot be determined directly. The facts at present at the disposal of astronomers are insufficient for the purpose of doing this. It appears probable, however, that the angle referred to is from twenty to twenty-five degrees, and the oblateness less than 1/100. Prof. Newcomb, without going into detailed calculations, has assigned the same cause to the phenomenon.

The fifth satellite of Jupiter, discovered by Prof. Barnard in 1893, ought to exhibit a similar change to that undergone by Neptune's attendant. It does not appear that the four larger Jovian satellites are able to disturb the new one in an appreciable manner; in this case, moreover, the large oblateness of Jupiter must be taken into consideration. But the oblateness produces another effect. It may not modify the position of the orbit of the satellite because this small body revolves in the plane of the planet's equator, but it may cause the orbit to turn in its plane, and calculations show that it ought to produce a complete turn in about five months. If, therefore, this orbit is not exactly circular, but ever so little eccentric, a time must come when the satellite must appear at a greater distance from the east than from the west limb of the planet, and this is what Prof. Barnard has actually observed. But seventy-five days after these distances must be reversed, for the greater distance should then be from the west limb. It is to be hoped that future observations will decide this point. The effect referred to ought also to be shown by the satellite of Neptune, though it is much less pronounced than the change of the orbital plane; nevertheless, its determination will not be long delayed.

[1] Neptune was looked for and found by Galle on September 23, 1846; the satellite was discovered by Lassell on October 10 of the same year.

SCIENCE IN THE MAGAZINES.

SCARCELY a month passes but what we have to notice astronomical articles in the magazines, a fact which testifies to the interest taken in all that appertains to star-gazing. The *Century* contains an article of this kind, entitled "A Comet-Finder," by Mr. F. W. Mack, and recounting the ways and work of Mr. W. R. Brooks, well known among astronomers as the discoverer of numerous comets. The title of the article is rather misleading, for while it refers to the man, it is apt to be confounded with the instrument he uses. From the article it appears that Mr. Brooks was born at Maidstone, in 1844, and went to America when he was thirteen years old. In 1870 he settled in Phelps, sixty miles from Syracuse, where he became the village photographer. Like many other notable astronomers, Mr. Brooks made his own telescopes. His first comet was discovered in 1881 with a five-inch reflector constructed by himself, and shortly afterwards he made the nine-inch silver-on-glass Newtonian instrument, with which, up to 1888, he discovered ten comets. Mr. Brooks then removed to Geneva, N.Y., to take charge of the Smith Observatory, which possesses a two-inch refractor. During his residence there he has discovered eight comets, four of them within less than one year. The total number of his discoveries is now nineteen. The article is illustrated by a photograph of Mr. Brooks, and views of some of the comets found by him. Under the title, "Driven out of Tibet," Mr. W. W. Rockhill describes an attempt made by him in 1891–92 to pass from China through Thibet into India. Mr. G. E. Waring discusses the different methods of sewage disposal, under the heading "Out of Sight, out of Mind." He favours an irrigation system similar to that used at Wayne, Pennsylvania. From an excellent article on "Forest Legislation in Europe," by Mr. B. E. Fernow, we obtain the following facts. In Germany, contrary to general opinion, laws regarding the use of private forest property are less stringent than among other nations who have paid attention to the matter. In Prussia, which represents two-thirds of Germany, private forests are absolutely free from governmental influence. In Saxony no State control exists. Other States differ in their laws regarding forest property. Of the private forests, seventy per cent. are without any control whatever, and thirty per cent. are subject to slight supervision. In Austria, however, the status of forest legislation is very different, a strict supervision being exercised not only over forests owned by communities, but also over those belonging to private individuals. To ensure a rational management of the forests, the owners of large areas must employ competent foresters whose qualifications satisfy the authorities, opportunity for the education of such being given in eight schools of forestry. In Hungary and Italy also the control of private forest property is vested in the State. In Russia, until lately, liberty to cut, burn, destroy, and devastate forests was unrestricted, but in 1888 a law came in force which, to some extent, put an end to this liberty of vandalism. The Russian Government now sustains twenty-four schools of forestry. A federal law was passed in Switzerland in 1876 giving the federation control over the forests of the mountain region, embracing eight entire cantons and parts of seven others, or over one million acres of forest. The employment of educated foresters is obligatory, and to render this possible, courses of lectures to the active foresters are instituted in the cantons. There is also an excellent forestry school at Zurich. In France not only does the State manage its own forest property in approved manner, and supervise the management of forests belonging to communities and other public institutions, but it extends its control over private forests by forbidding any clearing except with the consent of the forest administration.

Sir Robert Ball commences a series of articles on "The Great Astronomers" in *Good Words*, the subject of his sketch this month being Tycho Brahe. Dr. Dreyer's book on "The Life and Work of Tycho Brahe" has furnished the author with most of his facts, so the article can hardly be abstracted, and there is nothing in it to comment upon. Mrs. Percy Frankland contributes an article entitled "Half an Hour with the Microbes," and manages to compress a large amount of information in a few pages. An article by Sir Herbert Maxwell, headed "Assisted Sight," will be found interesting to Selbornians, for it deals with the sights of bird-life and movement which a spy-glass reveals to him who will be at the trouble to carry it.

