THURSDAY, JANUARY 12, 1893.

AMERICAN MECHANISM.

Modern Mechanism. Edited by Park Benjamin, LL.B., Ph.D. (London and New York: Macmillan and Co., 1892.)

IN order to appreciate this volume thoroughly, it is necessary in the first instance to consider the reason for its existence. Appleton's "Dictionary of Engineering," an American book, was published in the year 1851, and was the first to gather in cyclopedic form descriptions of products of American mechanical industry. Some thirty years afterwards it became necessary to bring the work up to date, and its complete reconstruction was decided upon. The editor observes that no previous work of a technical character had so signally, and so quickly, demonstrated its own usefulness; it rapidly became a recognized standard of American mechanical practice. Owing, however, to the great progress made in mechanical invention, and the marvellous rapidity with which electrical science has advanced, a new record of the results has become necessary, and hence the present volume.

The list of contributors includes the names of eminent men, well known in this country for their high attainments in the different branches of mechanical and electrical engineering, forming a sure guarantee that the information to be gleaned from the pages is valuable and accurate. It would be impossible in the space at our disposal to notice more than a small part of the contents. Some interesting information is to be found on the subject of aerial navigation, more particularly the interesting experiments being carried out by Mr. Hiram S. Maxim. Commenting on Prof. Langley's statement, that with a flying machine the greater the speed the less would be the power required, Mr. Maxim says: "In navigating the air we may reason as follows: if we make no allowance for skin friction and the resistance of the wires and framework passing through the air—these factors being very small indeed at moderate speeds as compared to the resistance offered by the aëroplane—we may assume that with a plane set at an angle of 1 in 10, and with the whole apparatus weighing 4000 pounds, the push of the screw would have to be 400 pounds. Suppose, now, that the speed should be 30 miles an hour; the energy required from the engine in useful effect on the machine would be 32 horse-power (30 miles = 2640 feet per minute, $\frac{2640 \times 400}{33,000} = 32$). Adding 20 per cent. for slip of screw, it would be 38·4 horse-power. Suppose, now, that we should increase the speed of the machine to 60 miles an hour, we could reduce the angle of the plane to 1 in 40, instead of 1 in 10, because the lifting power of a plane has been found to increase in proportion to the square of its velocity. A plane travelling through the air at the rate of 60 miles an hour, placed at an angle of 1 in 40, will lift the same as when placed at 1 in 10, and travelling at half this speed. The push of the screw would therefore have to be only 100 pounds, and it would require 16 horse-power in useful effect to drive the plane. Adding 10 per cent. for the slip of the screw, instead of 20, as for the lower speed, would increase the engine power required to 17·6 horse-power. These figures, of course, make no allowance for any loss by atmospheric friction. Suppose 10 per cent. to be consumed in atmospheric resistance when the complete machine was moving 30 miles an hour, it would then require 42·2 horse-power to drive it. Therefore at 30 miles an hour only 3·84 horse-power would be consumed by atmospheric friction, while with a speed of 60 miles an hour the engine power required to overcome this resistance would increase eightfold, or 30·7 horse-power, which, added to 17·6, would make 48·1 horse-power for 60 miles an hour."

Mr. Maxim goes on to observe that his experiments show that as much as 133 pounds can be carried with the expenditure of 1 horse-power, and under certain conditions as much as 250 pounds. It will be evident, therefore, that the question of motors is all important, and that the total weight per horse-power developed must be as low as possible. It is stated that the greatest force can be obtained from a compound high-pressure steam engine using steam at 200 to 350 pounds pressure, and such engines have been constructed weighing 300 pounds; the horse-power of these engines is not stated.

It will be interesting to watch the outcome of these investigations. They indicate that much information is being accumulated, and that sooner or later a successful aerial machine will be forthcoming.

The question of armour plates has long vexed the soul of the British Admiralty; many very costly trials have been carried out in order to find the most suitable plate for the service. All these data have probably been known in the States, and that country must have benefited by them. Under this heading we find much information in the book, American experiments being quoted and illustrated. Naturally, the Americans wish to make their own plates, and wisely endeavour to do so by rolling only, to do without the heavy expense of forging. These experiments show that the high-carbon nickel Harveyed plate is undoubtedly the best plate ever tested. As a result of these trials, orders have been placed for plates for the cruisers under construction. An excellent full-page engraving is given of the U.S. armoured battle ship *Indiana*, and to judge by the blackness of the smoke she is not using Welsh coal! The article on steam boilers is well written, and very complete, containing much useful information. Among the many types of boilers illustrated there is a good print of the Yarrow torpedo boat boiler. We miss, however, the familiar Thornycroft boiler, and note an American water tube-boiler for fast launches very like the Thornycroft in the arrangement of the tubes.

The boilers for marine purposes are purely of the British type, and there is nothing of importance to note on this subject beyond the many experimental results recorded.

Further on in the book there is an interesting description of railway-car heating. We are told that car-heating, in the usual acceptance of the term, has come to mean the heating of railway cars by the use of steam from the locomotive. This is important, showing as it does the direction in which American railway companies are moving in the solution of a problem at present occupying the best attention of engineers in this country. Generally, we are told, the systems consist of a separate hot-water circulating system in each car, in connection with a heater, fed by steam from the locomotive, by a continuous train pipe running the length of the train, and coupled together between the cars by flexible hose-pipes and universal couplings; the Sewall steam coupler being generally used. Another important railway necessity is the continuous brake. Under this heading the latest form of Westinghouse quick-action automatic brake is described. In the original design the brake is applied by the engine-driver allowing a little air to escape from the train pipe, lowering the pressure, and thus applying the brake by the automatic action of the triple valves. It is evident that the vehicle next the engine will feel this reduction first, and its triple valve will work before that on the second vehicle, and so on. On trains of ordinary length this very slight difference in time between the brake's application on each vehicle is of little consequence, but when this automatic brake is fitted to a long goods train it becomes a serious matter. The length of a goods train of fifty American cars is 1900 feet, and the brake should act instantaneously to be perfect. The new triple valve is itself designed to discharge air from the train pipe; so on the driver opening the driver's valve, allowing air to escape to apply the brakes, the reduction of pressure operates the triple valve on the first car; this lets out more air, and so on through the train, the brake on the last car, 1900 feet away, being operated in 2·5 seconds after that on the first car.

The vacuum automatic brake is not described or illustrated. This brake is now being more and more brought into use and for general purposes it appears to be simpler and less liable to get out of order than its competitors.

A considerable part of the volume is taken up with the applications of electricity, for lighting and motive power purposes generally. On dynamo electric machinery much has been written and well illustrated. The reader is taken step by step from the rudiments of the subject to its latest applications, from a description of armatures to the arrangements of the field-magnets, then to the varying designs of dynamos, including most of the known machines. The same may be said on the treatment of the electric motors. Under the head of the transmission of power there is more useful information to be found, this being all the more interesting, because of the proposed use of electricity as a means of transmitting some of the power of Niagara to distant towns. There is, however, something wanting under the heading of electrical measuring instruments. The only ones mentioned are Weston's volt and ammeters. At the present time the street tramways of this country are in an uncertain stage as far as motive power is concerned; horse-power is admittedly expensive; the steam locomotive seems to have got into disrepute; the cable and electric traction appear to be struggling for the mastery. It is interesting therefore to read the memoir on electric traction in this volume. The accumulator system is just described, but the overhead cable or trolley system takes up the greater part of the space, so it is safe to assume that the latter is more generally in use, the principle of which is as follows: the current starts from the positive brush of the dynamo, passing out to the main conductor, suspended over the middle of the track, and along this conductor until it reaches the point where the trolley of one of the motor cars is in contact. Here it divides, and a portion passes down through the trolley to the motors, and thence to the rails forming a return lead to the negative brush of the generator. The main portion of the current passes on to feed other cars upon the line in the same manner, each car taking the quantity of current necessary to develop the required power. There are at the present time nearly 500 electric railways in America, and taking the results of twenty-two electric trolley lines, we find that the expenses vary per car mile from 22·99 cents to 7·89 cents, the highest and lowest respectively. A view is given of the electric street railway at Washington, D.C.; the overhead conductors being not at all unsightly.

On electric welding there is also much information, the Thomson process being very fully described. It consists briefly in completing the electrical circuit through the parts to be welded together, the resistance being sufficient to heat the parts so as to weld them, this being assisted by pressure.

The Bernado process is not described; in this process the work to be welded is connected to one terminal of the dynamo. The positive terminal being connected with a carbon rod, held in a portable insulated holder, the carbon rod is then placed on the work, and immediately withdrawn slightly, thus forming an arc, where the metal melts, and with skill much can be done.

The locomotive practice in America has long been of interest to locomotive engineers in this country, owing to the many differences in design and practice. A very good *résumé* of American practice is to be found in the memoir under this heading. A useful table is given showing a few leading dimensions, weights, &c., of typical engines in use. Take, for instance, the express passenger engine, a four-coupled bogie engine, the cylinders being 20 inches in diameter and 24 inches stroke. The driving or coupled wheels are 72 to 78 inches in diameter. The weight on coupled wheels is 75,000 pounds (33·48 tons), the total weight of the engine being 116,000 pounds (51·78 tons), and that of the tender 72,000 pounds (32·14 tons. Comparing these data, we find that the American engine is heavier than an 18×26 cylinder British engine and not so powerful, assuming equal steam pressures; the tender is light in a similar comparison, probably carrying less water. The reputed weight of trains hauled given in the table is of little use, because the speeds are not given, and for this reason comparisons cannot be made.

The paragraph on locomotive boiler construction is far too short; many interesting details might have been added. It is stated that the circular smoke-box tube plate is a conspicuous difference between the practices of the two countries, being purely American, whereas the Midland Railway Company have, amongst others, used the arrangement for some time. Owing to the enforced use of anthracite coal in certain parts, many peculiar designs of locomotive boilers have been used, the Wootten boiler being probably the most common. All, however, have particularly large grate areas, which, in the case of the Wootten, may in some cases exceed 76 square feet, or four times the area of the grate of recent British engines. An illustration is given of an engine of this type, as well as a full-page engraving of a compound locomotive with a similar boiler. This compound is very different from the Webb or Worsdell engines common in this country, being the design of the superintendent of the Baldwin Locomotive Works. The cylinders are outside the frames—there are two on each side, viz. one high-pressure and one low-pressure. The distribution of the steam being effected in each pair by one piston valve, each pair of pistons is connected to one crosshead, coupled in the usual way to the wheels.

A compound engine of the "Webb" type is also illustrated. This engine was constructed to Mr. Webb's designs in this country for the Pennsylvania Railway in 1889. It is stated that the results of experiments showed a saving of fuel over the ordinary engine of from 20 to 25 per cent.

This book is so full of interesting matter of so varied a nature that it would be possible to prolong this notice far beyond the space available. Take, for instance, agricultural machinery; the Price ploughing outfit is typical of the rest, consisting of a traction engine drawing four gangs of three ploughs, the twelve ploughs cutting eleven feet wide. The subject of milling tools is also of interest, because it is only during the last few years British engineers have used this means of shaping metals, the system having been brought into general use in the States.

Under the head of the manufacture of steel all the usual processes are described. We are informed that the Whitworth compression process is only partly successful in the formation of sound ingots; with this statement we cannot agree; the Whitworth steel ingot after compression is certainly sound throughout.

Taking into consideration the great mass of information contained in the 900 odd pages of this work, and the general excellence of the matter accumulated, it is only just to congratulate the editor on the completion of a work which must prove useful to many, and which should find a place in all technical libraries. The volume goes far to describe modern American mechanism, exhibiting the latest progress in machines, motors, and the transmission of power.

SEEDLINGS.

A Contribution to our Knowledge of Seedlings. By the Right Hon. Sir John Lubbock, Bart., M.P., F.R.S., D.C.L., LL.D., with 684 figures in text. In two volumes. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1892.)

SEEDS and seedlings have occupied the attention of Sir John Lubbock for a somewhat lengthened period. They have formed the subject of various communications, on his part, to the Journal of the Linnean Society and other publications. In the present volumes, modestly styled a "contribution," he gives us the details upon which his inferences have been founded.

The physical and chemical aspects of germination are entirely passed over, but the morphological phenomena are treated with a fulness never before attempted. The author has availed himself of the resources put at his disposal by the authorities at Kew, where the larger proportion of the seedlings described were grown expressly for the purpose. The Natural History Museum and the Cambridge Botanic Gardens have also been requisitioned, and much help has been rendered by capable assistants, whilst the services of Sir Joseph Hooker and Mr. Rendle, in looking over the proof sheets, are duly acknowledged. A work of such dimensions, crowded with detail, could hardly have been produced without such zealous co-operation. Nevertheless unity of plan and uniformity of treatment are conspicuous throughout, and thus comparison is readily effected.

Some previously published papers in the Journal of the Linnean Society, dealing with the causes which determine the form of leaves and cotyledons, are reprinted as the introduction to the treatise. The conclusion therein arrived at is that the form of the embryo, and especially that of the cotyledons, is essentially influenced by the form of the seed. On p. 78 the author begins the detailed examination of seedlings taken from almost all the orders of flowering plants. Five hundred and thirty succeeding pages in the first volume, and five hundred and eighty-eight in the second volume, are thus occupied. This little bit of statistics will serve to show the amount of detail which is contained within these volumes. The plan adopted is to give, first of all, a general sketch of the principal modifications exhibited by the fruit and seed in each order. Then follows a more detailed description of the seed and of the seedling plant in various representatives of the order. As these descriptions are identical in plan throughout, they are of great value to the student of comparative morphology. Naturally some orders are much better represented than others, but sometimes the omissions are rather unfortunate. In the genus Araucaria, for instance, seedling representatives of which are common in botanic gardens and nurseries, the diversities in the form of the seedling and in the mode of germination are very remarkable. "Characters" derived from the seedling plant have been recognized as of the highest importance for classificatory purposes since the time of John Ray (1682–1703).[1]

But whilst this is generally the case, such extraordinary exceptions as that mentioned in Araucaria are very noteworthy, and not less so because the genus in question is one of the very oldest of which fossil botanists have cognizance.

Myrtaceæ and Sapindaceæ are remarkable for the extremely diverse character of the embryo in different genera, and of which due note is taken in Sir John Lubbock's book. In Rosaceæ, on the other hand, the diversity is much less, nor is there any important morphological difference in the seedlings of the great order Compositæ, and scarcely more in Umbelliferæ, so far as they are known. These are facts of great significance with reference to the theories of inheritance and relative antiquity of groups.

[1] It may not be without interest to cite what Ray says on this matter:—"Floriferas dividemus in *dicotyledones* quarum semina sata binis foliis anomalis, seminalibus dictis, quæ cotyledonum usum præstant, e terra exeunt vel in binos saltem lobos dividuntur, quamvis eos supra terram foliorum specie non efferant; et *monocotyledones* quæ nec folia seminalia bina efferunt nec lobos binos condunt." Thus Ray not only recognized the presence of one or of two cotyledons, but also their nature and their epi- or hypogeal condition. As Ray has been mentioned, it is certainly not inappropriate to allude to Grew also, for the first chapter of his "Anatomy of Plants" (1682), and the whole of the fourth book is devoted to the seeds and seedlings and in perusing them the reader will perceive that Sir John Lubbock has in a few cases been anticipated by his celebrated predecessor.

The gradual evolution of the perfect plant from the seedling is indeed a subject of great interest to the phylogenist, although it is difficult—nay, impossible—to separate those appearances which are merely hereditary from those which are the result of varying outward conditions, the more so because analogous conditions must have influenced the ancestors in past times even as they affect their successors now.

Amid such a mass of detail it is difficult to pick out points worthy of special note. We select two only out of many scores that might be mentioned. Some Onagrads are remarkable for the intercalary growth which takes place in the cotyledons, of which several illustrations are given in Sir John Lubbock's book. They call to mind the experiments of the late Prof. Dickie, who, by suppressing the plumule of seedling castor-oil plants, succeeded in inducing the cotyledons to continue their growth and to assume dimensions much greater than that which is habitual to them.

The small tubercles on the root of *Myrica californica* (vol. ii. p. 523, Fig. 663) have, so far as we know, not previously been observed. The author compares them to those found on *Alnus cordifolia*, and it would be interesting to ascertain whether these outgrowths are caused by an organism analogous to *Schinzia alni*, as described by Woronin, or to that which induces the peculiar tubercles on the roots of Leguminosæ, recently studied by Prof. Marshall Ward.

Monocotyledons generally have been rather badly treated by the author, although such genera as Potamogeton, Aponogeton, Orontium, and other Aroids, and Palms (of which not a single illustration is given) would have furnished examples at once interesting and easily accessible.

The work includes nearly seven hundred illustrations, faithfully executed, and very valuable to the student. The bibliography, in spite of its occupying no fewer than thirty-eight pages, is the weak part of the book. Some of the most important references are omitted, and whole series of species whose mode of germination has been recorded and sometimes figured, have been passed over. This only shows how colossal has been the task which Sir John Lubbock has set himself. We do not think the worse of the sun for having a few spots on his disc, nor are botanists at all likely to disparage this work because further research might have added a few more illustrations. As it is, it forms one of the most substantial and important contributions to botanical literature that have ever emanated from the press. It must continue to be a standard book of reference for generations, and it will, we hope, stimulate observers, according to their several opportunities, to prepare similar monographs on the various organs of plants.