A passing notice must suffice for the other magazines received by us.

In *Longman's*, Mr. C. T. Buckland, a cousin of the late Frank Buckland, describes some of his personal experiences with alligators, and W. Schooling recounts some of the myths and marvels concerning the Pleiades. Lord Lilford writes upon the destruction of wild birds in the *National Review*. He considers that the legal protection of eggs under specific names is impracticable, if not utterly impossible. The *National* also contains an article of interest to nature lovers, by "A Son of the Marshes." Two articles of more or less scientific interest appear in *Chambers's Journal*, one on "The Smoke Problem," the other on the new powder, Amberite. Mr. Phil Robinson contributes to the *Contemporary* a description of natural objects in spring, in which poetical fancy is happily blended with scientific observation. Serpent-worship, and the serpent's strange appearance and manner of progression, is Mr. W. H. Hudson's theme in the *Fortnightly*. Mr. R. B. Anderson describes, in *Scribner*, a winter's journey up the coast of Norway, and Mr. Morley Roberts writes on cannibalism in the *Humanitarian*.

DUST AND METEOROLOGICAL PHENOMENA.[1]

IN this communication are given tables containing over 1000 observations of the dust particles in the atmosphere, along with simultaneous observations on other meteorological phenomena, made by the author during the years 1891, 1892, and 1893. In Parts i. and ii. on the same subject are nearly 500 similar observations, made at the same places, during the two preceding years; so that there are in all now over 1500 observations of atmospheric dust, to produce which required the testing of over 15,000 samples of air. With such a number of observations it seemed not unreasonable to expect that more definite results could now be worked out than were possible before.

At the beginning of the paper reference is made to observations made in the south of France, at Hyères, Cannes, and Mentone. After this the observations made at the Italian lakes are described. At none of the places in these districts was very pure air ever met with. No air with a smaller number of particles than 600 per c.c. was tested.

At Baveno, in addition to the usual test at low level, a number were made at different elevations on the slopes of Monte Motterone, with the following results. With the wind blowing up the slopes, the means of seven observations gave the following number of particles per c.c. at the different levels :—

At low level.	At 1000 feet.	At 1500 feet.	At 2000 feet.
4857 ...	4750 ...	3430 ...	3125

And the mean values of eight observations when the wind did not blow up the slopes :—

At low level.	At 1000 feet.	At 1500 feet.	At 2000 feet.
4743 ...	3270 ...	2195 ...	1453

Thus with the wind blowing up the slopes, and carrying up the impure air, the amount of dust at 2000 feet was only reduced to 0·64 of the number at low level, while if the wind was from other directions it was reduced to 0·3.

The observations made on the Rigi Kulm during three visits, of a week each, in the different years are then discussed, and the conditions existing during each day described separately, along with the different meteorological phenomena witnessed on the different days. The conclusion arrived at in the previous visits as to the exaggerated descriptions given by many writers, of the beauty of the colouring on earth and sky seen at high level at sunrise and sunset, is entirely confirmed. During the visit, in the five years no colouring at sunrise or sunset has been witnessed from the Rigi equal to what is frequently seen at low level.

The observations show that the sunset colours depend very much on the amount of dust in the air. When the atmosphere is comparatively free from dust the colouring is cold, but the lighting is clear and sharp; and when there is much dust, there is more colour on the mountains and clouds, and in the air itself, and the colouring is warmer and softer. At high level the colouring is not only more feeble, but it is also of shorter duration. A thick veil of haze seemed to hang in the air between the observer and the mountains on all days when the number of particles was great, and it became very faint when the number was small.

The paper then proceeds to investigate the effect of the direction of the wind on the number of particles at this station, and discusses the conditions with the aid of the dust observations and the weather charts of Switzerland—the general air calculation over Switzerland being obtained from the reports of the high level observatories, namely the Santis, St. Gothard, and Pilatus, and low level currents from the reports of the low level observing stations. The results of this investigation are summed up in two tables. In one of these tables are given the highest and lowest numbers observed when the wind was southerly and blew from the pure area of the Alps; and in the other, the observations when the wind was from the inhabited parts of Switzerland. The following are the means of all the observations :—

Direction of wind.	Highest number.	Lowest number.	State of the air.
Wind from Alps ...	1305 ...	421	Clear to very clear.
Wind from plains ...	5756 ...	1063	Medium to thick.

The condition of the air on the occasions of the different visits to the Rigi varied greatly. During the visit in 1889, the wind always blew from the Alps, the number of particles was low, and air very clear. During the visits in 1892 and 1893, the wind never blew steadily for any length of time from the pure direction, the air was always much hazed, and the number of particles great.