MAXWELL T. MASTERS.

EPIDEMIC INFLUENZA.

Epidemic Influenza: a Study in Comparative Statistics. By F. A. Dixey, M.A., M.D. (London: Henry Frowde and H. K. Lewis, 1892.)

AFTER an epidemic disease has visited a country, when the pathologist and practical physician have had their say, there still remains the work of the statistician to be done. It is his province to sum up the results of the visitation in the clear light of hard figures, and to trace its onset and decline in mathematical curves. Such work is of value in more than one direction. It preserves for future generations a definite record of an epidemic of greater precision than the impression left on the mind of the physician: it enables a comparison to be drawn between our own experience and that of other countries: by the sifting and sorting of facts which it necessitates it may lead to the discovery of relationships with allied diseases which may prove of no small value to the pathologist.

This work has been done for influenza by Dr. Dixey in a very thorough and painstaking manner from the material collected under the supervision of the Registrar-General. It says much for the completeness of our registration system in London, that it is possible to compile from them such tables and curves as those with which we are presented in this work, nor are such materials available from any other city in Europe. The only cities whose statistics have been found by Dr. Dixey sufficiently accurate for comparison with our own are Paris and Berlin.

Dealing first with the epidemic of 1889–90, he shows in Table 1 the rise and progress of the disease in London, as indicated by the weekly returns of fatal cases, grouped according to the seven age periods adopted in the official returns. Table 2 gives us, so far as the returns of the period permit, the similar figures for the epidemic of 1847–48. The similar characters of the two epidemics are strikingly illustrated: in both we see the same extreme suddenness of rise, and the same features of decline, rapid at first, but becoming gradually slower during the succeeding months. In the next two tables are included similar figures for Paris and Berlin, and in these, and in Table 5, the author gives an analysis of the meteorological conditions accompanying the rise and fall of the epidemic in the three cities. These are of interest as showing how little influence the weather had on the course of the disease as a whole.

In the tables which follow—which are perhaps of greater interest than any of the others Dr. Dixey has compiled—the effects which influenza has exerted on the mortality from other diseases in London and other cities are shown. These effects are of two kinds: influenza may aggravate the mortality of pre-existent disease such as phthisis or heart disease, or diseases such as bronchitis or pneumonia may occur as complications of influenza and swell its death-roll. It is interesting to observe that whereas in 1847–48, which was in all respects a more fatal epidemic than that through which we have just passed, bronchitis showed the most extreme departure from the normal mortality, pneumonia holds that place in the late epidemic, while bronchitis falls into the second rank. In this connection may be mentioned a point of much interest illustrated in Tables 10, 11, and 12, which deal with the age incidence of influenza and its concomitant diseases. It is possible to draw curves showing the special age incidence of each, and each curve has its own special features. Now during an influenza epidemic the pneumonia curve is found to be modified so as to take on some of the characters of the influenza curve, thus affording corroborative evidence of a conclusion already reached both in this country and in

Germany, that influenza may occur sometimes as an apparently primary pneumonia.

The remaining tables deal with the data afforded by the epidemics of 1891 and 1892 in this country and abroad. That of 1891 is shown to have been much more fatal, especially at advanced periods of life, than that of 1890, while that of 1892, here treated of with less fulness than the preceding, seems to have been of still greater severity. Those who would follow Dr. Dixey into the details of these outbreaks must study the work for themselves. It is a contribution to statistical literature of very great value, and will save an infinity of labour to those engaged in the study of influenza.

A word of praise must be bestowed in conclusion upon the graphic charts with which the tables have been illustrated, those in particular which deal with the mortality curves from influenza and its allied diseases. These have been calculated and mapped out as percentage deviations from the mean, and show the main facts at a glance in a way which mere columns of figures fail to do. Those also which illustrate the age incidence of the diseases in question are of great value.

OUR BOOK SHELF.

An Elementary Text-Book of Hygiene. By H. Rowland Wakefield. (London : Blackie and Son, 1892.)

THE appearance of yet another elementary text-book upon the subject of Hygiene has the effect of aggravating the *embarras de richesses* which already obtains in this department of study; one is therefore justified in questioning the utility of the present volume, and on reading in the preface that it is adapted to the requirements of the Science and Art Department, there is all the more matter for surprise at its appearance in the face of three other publications—each better than the present—which have been written to meet the same end.

The manual is well printed and concisely written, and a surprising amount of matter is condensed within its tiny compass. This latter fact, however, is not entirely a matter for congratulation, for apart from making the book "dry reading," it must have the effect of rendering it in many places difficult of comprehension to those for whom it is intended, *i.e.* those who approach the subject with no prior knowledge whatever.

And thus it comes about, that in less than 200 small pages the whole range of Hygiene is surveyed, including chapters upon Eyes and Sight, School Hygiene, House Sanitation, Personal Hygiene, Parasites, Infectious Diseases, Accidents and Injuries.

Though the material given has been on the whole well selected and carefully compiled, the work is a little uneven; one finds seventy-three pages devoted to "food," whereas "water" is dismissed in seventeen, and "sewage and its removal" in eleven.

Here and there is evidence of the fact that the author is not of the profession to which Hygiene holds a filial relation, and that he was not quite at home with some of the departments of the subject—even in their elementary form—which he had set himself the task of handling; the very few errors and ambiguities which this fact is accountable for, are, however, too trivial to much affect the general accuracy of the book.

The small work will doubtless suffice for the examination requirements of those for whom it is intended, but the brevity and superficiality of treatment which is so frequently apparent within its pages, will not justify one in recommending it to those who wish to lay a good and useful foundation for a study of the science of Hygiene.

Ostwald's Klassiker der Exakten Wissenschaften. Nos. 38–40. (Leipzig: W. Engelmann.)

WE are glad to note the addition of three volumes to this admirable series. No. 38 is the second part of the original account of the photochemical researches of R. Bunsen and H. E. Roscoe (1855–59). The other volumes are translations of a paper by Pasteur on the minute organic bodies in the atmosphere (1862), and of papers by Lavoisier and Laplace on heat (1780 and 1784). In all the volumes there are figures in the text.

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.*]

Geographical Names.

As the names of places given to the public with the authority of the Geographical Society of London are very apt to be accepted by geographers and be ultimately inserted in atlases and works on geography, I have to call attention to the paragraph "Nomenclature of the Karakoram Peaks," under "Geographical Notes," p. 857, in the December number of the Proceedings of the R.G.S., 1892, which I have lately read. It is to be regretted that so much reliance and importance has been placed on what a native drew on the sand, and the names he gave to various peaks. Natives are not always to be depended upon, not even when the topographical features are in sight, and unless verified from other and independent informa ion, the names they give cannot be implicitly trusted and placed on record, as is so well exemplified in this case. The traveller must also have a considerable knowledge of the native languages or he may be very much misled. As fortunately I know both the places bearing the names given for two very conspicuous peaks, it may not be too late to prevent these names thus put forward from being accepted and perpetuated. "Skeenmung" or "Skinmang" is the name of a comparatively level piece of somewhat grassy ground at the great bifurcation of the Punmah Glacier, the name itself is expressive and is derived from "*Skeen*" an ibex, and "*Mang*," a level place in Balti = *Marg*, Kashmiri, *Maidan* Hindustani—which disposes of it as a likely designation for a peak.

Next we have "Chiring" given as the name of K2, the second highest peak in the Himalayas, quite as inaccurate, for it happens to be the name of another camping spot or bivouac at the end of a spur and about halfway between Skeenmang and the Mustakh pass, as used about the period I was there (1860). It is situated just above a very narrow part of the glacier, where its action is most marked on the rocky sides. "*Chirna*" in Hindustani is to rend, tear, and Chiring Gause is the name of all that portion extending six miles up to the main watershed.

H. H. GODWIN-AUSTEN.

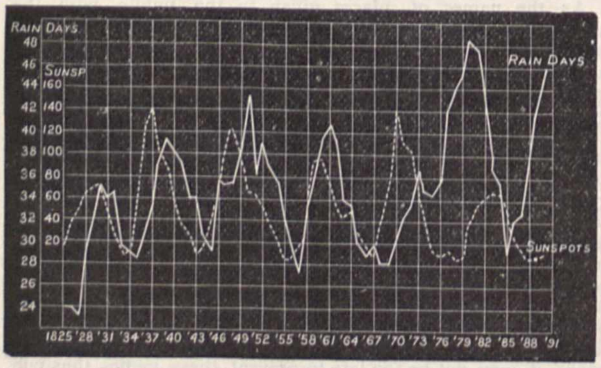
Shalford Park, Guildford, January 7.

The Weather of Summer.

THE number of days with rain, in summer, at Greenwich, during most of this century, has been subject to a pretty regular fluctuation. The curve (from 1825) having been smoothed by means of five-year averages, we obtain that shown in the diagram. And putting with it a curve of sun-spots, we find a strikingly definite correspondence (somewhat "lagging" in character) throughout at least four of the sun-spot cycles, the rain day maxima coming soon after the sun-spot maxima, and rain day minima soon after sun-spot minima. In recent years, however, the curves appear to have got out of step (so to speak) with each other; so that, *e.g.* we find a rain day *maximum* in 1880, two years after the sun-spot *minimum* of 1878, and a rain day *minimum* in 1885, two years after the sun-spot *maximum* of 1883.

I do not remember to have seen the facts of our summer weather put in this way. But it is well known that, in the discussions which arose some time ago about sun-spots and rainfall, there appeared some reason to believe that in the period of those four earlier sun-spot cycles, at least, we had had, on the whole, wetter years about sun-spot maxima than about the minima. A good deal was written on the subject (as your own columns show) in the seventies; and the data used seem to have been generally those of annual rainfall. Of late, apparently, the matter has attracted less notice; for the reason (I suppose) that the correspondence referred to has not been maintained, and recent facts have seemed rather against the theory of a causal relation between the two orders of phenomena.

Thus the teaching of the curve here given appears to harmonize, in general, with known facts about annual rainfall. I do not propose to try and weigh the data so far as they may be considered to favour the theory just indicated (earlier and greater part of the curve), nor the data which may be considered adverse (in the short, later part). It seems to me that the curve may be usefully studied *per se*, apart from any relation to sunspots. Thus we might note the fact that all those maxima where our summers have got to a turning point from wet to dry have been quite near the beginnings of the decades. The dates are 1830, 1839, 1850, 1861, and 1880. The curve ends at 1890 (the final point representing, of course, 1888–92), and the position of this point, together with the date, seem to warrant our



Smoothed curve of rain days in Summer at Greenwich, with curve of Sun-spots.

looking for an early descent of the curve, and a commencing series of (on the average) drier summers than we have had lately.

We might also note that the minima of the curve have ranged from the fives to the eights. Thus we have, 1827, 1835, 1845, 1857, 1868, 1885. Should the recurrence continue, we might look for the next minimum about 1895–1898. Of course there may be difference of opinion as to the strength of the presumption here afforded for such a forecast, and no good reason is offered (beyond experience) why the curve should now take the course roughly indicated.

It is not at variance with the above view that there is reason, it would appear, to anticipate soon a series of wetter *years*. In an article contributed to the *Times* of October 22 last year (cited in NATURE, vol. xliv. p. 630) Mr. Symons says: "There is no doubt that since 1887, at all events, the rainfall over England has been much below the average; and a consideration of all the facts leads to the conclusion that such a period of scarcity is very likely to be followed by one of abundance, and that the coming few years will probably be more rainy than those recently experienced, although possibly the increase will not occur in the summer months—at a time when it would be most noticed."

A. B. M.

"Aminol."

MY attention has only now been called to the letter of Dr. Klein, which appeared in NATURE, *ante*, p. 149.

To the remarks referring to "Aminol" (with Periodate I am in no way concerned) I desire, with your kind permission, to make the following reply, as they contain inaccuracies which, if not corrected, must do me injury.

The samples of "Aminol" alluded to by Dr. Klein were sent by me to a number of medical practitioners who had kindly consented to give it a trial. The strength of the samples was 1 in 5000.

Dr. Klein has carried out between September, 1890, and March, 1891, five separate consecutive series of experiments with "Aminol," with the object of testing its applicability to the treatment of certain external disease processes. His results are recorded in a report, the summary and conclusions of which were published last year with his full approval. The strength of solution employed in the first four series (which were only of a tentative nature with a view to arrive at a proper strength of solution for practical application) was 1 in 6000; in the fifth series a solution of the strength of 1 in 600 was used. Dr. Klein's letter leads one to suppose that he operated only with the latter strength.

The pathogenic germs selected for testing the power of the disinfectant were: spores of *Bacillus anthracis*, sporeless *Bacillus anthracis*, *Staphylococcus aureus*, *Bacillus diphtheriæ*, and *Streptococcus erysipelatis*. Amongst the results obtained with the solution of the strength of 1 in 6000 his report mentions the following: In Series IV., "On *Staphylococcus aureus*, which may be taken as the most resistant microbe amongst those associated with surgical and other external disease processes, the "Aminol" solution (1 in 6000) did produce an effect, though a limited one, after two hours already, and after twenty-four hours destroyed the microbes." In Series I.: "'Aminol' solution (1 in 6000) kills the *Bacillus diphtheriæ* in two hours. This was confirmed in Series III." In this connection it deserves to be noted that I possess already ample evidence, which will be published in due course, of conspicuous successes obtained in practice not only with the solution of the strength of 1 in 5000, but also with dilutions of the same, even to 1 in 20,000.

Dr. Klein's statement of the results which he obtained with "Aminol" in the strength of 1 in 600 is misleading. He says: "Spores of *Anthrax bacilli* remained unaffected after eight hours, only after an exposure of twenty-four hours did the number of living spores decrease; but some escaped disinfection even after so long an exposure. Now what are the facts? I quote from Dr. Klein's report:—

"Spores of *Bacillus anthracis* after 1, 2, 8, and 12 hours	good growth.
"Spores of *Bacillus anthracis* after 24 hours	growth reduced from 100 to 6."

Is it putting the case fairly or even clearly, seeing that no tests were made between twelve and twenty-four hours, to say "only after twenty-four hours did the number decrease," and seeing that only 6 per cent. remained after twenty-four hours? Is not that a decrease practically amounting to disinfection? Would it be extravagant to assume that the insignificant percentage remaining would be eliminated after a very little longer exposure (say another hour), and is there any doubt that a solution of the strength of 1 in 500 or 1 in 400 would have accomplished complete disinfection in a much shorter time than twenty-four hours? But in order to illustrate the significance of the results actually obtained with this solution of the strength of 1 in 600, let us see which other disinfectants can kill anthrax spores in twenty-four hours. I quote from "Koch on Disinfection," abstracted and translated by Whitelegge, published by the New Sydenham Society:—

(1) "For practical purposes a disinfectant should not require much longer than twenty-four hours."

(2) "Except chlorine, bromine, and iodine, only mercuric chloride, osmic acid, and potassic permanganate (5 per cent.) destroyed anthrax spores within twenty-four hours. Since a 5 per cent. solution of permanganate is inadmissible for disinfection in bulk, and osmic acid is out of the question, we have left only mercuric chloride and iodine, bromine, and chlorine."

The strengths in which the above-named substances succeeded in destroying anthrax spores in twenty-four hours are stated in Koch's tables thus:—

Permanganate,	aqueous solution	5 per cent	(1 in 20).
Bromine	,,	2 ,,	(1 in 50).
Chlorine	,,	?	
Iodine	,,	?	
Mercuric chloride	,,	1 per cent	(1 in 100).
Osmic acid	,,	1 ,,	(1 in 100).

Now put against this the fact, quoted above, that Dr. Klein found "that 'Aminol,' strength 1 in 600, killed 94 per cent. of anthrax spores in twenty-four hours," and further (I am quoting his report again), "that this solution is a perfectly harmless fluid as regards the human organism; therefore no undesirable disturbances could ensue owing to its being absorbed; this is well known to be the fact with some antiseptics, as in carbolic acid applications or in the use of perchloride of mercury."

Does not all this clearly establish the claim of "Aminol" to be called not only a true disinfectant, but a most potent and a most safe one at the same time?

But with all this (I mean what relates to its effect on anthrax spores) its application in medical and surgical practice has nothing to do, unless it be to demonstrate its comparative potency, for, as Dr. Klein himself points out in his report, "The spores of *Bacillus anthracis* may be left out of consideration, as they do not occur in the living body; under these conditions the *Bacillus anthracis* is always sporeless; a malignant carbuncle of the skin contains the *Bacillus anthracis* only in the sporeless state, and in infection with anthrax generally the bacilli are always in the sporefree state both in the blood and in the tissues."

What is of real importance in practice is the effect of "Aminol" on the other pathogenic germs on which Dr. Klein has tested it. And here again his letter states the case in a manner which is apt to mislead: "*Anthrax bacilli*, *Staphylococcus aureus* and others were destroyed, but only after a lengthy exposure."