The effect of the amount of dust on the transparency of the air on the Rigi is then discussed. The above table, showing the effect of the direction of the wind on the number of particles, also shows the effect of the dust on the transparency. On all days when the wind was southerly, and the number of particles low, the air was clear, or very clear; whereas when the wind blew from the plains, and the number went high, the air was always greatly hazed. The effect of the dust on the transparency is then shown in another way, the result being given in the following table, in which are entered the number of times Hochgerrach was visible, and the condition of the air at the time as regards haze, dust, and humidity :—

Number of times visible.	Amount of haze on Hochgerrach.	Number of particles per c.c.	Wet bulb depression.
8 ...	$\frac{1}{4}$ to $\frac{1}{2}$ ...	326 to 850 ...	3° to 10°
2 ...	$\frac{3}{4}$ ...	1375 to 1575 ...	6°·5 to 8°
3 ...	Just visible ...	1825 to 2050 ...	4° to 6°·5

Hochgerrach is situated at a distance of about seventy miles from the Rigi, in an easterly direction; its visibility, therefore, may be taken as an indication of very clear air. The above table shows that it was visible on thirteen occasions. On eight of these it was only from $\frac{1}{4}$ to $\frac{1}{2}$ hazed, and the number of particles was at a minimum. The table also shows that as the number of particles increased the haze also increased, and at last the mountain became invisible when the number went a little over 2000 per c.c. As the number of particles frequently remained above 2000 for days at a time, Hochgerrach could only be seen at intervals.

The paper then passes on to consider the daily maximum on

[1] Abstract of paper read before the Royal Society of Edinburgh, by John Aitken, F.R.S., on February 19. (Communicated by permission of the Council of the Society.)

the Rigi. The daily maximum does not appear on all days; winds from pure directions generally prevent it, either by checking the ascent of the valley air, or by the valley air being pure, or by the pure valley air not being much heated by the sun, and therefore having but little tendency to rise. The daily maximum is very marked when the wind is from the plains. The hour at which the rise in numbers begins and the hour of maximum are very irregular. Sometimes the rise begins in the morning, but sometimes it is the afternoon before it puts in its appearance. The maximum number is generally attained some time in the afternoon, if not checked at an earlier hour by change of wind, or by clouds. The amount of the daily maximum varies greatly; sometimes it is only two or three times the morning number, but it has been observed as much as eight times.

While on the Rigi the author had frequent opportunities of observing the well-known tendency of Pilatus to be shrouded in cloud. The clouding was frequently observed to extend down the slopes far below the level of the Rigi Kulm, while the Rigi kept free of cloud. It is shown that this greater cloudiness of Pilatus is only what might be expected from the nature of the surroundings. The Rigi is a true isolated mountain, whereas Pilatus is not, though it looks quite as isolated as the Rigi from many points of view. It is, however, only the terminal peak of a very long wall of mountains extending in a westerly direction for about twenty-five miles. As the upper ridges of this wall are from 6000 to 7000 feet high, all winds from the north and west are compelled to rise when they meet this barrier, and in rising condensation takes place; whereas winds from all directions can pass on all sides of the Rigi, and are not compelled to rise to the same amount. It is well known that the north and west winds cause Pilatus to be clouded, and these are the winds specially compelled by the Pilatus range to rise and to form clouds.

The observations made at Kingairloch, in Argyllshire, are then described, along with a parallel series of observations made at the same hours on Ben Nevis. Diagrams are given showing the conditions at the two stations during July in the different years. Attention is first drawn to some very abnormal dust readings obtained at Kingairloch. During north-west winds the number of particles is generally very low, but on the afternoons of some days the numbers went high. It was found that these abnormal readings were always accompanied by certain conditions of weather: if the sky remained completely clouded all day, the numbers were always low during the whole of the day; but, on the other hand, if breaks formed in the clouds, the number began to rise, and the increase was very much in proportion to the amount of clear sky. It is also shown that these abnormal readings came far more frequently with anticyclonic than with cyclonic circulation; but as these are the conditions which bring more or less cloudy skies, they do not seem to have much influence in themselves. Tests were made to see if the abnormal readings were due to local impurity, but no evidence of this could be obtained. The fact that they come and go with sunshine seems to negative any such idea; at least, if they are local, they must be of a nature of which at present we know nothing. It is suggested that it may be possible that sunshine under certain conditions may produce some change in the constituents of our atmosphere, which gives rise to something that forms a nucleus in saturated or supersaturated air. The fact that during the days of abnormally high readings the air did not become hazed to anything like the extent indicated by the number of particles, seems to suggest that these nuclei are of molecular dimensions, and it is even possible they may not be nuclei at all while the air is dry, but form nuclei in saturated air. Nothing corresponding to these abnormal readings can be discovered in the observations made at other places. In discussing the effects of dust, these abnormal readings have been omitted, and the mean of the morning and evening figures taken as the number for the day.

The investigation of the amount of dust, and the direction of the wind, shows that winds from the north-west quadrant are the purest at this station, and those from the south-east quadrant the most impure. All the high readings at Ben Nevis were observed in south-east winds. The effect of the direction of the wind is shown by diagrams, the dust curves being low with north-westerly, and very high with south-easterly winds.