Now what does his report say? "Series V. From this series it will be seen, therefore, that the solution used in the same (1 in 600) acted very differently from that used in the previous experiments (1 in 6000) inasmuch as the *Staphylococcus aureus*, which was not killed heretofore in eight hours, was in this instance completely disinfected in that time, and was considerably reduced even in one hour. The sporeless *Bacillus anthracis*, *Bacillus diphtheriæ*, and *Streptococcus erysipelatis* were killed in one hour." Can it be fairly said, then, that these were killed only after lengthy exposure, and does the word "only" apply at all to the one-hour results, when it is considered that there was no test made under the one hour? What is there to show that those of which there was no growth after one hour's exposure to the disinfectant had not been killed after ten minutes already?

Does it not look, then, as if Dr. Klein had penned his letter without consulting either his notes or his report?

A word in conclusion. Dr. Klein, for whom perhaps nobody entertains a higher personal regard than myself, may rest assured that the designation, "a true disinfectant," is meant by me to apply only to such strengths of solutions of "Aminol" as can compete with those substances and their respective strengths to which Koch has accorded that appellation. Nor need he to apprehend that anything has been or will ever be done by me intentionally committing him to what is not fully warranted by his actual results as recorded in his authorized published report. HUGO WOLLHEIM.

101, Leadenhall Street, E.C., January 2.

THE point at issue between Mr. Wollheim and myself is a very simple one, and needs no long explanation on behalf of Mr. Wollheim. As you will see from the letter which you kindly printed in NATURE, *ante*, p. 149, Mr. Wollheim, without my authority, has sent round a leaflet with my name on it, accompanying bottles of "Aminol," stated to be "a true disinfectant."

1. On this leaflet my name is introduced in a somewhat misleading manner, for it quotes to a large extent from my reports on the lime and brine experiments on microbes without saying so, but leaving the reader to infer that these reports of mine refer to "Aminol."

2. Mr. Wollheim never asked my permission or informed me of his intention of sending with each sample bottle of "Aminol" such a leaflet. It is unnecessary to say that had he asked me whether he could use my name on a wrapper of a patent medicine I should have emphatically answered *no*. He has recently informed me that he has cancelled the leaflet.

3. The samples of "Aminol" sent out were of the strength of 1 in 5000, the experiments in which I showed that "Aminol" possesses a certain disinfecting power were made with a strength of 1 in 600. This strength did not kill spores of anthrax in 12 hours; 1 in 6000 did not kill *Staphylococcus aureus* in 8 hours.

A substance which, like the "Aminol" sent out (viz. 1 in 5000), cannot kill *Staphylococcus aureus* in 8 hours, and has practically no effect on spores of *Bacillus anthracis* cannot be considered "a true disinfectant."

To show that Mr. Wollheim had a very strange idea about the whole matter, one has only to compare the actual facts of the case, as regards "Aminol" of the strength of 1 in 5000, with the motto put on the leaflet and the inscription on the label of the samples. For Mr. Wollheim quotes Koch to the effect that no disinfectant can be called a true disinfectant that does not kill spores, and notwithstanding that I have shown that "Aminol" even of the strength of 1 in 600 cannot kill spores in 12 hours, yet Mr. Wollheim advertises the "Aminol" of the strength of 1 in 5000 as "a true disinfectant." A true disinfectant kills spores after short exposure; a substance that requires many hours to do so cannot claim the name of a specific disinfectant. Vinegar, dilute acids, alkalies, and a host of substances affect spores after exposure for many hours (8, 12, and 24 hours), yet no one would consider these substances as specific disinfectants.

Again, a substance used in a certain strength (say 1 in 600) may have considerable disinfecting power on non-spore bearing microbes, with or without having any conspicuous action on spores. The same substance more diluted (say 1 in 5000) may have retained such action only to a very insignificant degree. Take for instance perchloride of mercury; while this substance is a powerful disinfectant when used in the strength of 1 in 500, 1 in 1000, even 1 in 2000, it has greatly less effect when used in more increased dilution.

No one is justified in advertising perchloride of mercury of the strength of 1 in 100,000 as "a true disinfectant," knowing that 1 in 500 or 1 in 1000 only can be so called. How much more does this hold good for a substance like "Aminol," which even in the strength of 1 in 600 does not kill the spores of anthrax in 12 hours, a period which for practical purposes of disinfection is out of the question. E. KLEIN.

19, Earl's Court Square, S.W., January 9.

Super-abundant Rain.

IN NATURE of November 10 the fact that "very nearly one-third" of the annual rainfall fell in one month at Nant-y-Glyn, in North Wales, is recorded as "remarkable."

But at Peshawar, on the north-west frontier of India, we received during last August a rainfall of 17·75 inches, the average local annual fall, calculated from the last fifteen years, being 13·51 inches.

We therefore had very nearly sixteen months fall in one month, and by far the largest portion of this fell in ten days of the month.

I need hardly add that the whole valley was flooded, and that we have since paid for our super-abundant rain in the form of very prevalent and fatal malarious fever. H. COLLETT.

Peshawar, December 19, 1892.

Earthquake Shocks.

THERE were two unmistakable shocks of earthquake on the afternoon of Tuesday, January 3, the first at 2h. 15m. 15s. G.M.T., and the second at 2h. 17m. I was sitting in a railway carriage at Severn Junction Station waiting for the Bristol passengers, when I felt a sensible upward movement of the seat (as if pushed from below) and saw the carriage sway. The movement was from south to north (*i.e.* at right angles to the railway). This was repeated four times in about six seconds. At 2h. 17m. there were two more (less strong) shocks. The carriage was placed in a siding, and there was no train at the station, and the air was calm and frosty. Ice was said to have cracked near here at this time. E. J. LOWE.

Shirenewton Hall, Chepstow.

A Brilliant Meteor.

ON Wednesday, January 7, at about 6.35 p.m., I was fortunate enough to see a brilliant meteor descending a little north of Castor. My attention was drawn to it by the brilliant light it threw over the country. The head was a ball of dazzling white and the tail yellow, with red streaks. It disappeared before reaching the earth, and I heard no report or rushing sound whatever.

As the duration was only a few seconds the above are more impressions than observations. W. POLLARD.

Pirton, Herts, January 7.

CHEMICAL SOCIETY'S MEMORIAL LECTURES.

AT an extra meeting of the Chemical Society, held on December 13 last, this being the first anniversary of the death of Stas, a paper was read and discussed which had been prepared for the occasion by Prof. J. W. Mallet, F.R.S., of the University of Virginia, U.S.N.A. —himself a high authority on atomic weight determinations, and well known to chemists through his papers on the atomic weights of aluminium and gold, published by the Royal Society of London.

The lecture marks a new departure in the work of the society. Hitherto our learned societies have been in the habit of publishing more or less complete—it would probably be nearer the truth to say incomplete—obituary notices of their foreign members. The Chemical Society has come to the conclusion, however, that inasmuch as its foreign members are always men of great distinction who, as a rule, have lived a considerable number of years after accomplishing their life work, it will be to the advantage of its fellows and of chemists generally, if the obituary notices of foreign members take the form of critical monographs of the subjects with which they have principally dealt.

The anniversary of the death of the foreign member is obviously the most appropriate occasion for the delivery of such a lecture. During the past year the society has lost two of its foreign members: Hermann Kopp, noted as an historian, as well as on account of his very numerous exact determinations of atomic volumes and specific heats, and A. W. von Hofmann. The life and work of the first mentioned will form the subject of a lecture to be delivered on February 20 next, by Prof. Thorpe, the Treasurer of the Society, than whom no one is more qualified to undertake the task. Prof. Thorpe is not only a pupil of the deceased chemist, but has reverently followed in his footsteps—having very largely extended Kopp's observations on atomic volumes in an elaborate investigation, the importance of which was recognised by the Chemical Society in 1881 through the award to him of its first Longstaff medal.

Von Hofmann, although originally a foreign member, became an ordinary member of the Chemical Society on coming to England as professor at the school in Oxford Street, long since merged in what is now known as the Royal College of Science, London. Hofmann was never again regarded as a foreigner; he served the society both as foreign secretary and as president, filling one of the vice-chairs during the remainder of his life. It is felt that owing to the special nature of his relations to the society and to english chemistry, it will be necessary to deal with his case in an exceptional manner; it is therefore hoped that in May next Lord Playfair—who was so intimately connected in his early days with chemical science and with the society—in the first place will picture the state of affairs chemical at and prior to the time of Hofmann's arrival in England. Sir F. Abel, Hofmann's first pupil and assistant, will follow with an account of Hofmann at the Royal College of Chemistry, calling to his aid for this purpose the remaining friends and pupils of Hofmann. The coal-tar colour industry, which has now attained such important dimensions, it is well known, had its origin in the Oxford Street laboratory, and Dr. Perkin—its parent—has consented to sketch the history of its development. In this manner it is hoped to impart considerable "local colour" to the Hofmann memorial lecture, thereby distinguishing it from the notice which is being prepared by the German biographers.

Passing now to Prof. Mallet's lecture on Stas, which is of considerable length, as it will occupy fully sixty pages in the Society's Journal. The biographical portion is brief, as a number of such sketches have already been published. Stas was born on Louvain on August 21, 1813. He graduated as Doctor of Medicine. His taste for chemical research was evidenced in 1835, when, together with a friend, he investigated in an attic of his father's house the crystalline substance phloridzin which they had extracted from the root bark of the apple tree. He continued the study of this substance in Dumas' laboratory in Paris, and it is an interesting proof of the acumen of Berzelius that in his annual report on the progress of chemistry he referred to this first research made by Stas with praise, and a prediction of future eminence for the author.

The starting-point of the long train of research with which his name will ever be associated was the redetermination of the atomic mass of carbon which Dumas and he together undertook, in order to explain the fact, noticed by Liebig and others, that the sum of the carbon and hydrogen found in hydrocarbons by the combustion process, as calculated from the carbon dioxide and water, not unfrequently exceeded the quantity of material analyzed. As the result of this investigation, which was carried out with unprecedented care and the most elaborate precautions, the value hitherto accepted for carbon on the authority of Berzelius (76·432 O = 100) was considerably reduced (to 75·005). In 1840 Stas was appointed Professor in the École Royale Militaire at Brussels; he held this post for more than a quarter of a century, until an affection of the bronchial tubes and larynx obliged him to give up lecturing. He then received an appointment in the Mint, but resigned this in 1872 on political grounds, and withdrew into private life. He appears to have been a man of great independence of character.

Apart from his atomic weight investigations Stas did much work of value in other departments. His method of separating alkaloids from organic messes—no other name is applicable—which has been of such service in subsequent toxicological inquiries, was devised in 1850, in the course of the inquiry into the celebrated Bocarmé nicotine poisoning case. He examined into the methods of hydrolysing fats for the purpose of a report on the chemical section of the London 1862 Exhibition. In connection with the preparation of international standards he took an active part, along with Devile, in the inquiry into the properties of the platinum metals. It is known also that he did important work for his Government in investigating alloys for use in the construction of artillery.

Prof. Mallet prefaces his account of Stas's special investigations by an historical survey of the fundamental ideas which have gradually led up to the question, What is the mass of an atom of a particular element? Even in and beyond the days of Cavendish and Priestley the fact that atmospheric air was found of constant or nearly constant composition was long a stumbling-block in the way of clear distinction between a homogeneous compound and a uniform mixture. To the labours of Van Helmont, Boyle, and Boerhave much credit is due for the gradual advance towards the doctrine of the conservation of matter. The discoveries of Black and Cavendish brought it further into view, and it assumed its due importance and began to receive universal recognition with the constant appeal to the balance which Lavoisier made and taught others to make. Next came a comparison of the quantities of different substances, at first chiefly the then known acids and bases, which would enter into combination with each other. Proust, in the course of his controversy with Berthollet as to the fixedness of combining proportions, had observed that in certain cases it was true that in different compounds, consisting of the same constituents, for a fixed quantity of one constituent, the different quantities of another constituent bear to each other a simple multiple or sub-multiple relation. To Dalton, however, belongs the honour of announcing the principle as a general one, and of basing upon it a true chemical atomic theory of the nature of matter. Berzelius, in the early years of the present century, with apparatus in many respects inferior to that of the present day, and with scarcely any aid from chemical manufacturers in preparing pure materials and reagents, but with unsurpassed manipulative skill and the most honest criticism of his own work, produced the first fairly trustworthy list of numbers representing the proportions by weight in which the elements combine. Berzelius began work in this direction in 1807, his attention having been attracted by Richter's investigations; but soon afterwards he became acquainted with Dalton's new atomic theory of the nature of combination, and appears to have been impressed with its great importance, and at the same time with the need of more exact experimental data for its support and development. The wonderful accuracy of Berzelius's work generally is illustrated, as Prof. Mallet points out, by the fact that his number for oxygen, 16·021, becomes 15·894, almost exactly agreeing with the latest determinations of the present day, if the weighings of Dulong and Berzelius's three experiments on the synthesis of water be corrected for the buoyancy of the air. Since Berzelius many other chemists have worked in the same field, but his most worthy successor in such labours has undoubtedly been Stas. With greatly better resources in the way both of apparatus and material, with equal earnestness in seeking for the truth, with equal intelligence and skill he took up the task which became that of the largest part of his scientific life, and for a more limited list of elements than Berzelius had investigated, produced results of a degree of accuracy which it is high praise to say would have delighted no one more than Berzelius himself. He aimed at the determination with greater precision than any one before him had attained of the atomic weights of some ten or twelve of the elements. But by so determining these constants he endeavoured also to settle several general questions of fundamental importance in regard to matter as studied by the chemist.

Thus it has generally been assumed as true beyond dispute since the early part of the present century, that the mass of an atom of a given element is a constant quantity. This has, however, occasionally been doubted, and Stas himself considered the question as one requiring examination. His researches, however, lend no support to it. On this point Prof. Mallet expresses himself strongly in favour of the orthodox view.

Assuming that the atomic weights are immutable values, the question arises, Are they commensurable? This is the much-discussed hypothesis of Prout, the origin and development of which is very fully discussed by Prof. Mallet. A widespread feeling at one time undoubtedly existed among chemists that Prout's hypothesis, that the atomic weights of the other elements are integer multiples of that of hydrogen, if not true in its original form would ultimately prove to be so at least in a modified form. That Stas began his work under the influence of this feeling is clear from his own words:—

"Je le dis hautement lorsque j'ai entrepris mes recherches, j'avais une confiance presque absolue dans l'exactitude du principe de Prout."

But his experimental results clearly contradicted the hypothesis, and he satisfied himself that the atomic weights of the elements which he determined with such precision could not with truth be represented by integer multiples of the atomic weight of hydrogen, or the half or the fourth of this unit. In his own words:—

"Aussi longtemps que, pour l'établissement des lois qui régissent la matière on veut s'en tenir l'expérience, on doit considérer la loi de Prout comme une pure illusion. La simplicité de rapport de poids que présuppose l'hypothèse de Prout entre les masses qui interviennent dans l'action chimique, ne s'observe donc point dans l'expérience; elle n'existe point dans la réalité des choses."

The great majority of chemists—Prof. Mallet remarks—at the present day, are probably agreed in believing that the hypothesis of Prout has been shown by Stas to be untenable. But the fact that so many well determined atomic weights, referred to hydrogen as unity present numbers *nearly approaching integers*, is very striking and calls for further investigation. Stas himself is quoted as admitting this much. Prof. Dewar, in the course of the discussion after the paper was read, drew special attention to this question and gave several most striking instances of the nearer approach to whole numbers which resulted from a recalculation of the accepted values, using the lower value for oxygen (15·87) which so many recent researches tend to support, although on the other hand, of course, some of the values now near to whole numbers are considerably thrown out. Evidently there is ample opportunity for further experimental investigation of this all-important problem, and it is impossible—notwithstanding the extraordinary degree of accuracy attained by Stas—to formulate any final conclusion. The supreme interest attaching to the problem was clearly recognised by Stas himself, as the following words show:—

"Au point de vue de la philosophie naturelle, la portée de l'idée de Prout est immense. Les éléments des corps composés que nous considérons comme des corps simples en égard à leur immutabilité absolue pour nous, ne seraient eux-mêmes que des corps composés. Ces éléments, dont la découverte fait la gloire de Lavoisier et a immortalisé son nom peuvent être considérés ainsi comme dérivant de la condensation d'une matière unique: nous sommes naturellement conduits à l'unité de la matière, quoi qu'en realité nous constations sa pluralité, sa multiplicité."

This quotation is almost alone sufficient to show that Stas was a philosophical chemist of the highest order, and not a mere mechanical worker, as has sometimes been supposed; his unwearied attention to minutest details has undoubtedly served to completely overshadow the philosophical motives and aspirations by which he was guided.

Stas also endeavoured to obtain evidence with regard to the possible dissociation of the elements at high temperatures and to this end purified his materials with every imaginable precaution. The skill with which he carried out his operations is attested by the statement made by Mr. Crookes, the chairman at the reading of Prof. Mallet's paper, that he had seen in Stas's laboratory a large mass of potassium chloride, which Stas had been years in preparing, and in which he had failed to find a trace of sodium even spectroscopically—such an achievement appears almost inconceivable to the chemist. Stas, in fact, in the course of his work investigated the methods of analysis to be used with a degree of rigour, and discovered and applied refinements upon older methods of experiment with a degree of patience and skill, such as had never before been used in chemical investigation. Only those who are thoroughly conversant with such work can fully appreciate his labours; they probably will agree that owing to the multitude and diversity of the precautions to be taken, his work is the most difficult hitherto attempted, and that he stands unsurpassed among all who have undertaken the execution of exact physical measurements.

A lengthy section of Prof. Mallet's paper is devoted to the consideration of the objects to be aimed at and the methods to be pursued in future work. He advocates the repetition by competent hands of some one at least of Stas's fundamental results, calling attention to Stas's own emphatic expression of the wish that this should be done. It is also most important that no distinction should be made between rare and common elements, and that the atomic weights of all should be determined with the least possible delay and the highest attainable degree of accuracy. Certain of the elements particularly call for a more searching and exact investigation of their atomic masses, *e.g.* elements such as tellurium, which occupies a position in the periodic system not in harmony with its atomic mass, and cobalt, which plainly occupies the intermediate position between iron and nickel, and therefore should be intermediate in atomic mass.

In a number of cases the accepted value is based on the investigation of but a single interchange, the value for iron, for instance, being practically based on the results obtained on converting the metal into ferric oxide, and *vice-versâ*; and the relation of hydrogen to oxygen having been established by the reduction of cupric oxide. It is desirable that in such cases other and independent methods should be resorted to, *e.g.* that oxides of a number of metals other than copper should be reduced, with the object of detecting possible constant errors.

It is eminently desirable that an attempt be made to directly determine the ratio of hydrogen to each of the halogens without in any way bringing in the atomic mass of oxygen. Prof. Mallet suggests various methods deserving of study. Also it is very important that the metals of the yttrium and didymium groups should be further investigated. Prof. Mallet rightly terms the yttrium group the opprobrium of inorganic chemistry.

Nearly all that has been written hitherto in regard to the periodic relationship among the elements has involved the use of roughly approximate values only; but it is time that the foundation be laid for a more minute and critical study of the periodic system of classification. Anomalies in the classification as we now find it in our books, glimpses of more detailed relations than as yet clearly appear, tantalizing suggestiveness in so much of what is already before us, call for more precise determinations of the numbers we would discuss before we allow premature discussion to drift into mere fanciful speculation.

In regard to the methods which it is desirable shall be pursued in the determination of atomic masses, Prof. Mallet has much to say. He discusses the selection of processes, the purity of materials, the very numerous directions in which vigilance must be exercised in order to avoid extraneous or accidental causes of error, the quantities of material to be used, the practical precautions to be observed so as to secure accuracy of manipulation and in weighing and measuring, the mode of stating and calculating results, finally calling attention to the advantage to be derived from the application of greater working force and ampler means than can be commanded by private individuals to the determination of atomic masses; with reference to this last point, during the discussion on the paper, the opinion was freely expressed that it was undesirable that such work should be carried out in organized public or semi-public laboratories. The question is, no doubt, a difficult one to settle—such work demands a special temperament combined with genius of a high order and an infinite capacity for taking pains, qualities which must rarely occur united in a single individual. Moreover, in order that the value of a result may be appraised, it is essential to overlook every detail involved in the determination. Given the man, however, there can be no longer a doubt that every possible assistance he may require should be afforded him. It is marvellous that men like Berzelius and Stas, working all but alone and unaided, should have achieved results of such magnitude and universal importance—the moral effect of their example is certainly not less important than are the actual results of their labour.

The last section of Prof. Mallet's paper is devoted to the discussion of the form in which it is desirable finally to state the results. He here advocates the uniform substitution of the expression "atomic mass" for "atomic weight," on the ground that precision in language conduces to precision in thought—an aphorism far too commonly disregarded by chemists. We have now clear conceptions of atoms having constant mass for the same element, of determinable difference of mass in the case of different elements, the several masses and numbers of which regulate the composition of all known substances and the products resulting from interaction among them. The atomic theory has advanced far beyond the condition of a mere working hypothesis on which chemists long stood with more or less uncertain feet; but even if this were not so, considering it, to use a common metaphor, only as a scaffold, there is no good reason, so long as we stand on it and work from it, that we should be careless about tying our scaffold-poles and nailing our planks.

Lastly, Prof. Mallet urges that all atomic masses shall be expressed in terms of the mass of the hydrogen atom taken as unity, objecting strongly to the change to $O=16$ which several writers have recently advocated, the most objectionable argument put forward in favour of such change being, he thinks, that the numbers we use are expressive of *ratios* only—that any figures are allowable which correctly express combining ratios, and that there are no reasons for using one set of figures rather than another save mere arithmetical convenience. This involves a grave error, as in adopting as unity the mass of a single atom of any particular element, preferably that one of which the mass is the smallest, we have reason to believe that we express the mass of all the others in terms of this as a really existent, definite, and constant quantity of matter. It is, indeed, difficult to understand when the scientific necessity in so many cases of taking hydrogen as the unit is realized, how the change to $O = 16$ can be advocated except on the simple utilitarian plea that it is to the analyst's convenience.

Prof. Mallet's monograph is undoubtedly a most admirable exposition of the philosophical lessons to be learnt from the contemplation of Stas's labours.

EXTINCT MONSTERS.[1]

THE volume with this title treats of large animals. It is clearly and simply written, without any pretence at being scientific, and is an excellent book for boys and unlearned people who are curious to be informed upon the subject of fossil animals. It would have escaped criticism altogether but for emphatic words of praise in the preface, and one or two passages in which the author, with second-hand information, speaks authoritatively of predecessors who restored extinct types of life with the slender materials which were available forty years ago. The attraction of the volume and its novelty is a series of restorations of saurians and mammals drawn chiefly by Mr. Smit. These for the most part are based upon the restorations of skeletons made by Prof. Marsh, whose discoveries have inspired Mr. Smit's pencil as much as they have influenced the author's pen. There is not much anatomy beneath the skins of the "Monsters," and they have an aspect as though cotton-wool had taken the place of muscle, or as though the drawings were models for the "Lowther Arcade." This, however, is of less importance than the answer given to the question, Are they reasonably faithful to nature? It does not seem to me that they can claim this merit; they are only reasonably faithful to Marsh. Prof. Marsh draws an animal so as to give one type the maximum height to which the bones can be hoisted; while another is given the maximum length to which the remains can be extended. My own studies would not have led me to reconstruct one of the extinct reptiles upon the lines which are adopted in

[1] "Extinct Monsters." A popular account of some of the larger forms of ancient animal life. By Rev. H. N. Hutchinson, B.A., F.G.S., with illustrations by J. Smit and others. (London: Chapman and Hall, Ld., 1892.)

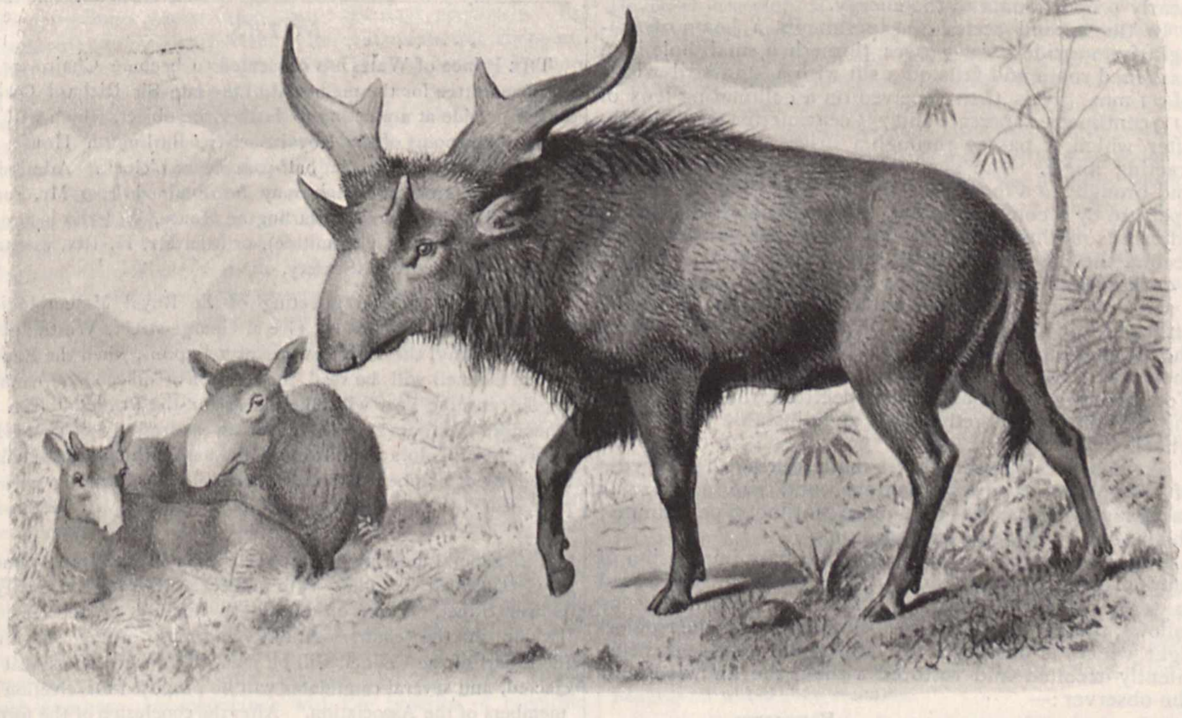
these restorations. As an example of how a restoration should not be made, we may instance the figure of *Stegosaurus ungulatus* (p. 104), in which the management of the limbs is out of harmony with the evidences of the muscular structure of the tail, and the supra-vertebral crest. The restoration of the Scelidosaurus from the Lias of England is unsatisfactory. There is no better ground for giving a kangaroo-like position to that animal than there would be for drawing Teleosaurus in the same position. The mobility of the neck as drawn is astonishing.

The restorations of mammals are happier. The subjects diverge less from existing types. And probably the most successful in the volume is the spirited restoration of *Sivatherium giganteum* from the Sivalic Hills, though the Glyptodon and Irish Deer are meritorious.

In the text the author is generally content with telling the story of the history of science; but he sometimes strays into less safe matter. Thus an account is given of the eye of the Ichthyosaurus. And it is urged that the bony plates exercised a pressure on the eyeball, so as to make the eye more convex, and improve the definition of near objects. The study of sclerotic defences does not support this interpretation; and in at least one generic division of the Ichthyosauria the sclerotic plates do not overlap at all, but join each other by their lateral sutural margins.

It is perhaps unfortunate that the author gives currency to nomenclature and classification of the terrestrial types of saurians which may not always prevail. If the genera with a bird-like type of pelvis are terrestrial representatives of birds, and the genera with a reptilian type of pelvis are terrestrial wingless representatives of Pterodactyls, then it may not be an advantage to have the Dinosaurs treated as a homogeneous group, or the divisions adopted by Prof. Marsh, or in the British Museum (Natural History), handed on to the unlearned as representing the best available classification. On page 75, the author introduces a restored skeleton of Megalosaurus, which is attributed to Prof. Marsh. The skeleton certainly is not referable to Megalosaurus, which never has the pubic bones or the ilium constructed as in the figure. The restoration has been previously used in Nicholson and Lydekker's "Palæontology," and in Dr. Woodward's "Handbook to the Geological Department of the British Museum," but we do not remember any published authorization for the use of Prof. Marsh's name as authority for confounding Megalosaurus with the allied American type.

Another example of the same kind of interpretation occurs in dealing with Stegosaurus. It is said to have been proved that bones to which the name Omosaurus has been applied really belong to Stegosaurus, and that an unnecessary name has been disposed of. The ground on which this determination is made, not being stated need not concern us now; but it is undesirable that a popular work, whose main merit is that it does not pretend to teach the facts of science, should appear to enunciate judgments on scientific problems. Having described the immense enlargement of the spinal cord in the sacral region of Stegosaurus, the author remarks:—"So this anomalous monster had two sets of brains—one in its skull, and the other in the region of its haunches!—and the latter in directing the movements of the huge hind limbs and tail did a large part of the work." Remarks of this character are sure to be misunderstood, are out of place and incorrect.



The four-horned extinct Mammal *Sivatherium giganteum*. The animal on the left is Heladotherium.

The author has read much, and shown an excellent capacity for quotation, but has not always succeeded in using the newest results. He has conscientiously endeavoured to tell the story which is contained in his quotations, but beyond this he does not pretend, except in the occasional use of supposed scientific principles as a means of accounting for facts of animal structure. He has dealt with a subject of great difficulty with commendable clearness, and will interest readers who would be unable to follow a more technical exposition of extinct types of life. H. G. S.

ENERGY AND VISION.

THE interesting researches of Prof. S. P. Langley on energy and vision have recently been published in the Memoirs of the American National Academy of Sciences. From this we gather that he was led to investigate the question by the fact that it was not generally recognized how totally different effects may be produced by the same amount of energy in different parts of the spectrum. Two series of experiments were necessary, the first to determine the amount of energy in each ray, the second to observe the corresponding visual effect. The energy was determined as heat by the use of the bolometer, the heat dispersed by a prism being very nearly proportionate to the energy.

In the second series of experiments a beam of sunlight from a siderostat passes through a small hole in a darkened room and falls on a slit with a standard width of 0·1 mm. It is then received on a collimating lens of 11·9 centimetres aperture and 755 centimetres focal length, after which it passes through a prism of about 60° refracting angle. The spectrum thus formed is reflected and brought to a focus on a second slit of one millimetre aperture by a concave mirror, any particular colour being adjusted on the slit by a rotation of the prism. This second slit is screened from all possible stray light by a dark curtain, and is used as a source of illumination for a series of numbers from a table of logarithms, which is attached to a sliding screen. The greatest distance from the slit at which the figures could be distinctly read was then determined, and the law of inverse squares applied. For the brighter colours of the spectrum, the light entering the first slit was reduced by an adjustable photometer wheel.

Actinometric measures were made during the progress of the photometric observations, and showed a solar radiation of 1·5 calories per square centimetre per minute; this naturally being an essential unit.

The energy necessary to give the bare impression of luminosity in different parts of the spectrum, expressed in terms of horse-power, was found to be roughly as follows, the *minimum visibile* being defined as the feeblest light which is observed to vanish and reappear when silently occulted and restored without the knowledge of the observer :—

		Horse-power.
Violet (λ 400)	...	0·000000 000000 00018000
Green (λ 550)	...	0·000000 000000 00000075
Scarlet (λ 650)	...	0·000000 000000 00017000
Crimson (λ 750)	...	0·000000 000000 34000000

These values were derived from observations made by a single observer, Mr. F. W. Very, and are, of course, subject to a large percentage of error.

The general results of the investigation may be best summarized in Prof. Langley's own words :—

"The time required for the distinct perception of an excessively faint light is about one-half second. A relatively very long time is, however, needed for the recovery of sensitiveness after exposure to a bright light, and the time demanded for this restoration of complete visual power appears to be greatest when the light to be perceived is of a violet colour. The amount of energy required to make us *see* varies enormously according to the colour of the light in question. It varies considerably between eyes which may ordinarily be called normal ones, but an average from those of four persons gives the following proportionate result for seven points in the normal spectrum, whose wave-lengths correspond approximately with those of the ordinary colour divisions, where unity is the amount of energy required to make us see light in the extreme red of the spectrum near A, and where the six preceding wave-lengths given correspond approximately to the six colours, violet, blue, green, yellow, orange, red.

Colour	Violet	Blue	Green	Yellow	Orange	Red	Crimson
Wave length	400	470	530	580	600	650	750
Luminosity	1600	62,000	100,000	28,000	14,000	1200	1

It appears from this that the same amount of energy may produce at least 100,000 times the visual effect in one colour of the spectrum that it does in another.

If now it be inquired what the actual value of unity is in ordinary measure, we are able to give this also with a fair approximation, and to say that the *vis-viva* of the waves whose length is 7500 (tenth metres) being arrested by the ordinary retina, represents work done in giving rise to the sensation of the deepest red light of about 0·001 of an erg in one-half second.

NOTES.

THE Prince of Wales has consented to become Chairman of the Committee for the memorial of the late Sir Richard Owen, and to preside at a meeting to further the object, which will be held in the rooms of the Royal Society, Burlington House, on Saturday, the 21st inst., at half-past eleven o'clock. Admission will be by tickets, which may be obtained from Mr. Percy Sladen, Linnean Society, Burlington House, W. (who is acting as secretary to the Committee), or from Mr. H. Rix, assistant secretary of the Royal Society.

THE annual general m eeting of the Royal Meteorological Society will be held at 25, Gre at George-street, Westminster, on Wednesday, the 18th instant, at 7.15 p.m., when the Report of the Council will be read, the election of officers and council for the ensuing year will take place, and the President (Dr. C. Theodore William s) will deliver an address on "The High Altitudes of Colorado and their Climates," which will be illustrated by a number of lantern slides. This meeting will be preceded by an ordinary meeting, which will begin at 7 p.m.

THE general meeting of the Association for the Improvement of Geometrical Teaching is to be held at University College, Gower Street, W.C., on Saturday, January 14, the Rev. C. Taylor in the chair. At the morning sitting (11 a.m.) the report of the Council will be read, the new officers will be elected, and several candidates will be proposed for election as members of the Association. After the conclusion of the formal business Mis. Bryant will give "A Model Lesson on Geometry, as a Basis for Discussion." After an adjournment for luncheon at 1 p.m. members will re-assemble (2 p.m.) to hear papers by Mr. G. Heppel on "The Use of History in Teaching Mathematics," and Mr. F. E. Marshall on "The Teaching of Elementary Arithmetic." Members who wish to have any special matter brought forward at the general meeting, but who are unable to attend, are requested to communicate with one of the Honorary Secretaries. All interested in the objects of the Association are invited to attend.