The next point discussed is the relation between the transparency of the atmosphere and the number of dust particles. The observations made during the last three years, as in the previous two, show that on all days when the number was small the air was clear, if the wet bulb depression was over 2°. In order to make the haze observations more satisfactory, it has been the custom for the last three years to enter in the notes the *limit of visibility in miles* at the hour the other observations were taken. This is done by estimating the amount of haze on a mountain at a known distance, and calculating the extreme limit it would be visible at in the same air. In working out the relation between the number of particles and the transparency, it is necessary to reject all observations made during rainy or doubtful weather. For reasons frequently explained, the observations were separated into sets, according to the humidity at the time; all the observations taken when the wet-bulb depression was from 2° to 4° being entered in one table, all those when it was from 4° to 7° in another, and all when it was 7° to 10° in a third. In the tables were entered the highest, lowest, and mean numbers of particles observed, while the conditions remained at all steady, and in another column was entered the limit of visibility at the time. The different observations were arranged in the tables in the order of the mean number of particles, beginning at the top with the observation with the least number, and ending at the foot with the observation with the greatest number. This will be easiest understood by an example. The following table represents in abstract one of the tables with the Kingairloch observations for 1893, when the wet bulb depression was from 4° to 7°. As it is unnecessary to give all the observations, only the first and last are entered.

Date.	Lowest number.	Highest number.	Mean number.	Limit of visibility in miles.	C.	
July 14 ...	85 ...	850 ...	467 ...	250 ...	117,000	Mean. 106,000
July 2 ...	1600 ...	2400 ...	2000 ..	40 ...	80,000	

If we look down the column headed limit of visibility in the different tables, it is seen that in all of them the highest limit of visibility is always associated with the least amount of dust, and the least limit with the greatest amount of dust. The tables show clearly that the amount of haze depends directly on the number of dust particles in the air. It seemed probable that the same number of particles would produce the same amount of haze, whether these particles be distributed through a long or short length of air. If this be so, then the mean number of particles multiplied into the limit of visibility ought to be a constant. In the tables are columns headed C, in which the numbers so calculated are entered. From the tables it is seen that though the values of C for the different observations are not alike, yet they agree as well as could be expected, considering the difficulty in estimating the amount of haze and the probable variations in the size of the dust particles, which would influence their hazing effect. The tables for the Kingairloch observations in 1893 show that when the wet bulb depression was between 2° and 4° the value of C was 77,000; when the wet bulb depression was from 4° to 7° C was equal to 106,000 (see table above), and when the wet bulb depression was from 7° to 10° the value was 141,000.

The Kingairloch observations, when arranged in these tables, show the effect of the humidity, as well as of the dust, on the transparency. The value of C when the wet bulb depression is from 2° to 4° is only about one-half of what it is when the depression is from 7° to 10°. The damper air has therefore nearly double the hazing effect of the drier, because C is proportional to the number of particles required to produce a complete haze, that is, a haze thick enough to shut out all view. What that number of particles really is, is obtained by multiplying the different values of C by 160,932, the number of centimetres in a mile. When this is done we get the number of particles of dust per square centimetre, and of lengths of from 10 to 250 miles required to produce complete haze in air giving different wet bulb depressions.

Wet bulb depression.		Number of particles required to produce complete haze.
2° to 4°	...	12,500,000,000
4° to 7°	...	17,100,000,000
7° to 10°	...	22,600,000,000

The above figures show the effect of the humidity very clearly. Nearly double the number of particles are required to produce the same amount of haze when the air is very dry than when it is dampish. It will also be noticed that the transparency of the air is roughly proportional to the wet bulb depression. It should be noted that it is not the amount of vapour in the air that produces this effect, but the nearness of the vapour to the dew point which seems to enable the dust particles to condense more vapour by surface attraction and otherwise, and thus, by becoming larger, they have a greater hazing effect. The above table shows the relation between the humidity, the dust, and the transparency, so that knowing any two of them we can calculate the third.

The paper then proceeds to an examination of the relation between the dust and the haze from the Ben Nevis reports for the periods of the Kingairloch observations, when it is seen that on all days when the air was very clear the number of particles was small at high and low levels, and the transparency was least when the amount of dust was greatest. On one occasion Ireland, which is 125 miles distant, was seen from Ben Nevis, and only a thin haze was visible. On that day the number was about 200 per cc. at low level, and under 200 at high level, and, as the numbers remained very constant at both levels all day, this day may be looked upon as one of the purest as well as one of the clearest observed.

The next set of observations discussed are those made at Alford, in Aberdeenshire. The air at that station was always very pure, except when the wind was southerly, and brought impure air from the inhabited districts. The values of C for the different humidities were calculated from the Alford observations, and the results will be found in the following table. When at Alford some observations were made on Callievar, a hill about 1747 feet high. The values of C from three observations made on Callievar do not agree with the others, being only about one-half as great.