DR. LUDWIG BECKER has been appointed to the chair of astronomy at the University of Glasgow.

THE Comet Medal of the Astronomical Society of the Pacific Coast has been awarded to Mr. Edwin Holmes, of London, for his discovery of a new comet on November 6.

ON Tuesday next (January 17) Prof. Victor Horsley, F.R.S., will begin a course of ten lectures, at the Royal Institution, on "The Functions of the Cerebellum and the Elementary Principles of Psycho-Physiology." The Friday evening meeting will begin on January 20, when Prof. Dewar, F.R.S., will give a discourse on "Liquid Atmospheric Air."

THE severe frost which set in just before Christmas was succeeded by a rapid rise of temperature in Scotland on Friday, but in England the thermometer did not rise much above the freezing point until about twenty-four hours later. On the 5th and 6th instant the thermometer fell below 10° in many parts of Great Britain, and snow was falling in Scotland, which afterwards spread to many parts of England. The absolute shade minima recorded were—2° at Braemar, and 2° at Fort Augustus, in the north of Scotland. The distribution of pressure was unusually high over Scandinavia and northern Europe (inadvertently referred to in our issue last week as over these islands) having reached about 31·3 inches in Central Russia on the 4th, while areas of low pressure lay over the Gulf of Genoa and the south-west of Ireland. The latter depression gradually extended eastwards, causing strong easterly gales on the Irish coasts, while the anticyclone over Europe gradually gave way, the barometer at Haparanda on Monday being 1·5 inch lower than a few days previously. By Sunday all stations reported temperatures above the freezing point, while in the south-west of Ireland the maxima reached 47° and in the south of France even 63°. These changes were accompanied by rain in most parts of the country, which added materially to the rapidity of the thaw. Bright aurora was seen on Monday night in Scotland and Ireland. On Tuesday an anticyclone from the north-westward was spreading over our islands, with finer weather and lower temperatures generally, frost occurring in the north of Scotland and the central parts of England. The *Weekly Weather Report* of the 7th instant showed that the temperature in the eastern and midland parts of England was 12° to 13° below the average for the week; at several of the inland stations in England the daily maxima were below 32° through the whole period.

AN enlightened Bengali, Babu Govind Chandra Laha, has contributed fifteen thousand rupees towards the expenses of the proposed snake laboratory at Calcutta. We may expect, therefore, that the institution will soon be in full working order. According to the *Pioneer Mail*, two main lines of research will be followed in the laboratory. So-called cures for snake-bites will be tested under strictly scientific conditions, and the properties of the snake poison as such will be investigated. The laboratory will be the only institution of its kind in the world, and the Committee of the Calcutta Zoological Gardens, who have taken the matter in hand, expect that it will be largely resorted to by the scientific inquirers who visit India during cold weather. In accordance with the practice of scientific laboratories in Europe, a charge will be made for the use of the tables and instruments at a rate sufficient to cover working expenses. Work done on behalf of the Government will also be charged for according to a regular scale.

THE members and friends of the Society for the Study of Inebriety met on Tuesday to congratulate Dr. Severin Wielobycki on having completed one hundred years of life.

PROF. BAIN contributes to the new number of *Mind* an interesting sketch of the career of the late Prof. G. C. Robertson, with whose name *Mind* will always be intimately associated. Prof. Bain includes in his article the admirable notice of Robertson written by Mr. Leslie Stephen for the *Spectator*.

WE are glad to note the publication of a fifth edition, revised and augmented, of the Official Guide to the North Gallery at the Royal Gardens, Kew. It includes a short and interesting biographical notice of Miss North. A map is given to convey some idea of the extent to which her collection illustrates the vegetation of the temperate and tropical regions of the world.

A NEW edition of the list of members of the Institution of Civil Engineers, corrected to the 2nd inst., the seventy-fifth anniversary of its establishment, shows that the aggregate number of all classes is 6341, an increase during the past year at the rate of 3½ per cent.

A PSYCHOLOGICAL laboratory has been established at Yale College, where Prof. Ladd has for some years been lecturing on physiological psychology. *Science* gives an interesting account of the new institution, which has been placed under the charge of Dr. E. W. Scripture, a pupil of Wundt. The laboratory consists of fifteen rooms, three of which, including an "isolated" room, are given over entirely to research. The isolated room is a small room built inside of another room; four springs of rubber and felt are the only points in which it comes in contact with the outer walls. The space between the walls is filled with sawdust as in an ice-box. The room is thus proof against sound and light, and, according to *Science*, affords an opportunity of making more accurate experiments on the mental condition than any yet attempted.

STUDENTS of ethnography will be interested to hear that Dr. N. B. Emerson, of Honolulu, is preparing a full account of the Polynesian canoe. In a communication printed in the new number of the Journal of the Polynesian Society he points out that the various migrations of the ancient Polynesians and their progenitors, from whatever source derived, must have been accomplished in canoes or other craft, and that the *waa*, the *pahi*, &c., of to-day, however modified they may be under the operation of modern arts and appliances, are the lineal descendants of the sea-going craft in which the early ancestors of the Polynesians made their voyages generations ago. He holds, therefore, that a comparative study of the canoes cannot fail to shed light on the problems of Polynesian migrations and relationships.

AN interesting little paper on the destruction of wild birds' eggs, and egg-collecting, is contributed to the new number of the *Annals of Scottish Natural History*, by Col. W. H. M. Duthie. Collectors who require to be specially dealt with he groups in three classes—the aimless, the greedy, and the mercenary. In contrast with these is "the true collector," whom Col. Duthie defines as "a naturalist, acquainting himself with birds, their habits, flight, migration, language, and breeding haunts; his egg-collecting being only one of the means of acquiring this knowledge." The true collector should collect for himself, and should never receive an egg into his cabinet unless authenticated by an individual in whom he can implicitly trust. If all collectors were of this type, egg-dealers would cease to exist, and with them would disappear the tribe of hangers-on whom they maintain.

A GOOD study of the form of eggs has been recently made by Dr. Nicolsky of St. Petersburg. He constructs an abstract formula, by which different eggs can be compared without regard to absolute dimensions. Calling the longer axis 1000, he obtains a figure representing the ratio of the longest transverse axis to it, and another, that of the distance of the obtuse end from the "centre," or point where the longer axis cuts the plane of the equator; then forms a fraction with these two figures, and takes it as the formula of the egg. Various explanations have been offered for the different forms of eggs. Dr. Nicolsky traces all to gravity. He considers that every egg not yet coated with a solid shell departs from the spherical form and elongates, simply because of pressure on it by the walls of the ovary. In birds which keep a vertical position when at rest (such as the falcon and owl) the soft egg becomes short through the bird's weight acting against the ovarian pressure. In birds which, like the grebe, are nearly always swimming, the egg lengthens, because the body weight acts in the same direction as the ovarian compression. Lastly, eggs become pyriform (more pointed at one end than the other) in birds which, like the guillemot, often change their position, sometimes swimming and diving, sometimes perching on rocks, &c. An examination of all the eggs in the zoological collection of the St. Petersburg University fully bore out these views. Dr. Nicolsky thinks it would be useful to test the theory by experimentation, birds being kept in a vertical or horizontal position at the laying time.

FOR twelve years (1878 to 1890) M. P. Plantamour made careful observations of the displacements shown by two spirit levels (one north-south, the other east-west), in the cellar of his house at Sécheron. The instruments were transferred to the Geneva Observatory, and the work resumed by M. Pidoux in April 1891 (after six months' interruption). M. Plantamour found that the mean air temperature had a preponderating influence in the oscillations observed, while some other factors of obscure nature were involved. The first year's data at Geneva (*Arch. de Sci.*) reveal an annual oscillation of the ground of the Observatory about an axis directed north-east and south-west, such that the south-east part sinks in summer and rises in winter. The east side went down till July 16, then rose gradually till the end of December (29), thereafter sinking again. The extremes were $-4''\cdot73$ and $+4''\cdot85$ (an amplitude of $9''\cdot58$). The variations of the south side were similar, but the amplitude somewhat greater. The north-south level showed some quite abnormal variations in the autumn of 1891, to which, however, the author does not attach great importance.

AN interesting contribution to our knowledge of the adaptation of structure to function in the human body is afforded in an investigation by Signor Minervini (of the Naples Society of Naturalists) of the blood-vessels of the skin in different parts. Portions of skin were prepared so as to show the exact structure of the chief arteries in them. The results are as follows:—(1) The artery-walls of the skin in men are generally thicker than those of other organs. (2) This greater thickness is due generally, and during most of life, to thickening of the middle layer; but in childhood the outer, and in advanced years the innermost, layer is most developed. (3) The artery-walls in the hollow of the hand, the finger-tips, and the sole, are, other things equal, thicker than those in the back of the hand, the forehead, the arm, &c. This greater thickness is due chiefly to a greater development of the middle layer, and in all ages of life. The arteries in the hollow of the hand in the case of occupations involving hard manual labour show a greater increase of thickness than in the case of those with little or no such work. In these cases all three layers of the artery are thickened, but the middle layer most. (4) In women all the chief arteries of the hollow of the hand and of the back of the hand are somewhat less thick than in men. The difference is not great, but occurs at all ages.

IN a paper on the Santa Isabel Nitrate Works, Toca Chile, read lately before the Scottish Institution of Engineers and Shipbuilders, and now printed in the Institution's Transactions, Mr. G. M. Hunter has something to say regarding the origin of "caliche," as nitrate of soda is called in its native state. Some contend that "caliche" is a marine deposit, others that it is an animal deposit, while others say it is a vegetable deposit. Mr. Hunter holds the first of these views. The coast of Chile has several times been disturbed and upheaved by volcanic agency, and he suggests that a large tract of sea was enclosed and heaved up to the present height of the nitrate region, and there formed an inland sea, which, after a lapse of time under a tropical sun, evaporated, leaving the salts to percolate and form the beds of nitrate. From the formation of the ground, showing depressions and ravines leading to the sea, it is evident that immense volumes of water at some remote period have passed through them. In proof of this, Mr Hunter points out that no "caliche" is ever found in such places, the accepted opinion being that there has been a "wash out," as it is called. During a later period than that of the formation of the "caliche" great floods passed over the plains, as is shown by the deep tracks of rivers, and the smooth washed appearance of the surface. Such periodical floods are common in tropical, rainless regions, and would not call for special remark, but from the fact that wherever these river tracks or washed surface appear no "caliche" can be found. This is so well known that even the workmen never attempt to search for it in such places. The only surface indication for the presence of "caliche" is rising ground covered with small black stones. The "caliche" in its native state is white, very compact and amorphous, not unlike rock salt, but when rich in iodine it assumes various colours, according to the composition and quality of the iodine it contains. For example, at times it contains masses of bright yellow, red, or blue, and again wholly composed of a dull black colour, in which state it requires an expert to distinguish it from *costra* or rock.

MR. E. LOMMEL claims to have found a simple explanation of the Hall effect. A simple train of reasoning shows, he says, that the equipotential lines perpendicular to the lines of flow in a plate are also the lines of force due to the current. If iron filings are strewn upon the plate they will arrange themselves along the equipotential lines if the current be strong enough. On bringing the plate into a magnetic field these lines of force change their position. Hence the lines of flow, necessarily orthogonal to the lines of force, will also change in form and position.

ACCORDING to Dr. J. Böhm, the statement that *Phytophthora infestans*, the fungus which causes the potatoe diseases, hibernates in the tubers, is incorrect, nothing whatever being known about its mode of hibernation. He further states that the infection of the potatoes never takes place in the soil through the uninjured skin, but is always brought about through injury to the tubers by insects or snails. In potatoe-heaps sound tubers can never be infected by their diseased neighbours. An infected potatoe either does not germinate at all or produces a healthy plant.

IN examining milk which is suspected to contain the tubercle bacillus it is usual to subject a sample of the milk to the action of a centrifugal machine after separating the fat. One method of working is described by Ilkewitsch (*Münchener med. Wochenschr.* 1892). The casein in 20 c.c. of milk is coagulated with citric acid, and, after filtering, the residue is dissolved in a solution of sodium phosphate. The butter-fat is separated by shaking with 6 c.c. of an aqueous ether solution, and acetic acid is then added until the liquid is on the point of coagulating. It is then placed in a copper tube tapering at the bottom, and this tube is inserted in the centrifugal machine and turned at the rate of 3600 revolutions per minute for fifteen minutes. The bacilli collect at the narrow end of the tube together with other sediment and dirt. The liquid is poured off, and the sediment examined microscopically. Thörner (*Chem. Ztg.* 1892, pp. 791–2) gives another method, which is as follows:—20 c.c. of the suspected milk are mixed with 1 c.c. of 50 per cent. potash solution, and heated in a bath of boiling water until the fat is saponified, when the solution turns yellowish brown. By this treatment the casein and albumen become soluble in acid. Twenty cubic centimetres of acetic acid are added, the solution shaken, heated on water-bath for three minutes, transferred to a strong glass tube, and turned in the centrifugal machine for ten minutes. The liquid is poured off, and the sediment is washed by shaking with 30 c.c. hot water, and again turned in the centrifugal machine. The water is poured off, and the sediment placed upon cover-glasses, which are treated in the ordinary way.

staining with hot Neelsen's solution, decolourizing in 25 p.c. sulphuric acid, and finally staining in methylene blue; instead of washing the cover-glasses in sulphuric acid Thörner simply uses a solution of methylene blue containing sulphuric acid.

A METHOD of producing an intense monochromatic light is described by Dr. Du Bois (*Zeitschr. für Instr.* p. 165). It differs from the usual processes in the form in which the sodium is introduced into the flame. A mixture of sodium bromide and bicarbonate is made cohesive by adraganth and moulded into sticks 4 mm. in diameter and 12 to 15 cm. long. These are kept in the flame of a Linnemann burner by means of a rack and pinion motion. Their conductivity being very low, they are only vaporized at the extreme end. The latter must be covered to avoid a continuous spectrum. At the greatest intensity, two or three centimetres of the substance are consumed per minute. The spectrum exhibits, besides the enormously preponderating D lines, a air of lines in the green, and a fainter pair in the red.

FROM the ages of persons who have died in France during the last 32 years, M. Turquan computes the average life there to have been about 38 years for women, 36 for men, and 37 years for both sexes together (*Rev. Sci.*). But this is now exceeded, and the average is over 40 years; a result, partly, of more attention to hygiene, partly of a diminished birth-rate. From a map showing the distribution of the average life, one finds the average very low in Finistère and Brittany (28 years 11 months in the former) in the Nord, the Pyrénées Orientales, &c., and especially in Corsica (28 years 1 month). In Finistère and Corsica one finds least hygiene and most children, but not the highest mortality of children. In some parts of Normandy, with a high infantile mortality, the mean life is yet very long. Thus it is about 48 years in Eure, 47 in Orne and Calvados, &c. The difference between the average life of men and women rises to 4 years (excess in case of women) in the north-west, and diminishes as you come towards the Mediterranean; and in Basses Alpes and Gard (in the south-east) man lives longer than woman by about a year and a half. In Normandy and Brittany there are most widows, and woman appears to have a greater vitality.

IT is now many years since electric currents were proved to exist in plants. In the study of these currents, an important step in advance was taken when Prof. Burdon Sanderson proved their existence in *uninjured* parts of living plants (it was usual before to apply electrodes, often polarizable, to cut parts). As to their cause, certain experiments made by Kunkel, some time ago, led him to think it was in the purely mechanical process of water-motion, set up on application of the moist electrode. The subject has been recently investigated by Herr Haake, who pronounces against this view. He used Du Bois Reymond's clay electrodes, with some woollen fibres projecting at the ends, and he enclosed the leaves in a tube in which they were guarded from air-draughts and kept moist. Arrangements were also made for various operations, such as varying transpiration, admitting hydrogen, removing oxygen, &c. (for details see *Flora*, p. 455, of this year). Herr Haake's results are briefly these:—1. It is unquestionable that changes of matter of various kinds are concerned in the production of the electric currents, especially oxygen respiration, and carbonic-acid assimilation. 2. Water-movements may possibly share in their production, but certainly their share is but a small one.

THE *Izvestia* of the East Siberian Geographical Society (vol. xxiii., 3) contains an account of M. Obrutcheffs' further researches in the Olekma and Vitim highlands. In the north-eastern, formerly quite unknown part of this region, the author found a further continuation of the "Patom plateau"—that is, a swelling from 3500 to 4000 feet high, devoid of tree vegetation, with ridges and mountains rising over it to heights of from 5000 to 5600 feet. They consist of granite and crystalline schists, probably of Laurentian age, covered with younger, probably Huronian, gneisses and schists. The other parts of the highlands consist of Cambrian and Lower Silurian deposits, while Upper Silurian limestones and Devonian Red sandstones are only met with in the valley of the Lena. We thus have a further confirmation of the hypothesis, according to which the great plateau of north-eastern Asia is a remnant of an old continent which has not been submerged since the Devonian epoch. Further traces of mighty glaciation have been found in the south-east part of the region. As to the gold-bearing deposits, they are pre-glacial in the south, and post-glacial or recent in the north. The high terraces in the valleys are indicative of a considerable post-pliocene accumulation of alluvial deposits, and of a subsequent denudation on a great scale.

MESSRS. MACMILLAN AND CO. announce that a new edition of Sir Archibald Geikie's "Text-book of Geology" is in the press, and will appear shortly.

THE third and fourth volumes (completing the work) of Mr. H. C. Burdett's "Hospitals and Asylums of the World" will be published by Messrs. J. and A. Churchill about the end of this month. Vol. iii. deals with the history and administration of hospitals in all countries throughout the world. Vol. iv. relates to hospital construction, and contains a bibliography and portfolio of plans.

MESSRS. R. SUTTON AND CO. have published a second edition of Mr. J. E. Gore's "Scenery of the Heavens," with stellar photographs and various drawings. Mr. W. F. Denning contributes to the volume a chapter on fireballs, shooting stars, and meteors.

THE second annual issue of "The Year-Book of Science," edited by Prof. Bonney, F.R.S., is now in a forward state of preparation, and will be shortly published by Messrs. Cassell and Company.

MESSRS. DULAU AND CO. have published "Annals of British Geology, 1891," by J. F. Blake. This is the second issue, and geologists will be unanimously of opinion that it is a decided improvement upon the first. It contains a digest of the books and papers published during the year, with occasional notes.

LECTURES on the ear will be delivered in Gresham College, Basinghall Street, E.C., on January 17, 18, 19, and 20, at 6 o'clock, by Dr. E. Symes Thompson.

IN Mr. R. Assheton's letter (NATURE, vol. xlvii. p. 176) the sentence beginning line 31 of the second column should have read thus:—"But it is more metazoic—if I may use such a word—to call the whole animal resulting from the segmentation of the fertilized ovum, the sexually produced generation."

TWO interesting new compounds are described by Prof. Anschütz, of Bonn, in the current number of the *Berichte*. They are well-crystallized compounds of the lactides derived from salicylic acid and the next higher (cresotinic) acid with chloroform, which latter substance is so loosely united with the lactide that warming to the temperature of boiling water is amply sufficient to dissociate them. Hence the compounds may be employed for obtaining perfectly pure chloroform, and for preserving chloroform in a solid form in which it is not prone to decomposition. The lactide of salicylic acid has long been supposed to be formed when the acid is treated with oxychloride of phosphorus. Prof. Anschütz, however, shows that the product of this reaction contains many other substances in addition, but by working under special conditions he has succeeded in isolating pure salicylide. Salicylic acid is dissolved in an indifferent solvent, preferably toluene or xylene, before the addition of the phosphorus oxychloride. The product of the reaction is washed first with soda and afterwards with water. Owing to the property, discovered by Prof. Anschütz during the course of the work, which salicylide possesses of combining with chloroform, it may be extracted from the white solid product, after drying, by means of chloroform, the compound being deposited from the chloroform solution in large colourless transparent crystals belonging to the tetragonal system. The compound possesses the composition $C_6H_4.CO.O.2CHCl_3$. The chloroform readily escapes upon warming, in very much the same manner as the water of crystallization contained in many crystallized salts. The free salicylide remaining is a solid substance melting at 261°. As regards its molecular constitution it is shown, by the amount of lowering of the melting-point of phenol employed as a solvent, to contain four of the salicylic radicles $C_6H_4.CO.O$, and is probably a closed ring compound. In a precisely similar manner phosphorus oxychloride reacts with the three cresotinic acids, the acids next higher than salicylic, with formation among other substances of lactides, which may be isolated in the same way in the form of their chloroform compounds, $CH_3.C_6H_3.CO.O.2CHCl_3$. Orthocresotinic acid lends itself best to this reaction. The pure lactides are readily obtained from the chloroform compounds by warming to 100°, pure chloroform being gently evolved.

THE two substances above described, salicylide-chloroform and the corresponding compound derived from ortho-cresotinic acid, are admirably adapted for the preparation of pure chloroform, on account of their large content of the latter substance, salicylide-choloroform containing 33·24 per cent. and the cresotinic compound 30·8 per cent of its weight. Moreover, in closed vessels they may be preserved any length of time; when exposed to the open air salicylide-chloroform slowly loses its chloroform, but the cresotinic compound is well-nigh stable, even under these conditions. The same quantity of the free lactide may be used over and over again without decomposition, it being only necessary, in order to re-form the chloroform compound, to allow it to remain in contact with the chloroform to be purified for twenty-four hours at the ordinary temperature. None of the usual impurities in chloroform crystallize along with the compound, so that a perfect separation is effected. Again, it is well known that pure chloroform decomposes more or less on keeping; this loss may be avoided by storing it in the form of the lactide, and regenerating it when required by the application of a gentle heat, with the certainty of obtaining it perfectly pure.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus* ♀) from India, presented by Mr. W. Stutely; two Barbary Mice (*Mus barbarus*) from North Africa, presented by Lord Lilford; four Bearded Titmice (*Panurus biarmicus*), European; four Ani (*Crotophaga ani*) from South America; six Hog-nosed Snakes (*Heterodon platyrhinos*); a Striped Snake (*Tropidonotus sirtalis*); a —— Snake (*Pitnophis* ——), from North America, purchased.

OUR ASTRONOMICAL COLUMN.

THE MOTION OF NOVA AURIGÆ.—Prof. W. W. Campbell, of the Lick Observatory, has communicated further results relating to Nova Aurigæ to the December number of *Astronomy and Astrophysics*. He is now perfectly convinced that the variation in the velocity previously suspected is real, and probably due to orbital motion. The values given below have been calculated on the assumption that the brightest line in the spectrum of the Nova, since the reappearance in August, is really the chief nebula line. The bright lines were displaced towards the violet, indicating approach, whereas in February and March last they were displaced towards the red.

Date. 1892.		λ		Velocity of approach. Miles per sec.
Aug. 20	...	5003·6	...	128
21	...	3·7	...	125
22	...	3·7	...	125
23	...	3·1	...	147
30	...	2·4	...	173
Sep. 3	...	2·4	...	173
4	...	1·9	...	192
6	...	2·1	...	184
7	...	1·9	...	192
15	...	2·2	...	180
22	...	2·5	...	169
Oct. 12	...	3·6	...	128
19	...	3·8	...	121
Nov. 2	...	4·4	...	99
3	...	4·7	...	87

In the same journal Mr. Sidgreaves points out that the new lines cannot simply be revivals of those of February, and, further, that on account of the great difference of velocities and the reversed direction, they cannot be supposed to belong to the bright-line component of February. Neither is it likely that the dark-line component has become a planetary nebula, and the probability of three bodies rushing together being very small, Father Sidgreaves believes the new results to strengthen the view that the compound character of the spectrum was produced by local disturbances of a single star.

ASTRONOMICAL DISCOVERIES IN 1892.—In the *Observatory* for January Mr. Denning gives an excellent summary of the astronomical discoveries of 1892, a year which was very remarkable for the special attention given to the science by the press and the public. In chronological order the principal events were as follows:—

January 20.—Minor planet (324) discovered by photography by Max Wolf at Heidelberg. (Altogether 27 were discovered during the year by various observers.)

January 23-30.—Discovery of Nova Aurigæ by Dr. Anderson.

February 11.—The great sun-spot, extending over 150,000 miles of longitude, reached the sun's central meridian. This was followed by remarkable magnetic disturbances and displays of aurora.

March 6.—Comet discovered by Lewis Swift.

March 18.—Comet discovered by Denning at Bristol. On this day also, Dr. Spitaler, of Vienna, re-detected the periodical comet of Pons (1819) and Winnecke (1858).

August 6.—Opposition of Mars. Mr. Denning writes: "Practically our knowledge stands where it stood before. The results are not sufficiently discordant to settle disputed points."

August 27.—A new comet discovered by Brooks, of Geneva, N.Y.

September 9.—Prof. Barnard's memorable discovery of the fifth satellite of Jupiter.

October 12.—Comet discovered by photography by Prof. Barnard.

November 6.—Bright comet discovered in Andromeda by Mr. Edwin Holmes, London.

November 20.—A faint comet discovered by Brooks.

November 23.—Brilliant shower of shooting stars observed in Canada and the United States. The shower was evidently that of the Andromedes connected with Biela's comet.

COMET HOLMES.—Mr. Lewis Boss finds for this comet a period of 6·914 years, and concludes that no very close approach to Jupiter can have taken place in recent years; the eccentricity, however, is so small that important perturbations by Jupiter may have occurred. He further states that "the recent remarkable decrease in brightness of the comet seems to do away with the necessity of supposing that it has been recently made a member of the solar system. This decrease also renders it reasonably certain that the comet must have been subjected to some extraordinary disturbance of its internal economy, by the application of forces from without or within, with the result of giving to it that which was really an unaccustomed and temporary size and brightness" (*Astronomical Journal*, No. 283). According to Mr. Lockyer's views, such increase of brightness would be produced by the comet colliding with another meteor swarm lying in its track, and it is quite possible that the brightening of the comet at the time of the discovery was very sudden, thus explaining why the comet was not detected earlier.

The Rev. E. M. Searle (*Astronomical Journal*, No. 283) has derived a period fifteen days shorter than that of Mr. Boss.

M. Schulhof, of Paris, finds a period of 6·909 years. He also points out that among the known periodic comets that of De Vico shows the greatest orbital similarity to Holmes's comet, and he considers that they may possibly have a common origin.

Mr. Roberts, of the Nautical Almanac Office, accepting as real the supposed impression of the comet obtained by Mr. Schorling in a photograph of the region taken on October 18, found a period of fifteen years, but the general agreement of the latest computations seems to indicate that the image in question could not be that of the comet.

The comet is now so dim that it is not considered necessary to continue the ephemeris.

Ephemeris of Comet Brooks (November 20, 1892).—The following ephemeris of Comet Brooks (Berlin, midnight) is given in *Ast. Nach.*, No. 3140, by Kreutz :—

Date.	R.A. h. m. s.	Decl. (app.) ° ′	Log r.	Log Δ.
Jan. 12	21 40 18	+ 59 41	0·0786	9·8915
13	56 4	58 8·1	0·0791	9·9012
14	22 9 53	56 33·6	0·0797	9·9114
15	22 3	54 59·1	0·0803	9·9220
16	32 47	53 25·7	0·0810	9·9330
17	42 18	51 54·2	0·0818	9·9442
18	50 47	50 25·2	0·0826	9·9556
19	22 58 23	48 59·3	0·0835	9·9670

The Meteor Shower of November 23, 1892.—Further observations of this fine display of shooting stars are recorded in *Astronomical Journal*, No. 283. Prof. J. K. Rees counted 165 meteors in half an hour, and noted some as bright as Mars; all of them were very swift. The Rev. J. G. Hagen estimated that one observer, with a clear view to the west would have seen 250 meteors in half an hour, and notes that some were as bright as Jupiter. Mr. Sawyer estimated the maximum frequency as about 300 per hour, and, strangely enough, describes them as "slow-moving, generally quite bright, although none were observed as bright as the planets Mars and Jupiter." Both Prof. Rees and Mr. Sawyer note that the meteors appeared in clusters, four or five falling almost at the same instant, while for a few minutes none were seen. The radiant was near γ-Andromedæ, and there is little doubt that the shower was that due to Biela's comet.

GEOGRAPHICAL NOTES.

In M. Dybowski's journey from the Mobangi to the Shari, as described at a recent meeting of the Paris Geographical Society, he encountered one of the most systematically cannibal tribes which has yet been described. This tribe, known as the Bonjos, have only one object of purchase—slaves to be eaten. They refuse to sell food or any other products of their country for anything else, and the surrounding tribes capture and export canoe-loads of slaves for this purpose. The French expedition experienced great difficulty in obtaining food amongst a people who had no desire for ordinary articles of trade.

The boundaries of the republics of South and Central America are certainly the least definite lines on the political map of the world so far as civilized lands are concerned. The question of delimitation is never at rest. Dr. H. Polakowsky gives in the last number of *Petermann's Mitteilungen* a brief account of the negotiations and surveys relating to the frontier of Costa Rica and Nicaragua from 1858 to 1890. The difficulty in this case lies in the fact that the mouth of the San Juan river, a certain point of which was fixed on in 1858 as the coast frontier, is continually changing, and a breakwater belonging to the harbour and canal entrance of Greytown, in Nicaragua, now stands in what was formerly the territory of Costa Rica. On the Pacific coast years of diplomacy were required to fix the centre of Salinas Bay, but it is satisfactory to know that permanent boundary stones have now been erected at both ends of the line.

Mr. Coles delivered his second lecture to young people under the auspices of the Royal Geographical Society, on Friday evening, when a large audience of both young and old enjoyed his spirited descriptions of Iceland and British Columbia, illuminated by many anecdotes of personal adventure.

The defective condition of the charts, even of the coast of Europe, was strikingly brought out by the recent court-martial on the stranding of H.M.S. *Howe* in Ferrol Channel. The chart used on board was drawn from soundings made about a hundred years ago, with a few subsequent corrections, which failed altogether to indicate the rock on which the *Howe* struck. The Spanish authorities are reported to have refused permission for the new chart surveyed by the officers of the Channel Squadron to be published, and meanwhile the Hydrographic Office has cancelled the old chart.

A NEW SEISMOGRAPH.[1]

Before speaking of this memoir, let me enter a protest against the method of publishing these "Annali" in such a way as to convey the impression that the papers composing it were written three years before their actual date. All readers are warned that when the volume is bound up, and the paper covers are removed, they must post-date the papers by three years.

The seismograph described in the present paper is intended for stations of the second class. The objects in view in its construction were amplification of the record in a pendulum seismograph, and improvement of the warning apparatus in the form of a style seismoscope of the Milne type which the author finds frequently fails.

The amplifying lever is composed of fine placfont tubes arranged girder-like in the form of a short hollow triangular prism, surmounted by an acute triangular pyramid, which points downwards, and carries at its apex the writing style. The pendulum bob is a flattened cylinder, supported by a placfont wire 1·50 m. long. The amplifying lever at the junction of the three pyramidal and the prismatic tubes supports three radial arms meeting in the centre, as it were, of the pyramid base, and support a ball-and-socket joint of agate, the cup part of which is at the end of an arm projecting from the supporting wall. Immediately above this centre, and occupying the prism space of the lever, is the cylindrical box, the wire supporting which passes through a small hole in the centre of the base of the prism. We thus have a simple lever of the first order of light girder work. It is prevented from rotating in azimuth by including some steel wire permanently magnetized.

The style has been modified by lightening it and making it more rigid and non-oxidizable, which is done by using a capillary glass tube.

The registering apparatus is a smoked glass plate, supported over a clock, started at the moment of the earthquake by a seismoscope. To prevent the complex figures of the ordinary registration in a pendulum seismograph, the author has arranged so that the plate shall rotate through a segment of a circle every three seconds, so as to bring a fresh surface of smoked glass beneath the style.

Some modifications are then described. The principal one is making the bob annular, carrying a suitable aperture, in which is engaged the short end of a lever. This lever is composed of three very thin brass tubes, graduating away smaller from the fulcrum, which is a gimbal joint such as suggested by the reviewer some years since in Nature. This lever carries at its lower and longer end the style which records on the glass plate as in the original one described in this memoir.

Another modification is a combination of the triple and single suspension of the pendulum bob, that is, the bob ring is first suspended by triple wires to a button which in its turn hangs at the end of a single wire.

The details of these seismographs are fairly well worked out, but the employment of aluminium in many of the parts has been neglected. Likewise, no arrangement has been made for the oblique play of the engaged pinion in the newer lever. The only new point about this seismograph is the interrupted rotation of the recording plate. This has a decided advantage in giving a dissected record, but is part counterblanced by the fact that important movements that may be taking place at the moment

[1] G. Agamennone, "Sopra un Nuovo Pendolo Sismografico." *Annali dell' Ufficio Centrale Meteor. e Geodinamico*, ser. sec., pt. 3, vol. xi., 1889. (Roma, 1892.)

of the advance are represented by a curve or curves which would require a series of careful experiments to be carried out in each instrument, followed by difficult and elaborate calculation for each advance.

Much credit is due to the author for working out the modifications, but until we have some original method of finding a steady-point, not so far suggested, it is doubtful if we can improve on the Gray, Ewing, and Milne seismographs, that are not, as the author imagines, little used or tested instruments.

H. J. JOHNSTON-LAVIS.

PHYSICAL GEOGRAPHY AND CLIMATE OF NEW SOUTH WALES.