The difference in the value of C obtained from the Callievar observations opened up the question of the value of C as obtained from observations at low level. The difference in the two values might be due to the tests at low level being made in locally impure air, near the surface of the earth, while the estimates of haze are made partly through purer upper air, and in calculating the value of C it is assumed that the air all through the length in which the haze is estimated has the same amount of dust as at low level, whereas it may have less. If, then, the low level observations be made in polluted areas, they will give too high a value for C. The difference between the amount of dust at Kingairloch and Ben Nevis does not, however, account for anything like the difference given by the Callievar observations. As there were only three observations made on Callievar, it was thought as well to test this point by working out the values of C from the Rigi observations. When this was done they were found to be similar to those for the Kingairloch observations. The following table shows the different values of C at the different wet bulb depressions, calculated from the different sets of observations:—

Place.	Wet bulb depression.		
	2° to 4°	4° to 7°	7° to 10°
Kingairloch, 1893 .	77,000	106,000	141,000
,, 1892 .	No observations	117,000	175,000
Alford . . .	75,000	95,000	125,000
Rigi Kulm . .	75,000	104,000	124,000
Mean . . .	76,000	106,000	141,000

What are called purifying areas in this paper are those regions on the earth's surface in which the air loses more impurity than it gains. In all densely-inhabited areas it loses its purity, and in all uninhabited ones it tends to regain it; but all uninhabited areas are not equally good purifying ones. Much of the dusty impurity discharged into our atmosphere from artificial sources, by volcanoes, and by the disintegration of meteoric matter, falls to the ground, but much of it is so fine it will hardly settle. The deposition of vapour on these very small particles seems to be the method adopted by nature for cleansing them away; they become centres of cloud particles, and ultimately fall with the rain. It may be remarked that all very low numbers at Kingairloch were obtained in close misty rain, and in the clouds near the earth, in the very area in which the dust was being used up. This experience is confirmed by the observations made on Ben Nevis. From this it might be expected that the areas where most clouds form, and most rain falls, will have the greatest purifying influence. This conclusion is confirmed by the dust observations made in air coming from four great purifying areas, namely, the Mediterranean, the Alps, the Highlands of Scotland, and the Atlantic. The following figures show the mean values of the lowest readings observed in each of the five years in air coming from these areas; the Mediterranean, 891 per c.c.; the Alps, 381; the Highlands, 141; and he Atlantic, 72. It should be noted that these are not the mean numbers, but the mean of the lowest, and represent the maximum purifying power of the different areas.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

The sixth summer meeting of University Extension and other students will be held in Oxford from July 27 to August 24. Courses of study are provided in numerous subjects of interest and importance. Among the science courses are included lectures on physical problems relating to astronomy, by Dr. A. H. Fison. Mr. Henry Balfour, Curator of the Pitt-Rivers Museum, will lecture upon the arts of mankind and their evolution, illustrating his discourses by specimens exhibited in the museum. Geology, both lectures and field work, has been undertaken by Prof. A. H. Green, F.R.S. Dr. C. H. Wade will conduct lectures and classes in hygiene, and Mr. J. E. Marsh have charge of students in courses of practical chemistry at the chemical laboratory in the University Museum. A lecture on colour vision will also be given by Captain W. Abney. In addition to these courses, and many others on history, literature, economics, and art, there will be a course on the science and art of education, comprising lectures on psychology, the theory of education, and the educational systems of England, France, and Germany. Instruction in wood-carving, Sloyd, and photography can also be obtained at the meeting.

The *Oxford University Extension Gazette* announces that the council of the London Society for the Extension of University Teaching has decided to hold in London, on June 22 and 23, a conference representative of all the authorities concerned in the work of University Extension. The purpose of the conference will be to sum up and present the educational results of University Extension work since the inauguration of the movement, and to discuss practical proposals and a general policy for the future in the light of past experience. Official representatives of the Universities of Oxford, Cambridge, and London will be asked to preside over the three sessions of the conference, which by emphasising the unity of the University Extension system, will doubtless increase public interest in this branch of educational work.

SCIENTIFIC SERIALS.