A SECOND edition of an excellent pamphlet on the "Physical Geography and Climate of New South Wales," by Mr. H. C. Russell, F.R.S., astronomer royal for New South Wales, has just been issued at Sydney. It is published by authority of the New South Wales Government. The following extracts may be of interest to various classes of readers in Great Britain :—

Looking back through the pages of history, and the dim traditions of an earlier time, we find abundant evidence of a belief in the existence of a great south land to the south and east of what was then the well known earth. Those early navigators whose travels had fostered this belief, had doubtless followed down the Malay Peninsula and the string of islands which seem to form part of it, in search of spices and other treasures which the islands supplied. Pliny, who had evidently gathered up the traditions of "Terra Australis incognita," says that it lay a long way south of the Equator, and in proof of this mentions the fact, strange in those days, that when some of its inhabitants were brought to civilization they were astonished to find the sun rise on their left hand instead of on their right. And Ptolemy, A.D. 170, after describing the Malay Peninsula, says : Beyond it, to the south-east, there was a great bay in which was found the most distant point of the earth ; it is called "Cattigara," and is in latitude $8\frac{1}{2}^{\circ}$ south ; "thence (he goes on to say) the land turns to the west, and extends an immense distance until (as he believed) it joins Africa." And it may fairly be assumed that the extreme south latitude of Cattigara, and its situation in a great bay where the land turns to the west until it joins Africa, is proof that it was some point in the Gulf of Carpentaria, for no other place would fulfil the conditions. The idea that the land actually reached Africa was not Ptolemy's ; it was a necessary part of the system of Hipparchus, for he taught that the earth surrounded the water and prevented it from flowing away. It is not surprising, therefore, that the early navigators, following down the islands, came at length to that part of the Gulf of Carpentaria where the land turned to the west ; and believing Hipparchus' system of geography, thought that in turning to the west they were in reality turning towards home, and Cattigara was therefore the most distant point known. Marco Polo tells us that the Chinese navigators in his day (A.D. 1293) asserted there were thousands of islands in the sea to south of them, and in the present day we find proofs of their early visits to Australia in the traces of Chinese features amongst the natives of the northern coast ; indeed, some historians think that Marco Polo, in the account he gives of the expedition sent to Persia by the Great Khan, refers directly to Australia, under the name of Lochac. This place he says was too far away to be subjugated by the Great Khan, and was seldom visited ; but it yielded gold in surprising quantity, and amongst other wonders contained within it an immense lake or inland sea. It is impossible that such a description should apply, as has been thought, to the Malay Peninsula,—a country within easy reach, and one which his ships must have passed in every voyage ; and so far from being beyond his power, it was within the limits over which his sway extended. That Lochac formed part of the main-land was also quite in accordance with their ideas of the earth, which surrounded the ocean, and the abundance of gold is certainly more likely to be true of Australia than of the Malay Peninsula.

For long years after Marco Polo we find no direct reference to Australia, except the stories which lived amongst navigators, and seemed to lose none of their marvellous points by transmission. These kept alive the desire to explore the great south land, so rich in treasures and wonders. All the evidence collected so far goes to prove that the Portuguese had, early in the sixteenth century, explored at least the northern parts of Australia. What they learned was, however, kept a profound secret until about 1540, when one of their government maps was stolen ; and there are now in existence six maps believed to be copies of it, which were all published between 1539 and 1555. These all show Australia under the name of the "Land of Java," the real Java being called the "Little Java," and from this time onward frequent attempts were made to explore what had for so many generations been "Terra Australis incognita." Sturdy navigators could not understand the silence of the Portuguese, except as proof of the richness of the land, about which tradition told wonderful tales "It was a land of gold and spices, of magnificent tropical fruits and vegetation—a perfect paradise, in which the happy and simple inhabitants were loaded with jingling ornaments of gold. Its very atmosphere was elixir, and existence a round of enjoyment." No wonder that in an age when, at least upon the ocean, the power to take was mistaken for the right to do so, there were many who cast longing glances towards the southern Paradise. Whether these stories of gold had any foundation in fact or not, when barter was regularly exchanged on the coast of Australia, it is impossible now to say, but more recent discoveries of rich surface gold lend some colour to them, and the vegetable richness of the northern part of Australia is quite in accordance with tradition. But all the early English navigators were unfortunate, and Australia got a reputation the very reverse of what further investigation has shown that it deserves. In point of fact, all the glowing colouring of tradition is true ; but when Dampier, in 1688, sailed down the western coast, he saw nothing but a "dry sandy soil," and the "miserablest people in the world" ; and later on, when the first English settlers landed on Australia, they chose a bay, beautiful to look at, but there was no gold and no fruit worthy of the name, the soil was barren and sandy, and the climate in the worst part of its summer. No wonder that the fame of Australia was blackened, and report made it a miserable land, subject to droughts and floods—a land in which everything was turned topsy-turvy. The summer came at winter time ; trees shed their bark, not their leaves—were brown instead of green ; the stones were on the outside of the cherries ; and the pears, pleasant to look at, were only to be cut with an axe ; and there was nothing to eat, "unless, perchance, ye'l fill ye with root of fern or stalk of lily." Such was the early verdict upon Australia. Fortunately the first colonists, once here, were obliged to stop. By degrees they found that everything that was planted grew well ; that wheat in the valley of the Hawkesbury yielded 40 to 50 bushels to the acre, and in one memorable season actually ruined the farmers by its very abundance, for in the then limited market, the price fell so low that it was not worth gathering, and it was left in the fields to rot, while the farmers sought other work. Horses, sheep, cattle, and pigs throve marvellously, and some of the cows getting away, the bush soon contained numbers of wild cattle. Even wool did not deteriorate in the new Colony ; and step by step the facts became too strong for prejudice, and the first fleeces of Australian sheep sent to England lifted the veil. Manufacturers would gladly take as many as could be sent ; their demand for more wool extends with the supply, and now only from Australia can they obtain the fine wools which they need. Quantity and quality of wool have increased together, and the Grand Prize at the Paris Exhibition for our New South Wales wool has proclaimed the fact far and wide. Wool has done still more for the Colony. We took possession of it as a narrow strip of coast country ; the demand for pasture forced us to find a way over a hitherto impassable range, and the same want has driven all the desert out of the Colony, and covered it with sixty-two millions of valuable sheep (1892). The country which early writers upon Australia called a barren waterless desert is now growing the finest wool and yielding abundant water from wells, and when, in 1851, it was announced that gold had been discovered in abundance, the world was convinced that Australia was a promising country after all. Year by year the people have been coming in increasing numbers to supply our great want (population), and as our numbers increase new avenues of wealth and prosperity are opening before us.

Geographically, Australia has a grand position, lying between the 10th and 40th degrees of south latitude—that happy mean where it is neither too hot nor too cold. Surrounded by the ocean, the sea breezes temper what might otherwise be a hot climate in the summer ; the air is clear and dry, and yet brings rain in heavy showers. Vegetation is abundant, and includes all the cereals and fruits of the world, so that, in the words of the old tradition, it has "all the conditions which make life a pleasure."

Australia measures from north to south 1900 miles, and from east to west 2400 miles, and speaking generally, has a rounded outline, the only great inlets on the coast-line being the Gulf of Carpentaria and the Australian Bight. The total area is rather greater than that of the United States, and almost equal to the whole of Europe. On the east, north, and west, and at a short distance from the coast are found ranges of mountains, of no great elevation, yet almost the only high land. On the west and north-west coasts the mountains form a bold outline of granite, rarely more than 200 miles from the coast, and attaining to heights of 2000 to 3000 feet. Between these and the sea the land is low and good, but on the inland side is found a vast table land which slopes towards the unknown interior so gradually that the inclination is not easily seen, and no rivers running to the interior have yet been discovered—all known streams running to the sea.

On the east coast we have also the mountain chain parallel to the coast, but it is much higher and more extensive, and the strip of low land by the coast is much narrower, often not more than 30 miles wide, and at Point Danger the range comes right to the sea. This grand chain of mountains is known generally as the Great Dividing Range, and extends for about 1500 miles along the east coast. Near its southern extremity is the Snowy Range, the only spot in Australia where snow may always be found. The highest peak, Mount Kosciusko, 7170 feet, is also the highest land in Australia. The ravines on its sides always contain snow, and the mountains near it, about 6000 feet high, are also covered with snow for the greater part of the year.

Of this great continent island, the Colony of New South Wales holds the choicest portion—the southern part of the east coast—the part where, with remarkable sagacity, the first settlement was made. It has the best climate, all the most important rivers in Australia, the great bulk of the coal land, unlimited stores of all the useful minerals, and the finest pastoral and agricultural lands for extra-tropical vegetation; besides which, its extensive highlands afford climatic conditions for all purposes. It is naturally divided into three portions. The comparatively narrow coast district, from 30 to 150 miles wide, abundantly watered by rivers and smaller streams coming down from the mountains. The rainfall here, fed by winds from the Great Pacific Ocean, is very abundant, from 40 inches in the south to 70 in the north, and at Sydney 50 inches. The mountains have doubtless very much to do with this abundant precipitation, and at times the rains are so heavy that the rivers, fed by mountain torrents, carry heavy and dangerous floods. In years past wheat was largely and profitably grown, but rust has of late so frequently appeared that little or no wheat is grown, for it pays better to supply the city markets with dairy produce, Indian corn, and various kinds of hay. In the northern districts sugar-growing is a profitable industry, and increasing rapidly. About Sydney enormous quantities of oranges are grown for exportation.

The second division includes the mountains and elevated plains, and extends the whole length of the colony, varying in width from 120 to 200 miles. On the south, with the exception of the Monaro Tableland, the country is very rough and mountainous, the highest points, Mount Kosciusko and the Snowy Range, catch the rain and snow that feed the river Murray and the Murrumbidgee. Wheat grows well here, but nearly all the land is used for pastoral purposes. Proceeding northwards, the mountains decrease in height and extend laterally. A part of the land is taken up for agriculture, some for mining. In its natural state the western country is open plain or lightly-timbered, and large areas are covered with rich volcanic soil which seems fit to grow anything, but the want of labour and carriage, and the profit and security to be found in raising wool and meat, has for the most part tempted capital into squatting pursuits; but since the railway has reached this part of the country more attention is being given to agriculture, and it is rapidly extending. Between Goulburn and Bathurst, the western waters form the Lachlan and the eastern the Hawkesbury rivers, and from Bathurst northwards to latitude 25° all the western waters go to form the various tributaries of the Darling river. These mountains are from 2000 to 3000 feet, with some peaks rising to nearly 6000 feet. The central parts of the western slopes are celebrated for rich soil and herbage, and here also the greater part of the gold-mining area, as well as mines for other minerals have been found, including coal, which is also found in great abundance, with iron and lime, at Lithgow and other places. Deposits of copper, silver, lead, tin, and mercury are also found in abundance. A very large portion of the high land here is suitable for agriculture, and is being taken up for that purpose by degrees. English fruits—the apple, cherry, currant, &c.—grow to perfection here, as well as in other parts of the mountain districts.

The third division covers by far the greatest area, and consists of the Great Western Plains, extending away to the Darling river, and thence to the south Australian border. Here there are but few known mineral deposits except copper, and the enormous deposits of silver and lead at Broken Hill, and no attempt at agriculture. All the land may be said to be held for grazing purposes, and for that purpose, now that capital has been invested in tanks and wells for water supply, this country is unequalled. Sheep and cattle thrive in a remarkable degree, and form a most profitable investment, the climate being dry and wonderfully healthy for man and beast.

These are the three great natural divisions, made so by the conformation of the land and the climate. It will be evident from what has been said of the elevation of the mountains that snow is not a common feature upon them, and the only part where snow lies for any considerable time is the extreme south. As a necessary consequence, the river system is peculiar; indeed, it has often been asserted that Australia had no rivers—at least none which were of any use as such; but as we shall presently see, this statement, like many others affecting Australia, was made in ignorance. The necessity for increased pasture had driven the early colonists to cross the Great Dividing Range, aptly so-named, in search of pasture, in 1815, and the desire to extend the new pastures beyond the Bathurst Plains, which were the first discovered, led them on, and one of the first questions that demanded their attention was to account for the direction in which all the streams were flowing. The shortest road to the sea was to south-west, and yet all the water was running to north-west, and quite naturally it was asked—Could there be a great inland sea into which these rivers discharged? In 1818 Oxley started with a determination to see where at least one of them went to; so he followed the Macquarie for more than 200 miles, and found that he was going due north-west, further and further, as it seemed to him, from the natural outlet on the south coast. At last the river spread out to an apparently interminable marsh. Turn which way he would his progress was stopped by a shallow fresh-water sea, for sea he was at last convinced it must be, so great was its extent, and he was obliged to turn back. He had got there after two very wet seasons (1817 and 1818), and his inland sea is now known as the Macquarie Marshes; and the mystery was not solved until Sturt, in 1829, found all these streams trending to north-west unite in the Darling, and then turn to south-west.

Coming from mountains of such moderate elevation, these streams are necessarily dependent upon the rainfall, and have no snow to help them, so that in rainy seasons they become important rivers and in dry ones sink into insignificance; but since most of the rains which feed these waters are, as it were, offshoots of the tropical rains, they seldom fail altogether, and as a rule the Darling is navigable for four months of each year, and sometimes all through the year, up to and beyond Bourke. The current is very slow, seldom reaching two miles per hour, and therefore offers little hindrance to the steamers which carry wool and stores.

In the exploration of our rivers there was another surprise when settlement extended south-west from Sydney. The waters here were found to flow to the west, and the Lachlan has for a considerable portion of its course a south-west direction, that is, at right-angles to the Macquarie and the Bogan. Could the Lachlan, the Murrambidgee, and the snow-fed Murray ultimately join the waters that ran north-west from Bathurst? Sturt had not solved this question—he only followed the Darling part of the way down—and it was left for Sir Thomas Mitchell to find the junction of the two river systems in 1835, and to prove that the Darling and the Murray were united at and below Wentworth.

After dealing with the rivers and harbours of New South Wales, Mr. Russell discusses the temperature, rainfall, droughts, and winds of the colony. Of the temperature he says:—

In works of reference, Australia generally is credited with heat in excess of that due to its latitude. It is difficult to say why, unless it arose from a habit of one of our early explorers who carried a thermometer and carefully published all the high, and none of the low readings he got, until, fortunately for the colony, the thermometer was broken and the unfair register stopped. But not only the interior—Sydney even to the present day is credited, in standard works of reference, with a mean temperature of 66·2°, or more than three degrees higher than the true mean, which is 62·9°. Such an error is not excusable when meteorological observations have been taken and published for just forty years. There is another error made by some writers when describing Australia. It is shown by them inverted on the corresponding latitudes in Europe, and the reader naturally infers that Australia is as hot as those parts of Europe. Confining our attention to New South Wales, that is between 29° and 37° of south latitude, we find that generally it is cooler than a corresponding part of Europe. The mean temperature of the southern parts of England is about 52°, and that of France, near Paris, about the same, increasing as you go south to 58·5° at Marseilles. Taking this as a sample of the best part of Europe, let us see how the mean temperatures in the colony compare with those: Kiandra, our coldest township, situated on a mountain, is 46°; Cooma, on the high land, 54°; Queanbeyan, high land, 58°; Goulburn, high land, 56°; Armidale and New England district, 56°; Moss Vale, 56°; Kurrajong, 53°; Orange, 55°. These towns are scattered along the high table-lands from south to north, and represent fairly the climate of a very considerable portion of the whole colony. Next to this in point of temperature is the strip of land between the ocean and the mountains, and which is affected by the cooling sea-breezes. Here we have a mean temperature ranging from 60° at Eden, the most southern port, to 68° at Grafton, one of the northern ports. Sydney, in latitude 34°, has a summer temperature only four degrees warmer than Paris, which is in latitude 49°. Now the usual difference for a degree in latitude is a degree in temperature, and therefore, if Sydney were as much warmer than Paris as its latitude alone would lead us to expect, its temperature should be 74°, and that is 15° warmer than Paris; but as we have seen, it is only 4° warmer. This single example is enough to prove the comparative coolness of our coast districts. The investigation made during recent years shows that the mean temperature of the whole colony, as derived from forty-five stations scattered over it, is 59·5°, three degrees lower than that of Sydney, or only one degree hotter than that of Paris.

It may be mentioned that the highest shade temperature ever recorded in Sydney was 106·9°, and near Paris a temperature of 106·5° has been recorded.

The third great district, consisting of lower land and plains to the west of the mountains, has a climate considerably warmer in summer than the parts above described, owing to the powerful effect of the sun on land having little forest and little or no wind; but in winter the temperature sinks down much lower than the coast districts, owing to the great radiation; so that the annual mean temperature is not so great as the summer heats would lead one to anticipate. A table has been prepared for the purpose of showing by comparison with many places in Europe and America the temperature of the colony. The places have been arranged in order of temperature, taking for that purpose the mean annual temperature. This shows at once that the range of temperature here is equivalent to that offered by Europe from the north of England through France to Sicily. Such a range is more remarkable, because if New South Wales were placed on the map of Europe according to its latitude it would extend from Sicily to Cairo, whereas when placed by its temperature it stretches as we have seen from Sicily northwards to England. Nor is this all that the table shows us. For even when we find a place in Europe with a temperature equal to that of some place here, it is at once observed that the summer temperature in Europe is warmer than the colonial one and the winter colder; for instance, Naples, 60·3°; Eden, 60·3°; summer at Naples, 74·4°; at Eden, 67·9°; winter at Naples, 47·6°; Eden, 51·9; and so generally the southern country has the cooler and more uniform temperature. It is worthy of remark that the only places here of equal mean and summer temperature with places in Europe are those which are to be found on the western plains, as at Wagga Wagga, which has a mean temperature of 60·3°; Naples, 60·3°; and summer temperature of both is 74°; or again, to compare the places of the same or nearly the same latitude, Messina, in Sicily, latitude 38° 11′, has a mean temperature of 66°, summer 72·2°, winter 55°; Eden, New South Wales, in latitude 37°, has a mean temperature of 60·3°, summer 67·9°, winter 51·9°; or Cairo, in latitude 30°, mean of 72°, summer 85·1°, winter 58·2°; Grafton, latitude 29° 45′, mean 68·1°, summer 76·8°, winter 58·4°. It is useless to multiply examples,—we have here enough to show how much cooler Australia really is than the fervid imaginations of some writers have made it appear in print.