Bulletin de l'Académie Royale de Belgique, No. 1.—Another word on the definition of latitude, by F. Folie. If a displacement of the pole of inertia really exists, the difference between the astronomical latitudes of two places situated upon opposite meridians, such as Berlin and Honolulu, will be positive in summer and negative in winter. It is therefore best to take as a point of reference, not the instantaneous pole, but the mean position of the pole of inertia, *i.e.* the geographical pole. As regards the direction of displacement of the pole of inertia, M. Folie's latest conclusion is that it is retrograde, with a period of 321 instead of 423 days.—Explanation of the systematic differences between the catalogues of Greenwich, Melbourne, and the Cape, by diurnal nutation and the annual displacement of the pole of inertia, by the same author. The hitherto unexplained systematic differences between the three catalogues are eliminated by the introduction of the constant term entering into the expression for diurnal nutation.—A new gradual synthesis of benzene, by Maurice Delacre. This synthesis starts, like the one previously described, with acetophenone, and passes through dypnone and dypnopinacone to the γ varieties (not the α series) of dypnopinacoline, dypnopinalcohol, and dypnopinalcolene to triphenylbenzine.—Application of the refractometer to the study of chemical reactions, by J. Verschaffelt. The Pulfrich refractometer used, when compared with a standard spectrometer, gave a constant difference in the index of refraction amounting to −0·00069, this being probably due to the insertion of a prism of different material in the refractometer. With this correction the refractometer readings could be taken as absolutely trustworthy to the fourth decimal place. The author shows that all disagreements with the law governing the index of refraction of mixtures indicate a chemical reaction (1) if the observed index is lower than the calculated index; or (2) if it is higher by such an amount that the difference cannot be attributed to a change of volume.—On the parietal eye, the epiphysis, the paraphysis, and the choroid plexus of the third ventricle, by P. Francotti. This paper contains a detailed description, illustrated by excellent microphotographs, of these rudimentary organs as they appear in the slow-worm and the human embryo.

Wiedemann's Annalen der Physik und Chemie, No. 3.—On elliptic polarisation of reflected light, by K. E. F. Schmidt. This first part of the work deals with the influence of foreign surface layers. Contrary to the conclusions of Drude, Röntgen, and Lord Rayleigh, the author shows that no observation justifies us in assuming that the elliptic polarisation of light reflected from polished surfaces is produced by layers of the polishing material. The polish attached to the mirror is only capable of modifying the phenomenon. The constancy of the ellipticity of light reflected from mirrors cleaned by means of a gelatine film, which is pulled off when hardened, implies a constancy of the cause of this phenomenon, independent of the polishing powder used.—Remarks upon Paschen's paper on "The emission of heated gases," by E. Pringsheim. The author maintains that the so-called discontinuous heat spectra observed by Paschen, cannot be fitly described as such, since the "band" due to CO_2 extends over a region three times as large, and that of steam over one twenty times as large, as the whole visible spectrum.—On normal and anomalous changes of phase during the reflection of light by metals, by W. Wernicke. The change of phase produced by the reflection of light from a silver film between two transparent media, the anterior one of which has the higher index of refraction, is an acceleration which increases continuously from zero to ¼ or ⅜ of a wave-length as the thickness of the silver grows from zero to opacity. This is the normal change of phase. An anomalous retardation takes place when there are traces of another substance between the silver and the front medium. It may amount to something between ⅜ and ⅝ of a wave-length.—On the proportionality between lowering of freezing point and osmotic pressure, by Svante Arrhenius.—On a more exact method for the determination of the lowering of freezing points, by E. H. Loomis. The apparatus used was an improved form of Beckmann's freezing tube. To avoid the fluctuations of temperature associated with the melting or solidifying of ice in water, sometimes amounting to 0·1° C., the tube was lengthened so as to remove the substance from the warmer air, and a freezing mixture was in each case employed, which gave a temperature only about 0·3° lower than the actual freezing point of the substance experimented upon.

IN the numbers of the *Journal of Botany* for March and April, the articles are almost entirely descriptive. Mr. E. G. Baker has an interesting paper on the section *Rhynchopetalum* of *Lobelia*, in which two new species from Africa are described and figured.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, March 21.—Mr. R. Inwards, President, in the chair.—Mr. W. H. Dines read a paper on the relation between the mean quarterly temperature and the death-rate. The Registrar-General's Quarterly Returns for the whole of England since 1862 were taken by the author, and the number of deaths in each quarter expressed as a departure per thousand from that particular quarter's average; the value so obtained being placed side by side with the corresponding departure of the temperature at Greenwich from its mean value. The rule seems to be that a cold winter is unhealthy, and a mild winter healthy; and that a hot summer is always unhealthy, and a cold summer healthy. Mr. Dines also read a paper on the duration and lateral extent of gusts of wind and the measurement of their intensity. From observations and experiments which he has made with his new anemometer, Mr. Dines is inclined to think that a gust seldom maintains its full force for more than one or two seconds; and also that the extreme velocity mostly occurs in lines which are roughly parallel to the direction of the wind.—Mr. R. H. Scott, F.R.S., exhibited a diagram showing some remarkable sudden changes of the barometer in the Hebrides on February 23, 1894. At 8 a.m. the reading at Stornoway was 29·39 inches, being a fall of 0·7 inch since the previous day, and at 6 p.m. the reading was 28·58 inches. From the trace of the self-recording aneroid it appears that the minimum, 28·50 inches, occurred about 5.30 p.m., and that the fall during the half-hour preceding the minimum was nearly 0·2 inch, the rise after the minimum being nearly as rapid.—The other paper read was on the calculation of photographic cloud measurements, by Dr. K. G. Olsson.

Geological Society, March 21.—Dr. Henry Woodward, F.R.S., President, in the chair.—The following communications were read:—On the origin of certain novaculites and quartzites, by Frank Rutley. The novaculites of Arkansas have already been admirably described by Mr. Griswold in vol. iii. of the Arkansas Survey Report for 1890. One of the characteristic microscopic features in Ouachita stone is there stated to consist in the presence of numerous cavities, often of sharply-defined rhombohedral form, which Mr. Griswold considers to have been originally occupied by crystals of calcite or dolomite. The author, while admitting that the cavities were no doubt once filled by the latter mineral, differs from Mr. Griswold, and some of the authorities he cites, concerning the origin of the rock. Crystalline dolomites, when dissolving, become disintegrated into minute but well-formed rhombohedra. As the process of dissolution proceeds these crystals may become so eroded that the rhombohedral form is no longer to be recognised. The author pointed out that no inconsiderable proportion of the cavities in Ouachita stone present irregular boundaries, such as the moulds of partially eroded rhombohedra would show. He then offered a fresh interpretation of these cavities, so far as the origin of the rock was concerned: (1) He assumed that beds of crystalline magnesian limestone have been slowly dissolved by ordinary atmospheric agency and the percolation of water charged with carbonic acid or other solvent. (2) That, as the limestone was being dissolved, it was at the same time being replaced by silica, which enveloped minute isolated crystals and groups of crystals, some perfect, others in various stages of erosion. (3) That the silica assumed the condition of chalcedony, its specific gravity, as stated by Mr. Griswold and as determined by the author, being low in comparison with that of quartz. (4) The residuum of the original dolomite or dolomitic limestone was removed, leaving the perfect and imperfect rhombohedral cavities. A calciferous, gold-bearing quartzite from the Zululand gold-fields was described, and a similar origin ascribed to it, but in this case the original rock appears to have been simply a limestone, not a dolomite. The gold seemed to occur chiefly in the calcareous portions of the rock. The author also suggested a similar origin for the saddle-reefs of the Bendigo gold-field. In all of these cases the train of reasoning is based upon the conclusions arrived at in his previous paper, "On the dwindling and disappearance of limestones." He indicated that the stratigraphical relations of the Arkansas novaculites, as described in Mr. Griswold's report, were such as to warrant the assumption that limestones once occurred in the position now occupied by beds of novaculite. Many collateral matters were dealt with in the paper which cannot be given in abstract; among them was an attempt to classify quartzites. Dr. G. J. Hinde and Prof. Hull discussed some of the conclusions in the paper, and the author briefly replied.—Note on the occurrence of perlitic cracks in quartz, by W. W. Watts. The author of this communication described some specimens of the porphyritic pitchstone of Sandy Braes in Antrim, which are deposited in the Museum of Science and Art in Dublin, and in that of Practical Geology in Jermyn Street. They exhibit admirable examples of perlitic structure in the brown glassy matrix, and the presence of polygonal, circumferential, and radial cracks is noticed. The porphyritic crystals of quartz are traversed by curved fissures of retreat, not so perfect as those found in the glass, but better than those usually produced by the rapid cooling of Canada balsam. The fissures in the quartz are frequently prolonged into the matrix, undergoing only a very slight and almost imperceptible deviation in direction at the junction. But in addition to this the quartz is often found to act as a centre of strain, the inner cracks of the perlite being wholly in quartz, the next traversing both, and the outer ones in glass only. In other examples the outer cracks of a matrix perlite sometimes enter the quartz, while in others polygonal cracks occur, and join up, in the quartz, and give off radial cracks precisely like those of the matrix. These observations lead to the conclusion that the quartz and glass must have contracted at about the same rate, and that the observation of perlitic structure in a rock with trachytic or felsitic matrix by no means proves that the rock is necessarily a devitrified glass. —Mr. Rutley, Mr. Harker, and Prof. J. F. Blake spoke upon the subject of the paper, and the author replied to their remarks.

PARIS.

Academy of Sciences, March 27.—M. Lœwy in the chair.—A study of the crystallised acetylides of barium and strontium, by M. Henri Moissan. Nearly pure crystalline C_2Ba and C_2Sr are produced by heating the oxides of barium and strontium (or carbonates) with sugar charcoal in the electric furnace. These bodies are immediately decomposed by water, and give pure acetylene. Their properties and reactions resemble those of calcium acetylide. When exposed to the action of halogens at a slightly raised temperature they become incandescent, the barium compound being most readily attacked. —Electric registration of the movements of the semilunar valves determining the opening and closing of the aortic orifice, by M. A. Chauveau.—On two isomeric methylcyanocamphors, by MM. A. Haller and Minguin. The preparation and properties of α-methylcyanocamphor, $C_8H_{14}\left\langle\begin{array}{l}\text{CMeCy}\\ |\\ \text{CO}\end{array}\right.$, and β-methylcyanocamphor, $C_8H_{14}\left\langle\begin{array}{l}\text{CCy}\\ \|\\ \text{COMe}\end{array}\right.$, are described. By hydrolysis with alcoholic potash the former yields a dicarboxylic acid, the latter gives a hydroxymonocarboxylic acid and methyl alcohol. —Occultation of Spica Virginis, March 22, 1894, observed at Paris Observatory, by M. G. Bigourdan.—Observations of the planet BC, made at the Paris Observatory, by M. G. Bigourdan.—Note by M. Ch. Trépied on photographic observations of planets, made by MM. Rambaud and F. Sy, at the Algiers Observatory.—On the approximate development of the perturbation function in the case of inequalities of a high order.—Applications to Mercury and Venus, by M. Maurice Hamy.—On a corollary of Catalan's theorem, by M. Maurice Moureaux. An extension proving a theorem of which Catalan's is a special case. "If a sum of *n* squares be raised to any power which is itself a power of 2, there results a sum of *n* squares."—Results obtained by new arrangements for diminishing the vibrations of vessels, by M. Augustin Normand.—On the minimum electromotive force requisite for the electrolysis of electrolytes, by M. Max Le Blanc. A discussion of the remarks made by M. Berthelot on a previous paper, followed by further remarks by the latter. On the mutual solubility of salts, by M. H. Le Chatelier.—Action of nitrogen, nitrous oxide, and nitric oxide on alkaline ammoniums, by M. A. Joannis. Nitrogen has no action on sodammonium or potassammonium. Nitrous oxide, not in excess, reacts in accordance with the equation :

$$N_2O + K_2N_2H_6 = KNH_2 + NH_3 + KOH + N_2;$$

if the oxide be in excess a further action takes place :

$$2NH_2K + N_2O = N_3K + KOH + NH_3.$$

An alkaline salt of hydrazoic acid is thus produced from purely inorganic materials. Nitric oxide forms the alkaline hyponitrites KNO and NaNO with $K_2N_2H_6$ and $Na_2N_2H_6$ dissolved in liquid ammonia.—On the mode of action of the pancreas in the regulation of the glucose-forming function of the liver. New facts concerning the mechanism of pancreatic diabetes. Note by M. M. Kaufmann.—On physiological antiseptics, by M. A. Tripier.—Properties of the serum of animals protected by inoculation against the poison of serpents, by M. A. Calmette. The great value of such serum as a therapeutic agent is emphasised. Injections of the protected serum together with solution of chloride of lime possess great therapeutic power.—On the copulation of some Cephalopoda—*Sepiola Rondeletii* (Leach), *Rossia macrosoma* (d. Ch.), and *Octopus vulgaris* (Lam.), by M. Émile G. Racovitza.—On the seismic rose of a place, by M. de Montessus.

GÖTTINGEN.

Royal Society of Sciences.—In Nos. 15 to 21 of the *Nachrichten* appear the following papers of scientific interest :—

November 1.—Gauss, de integratione formulæ differentialis $(1 + n \cos \phi)^{\nu} d\phi$, edited (in Latin) by E. Schering. The paper was found by Prof. W. Meyer in the archives of the Society, and probably dates from 1795.

November 8.—W. Voigt, contributions to the molecular theory of piezo-electricity.

November 15.—A. Peter, experiments on the cultivation of "resting" seeds. J. Thomae, on the differentiation of a definite integral with regard to its upper limit.

December 13.—Robert Fricke, on indefinite quadratic forms with three and four variables. H. Weber, the equalisation of temperature between two heterogeneous bodies in contact. O. Wallach, on the behaviour of the oximes of cyclical ketones (I.).

December 20.—A. Brill, on symmetric functions of pairs of variables. W. Nernst, a method for the determination of dielectric constants.

December 27.—Robert Haussner, the theory of Bernoulli's and Euler's numbers.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Royal University of Ireland, Calendar for the Year 1894 (Dublin, Thom).—Fauna of British India, including Ceylon and Burma; Moths, Vol. 2: G. F. Hampson (Taylor and Francis).—A Monograph of Lichens: Rev. J. M. Crombie, Part 1 (London, British Museum, Natural History).—Papers and Notes on the Glacial Geology of Great Britain and Ireland : H. C. Lewis (Longmans).—The Health Results of Europe : Dr. T. Linn, 2nd edition (Kimpton).—Biological Lectures delivered at the Marine Biological Laboratory of Wood's Holl in the Summer Session of 1893 (Boston, Ginn).—Disease and Race : Jadroo (Sonnenschein).—Annals of the Royal Botanic Garden, Calcutta ; Vol. iv., the Anonaceæ of British India : Dr. G. King (Calcutta).

PAMPHLETS.—Notes on Polarised Light : A. E. Munby (Newcastle-on-Tyne, Reid).—Investigations of Recent Typhoid-Fever Epidemics in Massachusetts : Prof. W. T. Sedgwick (Boston).—A New Story of the Stars : A. W. Bickerton (Christchurch, N.Z.).

SERIALS.—Bulletin of the New York Mathematical Society, March (New York, Macmillan).—Science Progress, No. 2 (Scientific Press).—Journal of the Royal Agricultural Society of England, Vol. v. Part 1, No. 17 (Murray).—Internationales Archiv für Ethnographie, Band vii. Heft 2 (K. Paul).

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