Looking at this question of temperature generally, it will be seen that New South Wales is no exception to the general deduction of science that the southern lands are cooler than those of corresponding latitudes in the north, and it is only during hot winds, which are very rare in New South Wales, that the temperature rises to extremes. But to leave Europe, and compare the climate of New South Wales with that of America. Our limits of latitude would place us from Washington to New Orleans. Now the mean temperature at Washington is 55° and at New Orleans 68°, while that of Eden is 60·3° and Grafton 68·1°; so that if mean temperature were a complete test of climate it would appear that our coast is hotter than corresponding latitudes in America. But mean temperature is not enough; we must compare the summer and winter temperatures; and summer at Washington rises to 76·7° and at Eden only to 67·9°, 9° cooler; New Orleans summer is 82° and Grafton 76·8°; but 82° hardly represents the summer heat at New Orleans, for it is a steady broil, during which every day for three months of summer the heat is over 80°, a temperature that is only reached on this coast during hot winds, or in other words, very seldom. But winter temperature at Washington falls to 37·8°, and at New Orleans to 56°; at Eden 51·9°, and at Grafton 58·4°. Hence it is evident that on this coast the heat is very much less in summer and greater in winter than upon the coast of America. Such facts place the colony in a very different position in regard to climate from that which it has occupied in published works, for instead of being a hot country we see that its coast districts are much cooler than corresponding latitudes in Europe and America, and that in its elevated districts, which comprise a large part of it and much of the best land, it has a climate no warmer than the best and most enjoyable parts of Europe in much higher latitudes; but while bringing these facts into due prominence it is not the intention to deny that another considerable part of the colony, forming the western plains, is subject to greater heat, caused, no doubt, by the sun's great power on treeless plains, and the almost total absence of cooling winds; yet, although in summer the temperature here frequently rises over 100°, and sometimes up to 120°, yet, owing to the cold at night and in winter, the mean temperatures are not greater than those of corresponding latitudes in the northern hemisphere; and this part of the colony being remarkably dry, the great heat is by no means so enervating as a temperature of 80° in the moist atmosphere of the coast, and, what is of still more importance, it does not produce those terrible diseases which are usually the offspring of hot countries. This is also, no doubt, due to the dryness of the air. Stock of all kinds thrive remarkably well, and are very free from disease in those hot western districts.

SCIENTIFIC SERIALS.

THE *Quarterly Journal of Microscopical Science* for August 1892 contains:—On the anatomy of *Pentastomum teretiusculum* (Baird), by Prof. W. Baldwin Spencer, M.A. (Plates i. to ix.). Whilst collecting on Kings Island, which lies to the west of Bass Straits, half-way between the mainland of Victoria and Tasmania, numerous specimens of the copper-head snake (*Hoplocephalus superbus*) were found, in the lungs of which a large species of Pentastomum were parasitic; afterwards the same parasite was discovered in the lungs of the black snake (*Pseudechys porphyriacus*) in Victoria; on examination there seemed little doubt but that the species was the one described by Baird long ago (1862) from specimens obtained in the mouth of a dead copper-head snake in the Zoological Gardens, London, under the name of *Pent. teretiusculum.* In this paper we have a very complete account of the anatomy of this form, there being descriptions and figures of its external anatomy, schematic representations of the muscular, alimentary, secretory, nervous, and reproductive systems, and an account of the sense organs. The paper is illustrated by ten double plates.—On the minute structure of the gills of *Palæmonetes varians*, by Edgar J. Allen, B.Sc. (Plate x.). It would seem that so far as the gills of this crustacean are concerned, the statement made by Haeckel and Ray Lankester, that the circulatory system of the Decapods is everywhere closed, does not hold true. It would also seem fairly certain that the masses of cells surrounding the venous channels, in which Kowalevsky found litmus deposited a few hours after its injection, exercise an excretory function. In addition to these excretory cells, a large number of glandular bodies occur in the axis of the gill, and these are of two kinds—clear and reticulate glands.

The number for November 1892 contains:—On the development of the optic nerve of vertebrates, and the choroidal fissure of embryonic life, by Richard Assheton, M.A. (Plates xi. and xii.). That the optic nerve is formed by the differentiation of the cells of the optic stalk into nerve fibres, which consequently lose connection with the inner wall of the optic cup, and piercing the outer wall, make connection with the outer face thereof, is held to be probable by such writers as Balfour, Foster, Marshall, Haddon, and others, whilst the opinion that it is formed by the growth of nerve fibres either from the retina (outer wall of the optic cup) or from the brain, along the optic stalk, but outside it and unconnected with it, is or has been held by His, Müller, Kolliker, Hertwig, Orr, and has been recently supported by Keibel, Froriep, and Cajal. Schäfer seems to be uncertain which view to take. As the result of the author's investigations in the frog and chick, he concludes that the optic stalk takes no part in the formation of the nervous parts of the organ of sight. The optic nerve is developed independently of the optic stalk, and at first entirely outside it. The great majority of the fibres forming the optic nerve arise as outgrowths from nerve cells in the retina.—On the larva of *Asterias vulgaris*, by George W. Field, M.A. (Plates xiii. to xv.).—On the development of the genital organs, ovoid gland, axial and aboral sinuses in *Amphiura squamata*; together with some remarks on Ludwig's hæmal system in this ophiurid, by E. W. MacBride, B.Sc. (Plates xvi. to xviii.). Concludes that echinoderms agree with other cœlomata in the origin of their genital cells these latter have at first an unsymmetrical position in echinoderms, and afterwards take on a radially symmetrical disposition in correspondence with the secondarily acquired radial form of the body. The origin of these cells adjacent to the stone canal suggests a comparison of the origin of the genital cells near the nephridia in many annelids, but the homology of the stone canal with a nephridium has yet to be proved.—On a new genus and species of aquatic Oligochæta belonging to the family Rhinodrilidæ, found in England by W. B. Benham, D.Sc. (Plates xix. and xx.). This new worm receives the name of *Sparganophilus tamesis*; it was found in some numbers in the mud of the Thames, adhering to the roots of *Sparganium ramosum*, near Goring; the cocoon is drawn out to a point at one end, while in the other it shows a narrow frayed end. As the home of the Rhinodrilidæ is America, the author suggests that the cocoons of this worm may have been introduced into the Thames amongst the roots of water plants, or attached to timber from the United States.

American Meteorological Journal, December.—Atmospheric electricity, earth currents, and terrestrial magnetism, by Prof. C. Abbe. The author has collected from various telegraph companies particulars about electrical storms, which illustrate the magnitude of the disturbances that frequently occur. The present electrical and magnetic observatories, which usually observe only some part of the whole series of phenomena, need to be supplemented by completely equipped establishments recording continuously the north-south, the east-west, and the zenithal-antipodal differences of potential. The ordinary records of atmospheric electricity give merely the difference of potential of the earth and a point in the atmosphere defined as the end of the water-dropping collector.—Notes on the use of automatic rain gauges, by J. E. Codman. Observations were made continuously for three years with the object of showing what difference the size of the gauges would make in the amount of rainfall collected. The largest gauge had a diameter of over 22 inches, and the smallest 2 inches. The results show that the size of the gauge made no practical difference. He also gives the results of rainfall collected in gauges erected at various heights on a mast. The result showed that a gauge at an elevation of 50 feet or less above the surface of the ground will collect the same amount as one on the ground, provided both are situated in a position not affected by counter-currents of air. This result agrees with that found by Prof. Hellmann in his experiments at Berlin.—Sunshine recorders, by Prof. C. F. Marvin. Thus far two methods only have been in general use, (1) the focussing of the rays of the sun by means of a glass sphere and obtaining a burn on the surface of a card, and (2) the photographic method, producing a trace on sensitized paper. The first method records only bright sunshine, while the latter method is more sensitive and records fainter sunshine. Prof. Marvin has improved a method first developed by D. T. Maring of the Weather Bureau, consisting in principle of a Leslie differential air thermometer, mercury being used to separate the air in the two bulbs. When properly adjusted and exposed to sunshine the lower blackened bulb becomes heated and causes the column to rise above a platinum point and close an electric circuit. The instrument, of which a drawing is given, is said to respond promptly to sunshine and shadow. The other articles are:—Late investigation of thunderstorms in Wisconsin, by W. L. Moore.—Observations on the aurora of July 16, by T. W. Harris, and Temperature sequences, by Prof. H. A. Hazen.

THE articles in the *Journal of Botany* for November and December are mostly of interest to students of British botany. Mr. F. J. Hanbury adds two more to his new species of *Hieracium*, *H. britannicum* and *H. caniceps*; Mr. Bagnall describes a new species of bramble, *Rubus mercicus* from the Midland counties; and Mr. W. H. Pearson a new British liverwort, *Scapania aspera*. Mr. G. F. Scott Elliot contributes some useful hints on botanical collecting in the tropics.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 8, 1892.—"On the Photographic Spectra of some of the Brighter Stars." By J. Norman Lockyer, F.R.S.

The present communication consists of a discussion of 443 photographs of the spectra of 171 stars, which have been obtained at Kensington and Westgate-on-Sea during the last two years.

The chief instrument employed in this work has been a 6-inch refracting telescope in conjunction with—at different times—objective prisms of $7\frac{1}{2}^\circ$ and 45° respectively.

By this method the time of exposure is short, and good definition, with large dispersion, is easily secured. The spectra thus obtained will bear enlargement up to thirty times without much sacrifice of definition.

The 30-inch reflector and slit-spectroscope at Westgate-on-Sea have also been used in the inquiry.

My object has not been so much to obtain photographs of the spectra of a large number of stars as to study in detail the spectra of comparatively few.

In the classifications of stars adopted by others from a consideration of the visual observations, only the broader differences in the spectra have been taken into account. Prof. Pickering has more recently employed a provisional classification in connection with the Henry Draper Memorial photographs of stellar spectra, but this chiefly relates to photographs taken with small dispersion. With larger dispersion it becomes necessary to deal with the presence or absence of individual lines.

In the first instance, the various stars of which the spectra have been photographed at Kensington have been arranged in tables, without reference to any of the existing classifications, and taking into account the finer details. The basis on which the main tabular divisions of the spectra are founded is the amount of continuous absorption at the blue end. This distinction was not possible in the case of the eye observations.

The stars included in the first table are characterized by the absence of any remarkable continuous absorption at the blue end, and by the presence in their spectra of broad lines of hydrogen. These have been further classified in four sub-divisions, depending on the presence or absence of other lines.

In the stars of the second table there is a considerable amount of continuous absorption in the ultra-violet, and the spectra beyond K are very difficult to photograph as compared with the stars of the first table. In these stars the thickness of the hydrogen lines is about the same as in the solar spectrum. These also are arranged in two sub-divisions.

In all the stars included in the third table there is a very considerable amount of continuous absorption in the violet, extending to about G, and it is a matter of great difficulty to photograph these spectra, as most of the stars of this class are below the third magnitude. The hydrogen lines are very thin. One sub-division includes the spectra which show flutings shading away towards the less refrangible end of the spectrum. The other comprises stars without flutings in their spectra. The brightest star in this table, α Orionis, is discussed in detail, the result tending to show that the temperature of the absorbing iron vapours is not much greater than that of the oxy-hydrogen flame.

The relations of the various sub-divisions to which reference has been made are then traced.

One important fact comes out very clearly, namely, that whether we take the varying thicknesses of the hydrogen lines or of the lines of other substances as the basis for the arrangement of the spectra, it is not possible to place all the stars in one line of temperature. Thus, there are stars in which the hydrogen lines are of the same average thickness, while the remaining lines are almost entirely different. These spectra cannot, therefore, be placed in juxtaposition, and it is necessary to arrange the stars in two series.

The next part of the paper consists of a discussion of the photographic results in relation to the meteoritic hypothesis. In the Bakerian Lecture for 1888, I brought together the various observations of the spectra of stars, comets, and nebulæ, and the discussion suggested the hypothesis that all celestial bodies are, or have been, swarms of meteorites, the difference between them being due to different stages of condensation. The new classification rendered necessary by this hypothesis differed from previous ones, inasmuch as the line of evolution followed, instead of locating the highest temperature at its commencement, as demanded by Laplace's hypothesis, placed it much later. Hence bodies of increasing temperature were demanded as well as bodies of decreasing temperature.

The question how far this condition is satisfied by the new facts revealed by the photographs is next discussed.

This involves the consideration of some points in connection with the hypothesis to which brief reference alone has been made in previous communications. The phenomena to be expected on the hypothesis, and the actual facts, are given side by side below:—

Nebulæ.

The bright lines seen in nebulæ should have three origins:—	
(1) The lines of those substances which occupy the interspaces between the meteorites. Chief among these, from laboratory experiments, we should expect hydrogen and gaseous compounds of carbon.	(1) Lines at wave-lengths approximately very closely to the lines of hydrogen, and to some of the carbon flutings, appear in the spectra of nebulæ.
(2) The most numerous collisions between the meteorites will be partial ones—mere grazes—sufficient only to produce comparatively slight rises of temperature.	(2) There is a fluting most probably due to magnesium at λ 500, and the longest flame lines of iron, calcium, and magnesium are seen.
(3) There will, no doubt, be a small number of end-on collisions, producing very high temperatures, and there should be evidence of some high-temperature lines.	(3) The chromospheric line D_3 and another line at λ 4471 (which is always associated with D_3 in the chromosphere) have been recorded in the spectrum of the Orion Nebula.

Bright-Line Stars.

The lines seen in the spectra of bright-line stars should, in the main, resemble those which appear in nebulæ. They will differ, however, for two reasons given in the paper.	Prof. Pickering has shown that the Draper Memorial photographs prove that bright-line stars are intimately connected with the planetary nebulæ, the lines in the spectra being almost identical.

Stars of Increasing Temperature.

Stage 1.—Immediately following the stage of condensation giving bright-line stars, the bright lines from the interspaces will be masked by corresponding dark ones, due to absorption of the same vapours surrounding the incandescent meteorites, and these lines will therefore vanish from the spectrum.	The spectra of stars given in the third table answer these requirements. They show no bright lines under normal conditions.
Owing to the interspaces being restricted, absorption phenomena will be in excess, and low-temperature metallic fluting absorption will first appear. The radiation spectrum of the interspaces will now consist chiefly of carbon.	The dark flutings in the visual spectrum agree very closely in position with the flutings seen in the flame spectra of manganese, lead, and iron. The evidence afforded by the photographs proves the actual presence of carbon radiation.
Under these conditions the amount of continuous absorption at the blue end will be at a maximum.	The photographs show a considerable amount of continuous absorption in the ultra-violet and violet.
Stage 2.—With further condensation, the radiation spectrum of the interspaces will gradually disappear, and dark lines replace the fluting absorption owing to increase of temperature, though this line absorption need not necessarily resemble that in the solar spectrum.	The spectra consist of numerous dark metallic lines, but they do not exactly resemble the solar spectrum. α Tauri and γ Cygni are types of stars at this stage.
Stage 3.—(1) The line absorption and the continuous spectrum at the blue end will diminish as the condensations are reduced in number, as only those vapours high up in the atmospheres surrounding the condensations will be competent to show absorption phenomena in consequence of the bright continuous spectrum of the still disturbed lower levels of those atmospheres.	(1) These conditions are satisfied by such stars as α Cygni, Rigel, Bellatrix, δ Orionis, and α Virginis. In these there is no continuous absorption at the blue end, the spectra consisting of simple line absorption.
(2) Lines of iron and other substances will disappear at this stage, because the bright lines from the interspaces will counteract the lines in the same positions due to absorption of surrounding vapours.	(2) In the spectrum of α Cygni, which represents the earliest example of this stage, there are a few of the longest lines of iron, but in other stars of this class the iron lines disappear.
(3) The chances of violent collisions being now enormously increased, we should expect the absorption of very high-temperature vapours. The solar chromospheric lines may be taken as examples of lines produced at such temperatures.	(3) The new lines which appear include the chromospheric line at λ 4471, and possibly a few others.

The Hottest Stars.

The order of the absorbing layers should follow the original order of the extension of the vapours round the meteorites in the first condition of the swarm, and the lines seen bright in nebulæ, whatever their origins may be, should therefore appear almost alone as dark lines.	In stars like α Andromedæ we have absorption lines agreeing in position with some of the bright lines which appear in nebulæ.

Stars of Decreasing Temperature.

Stage 1.—Owing to the diminishing depth of the absorbing atmosphere, the hydrogen lines will, on the whole, get thinner, and new lines will appear. These new lines will not necessarily be identical with those observed in the spectra of stars of increasing temperature. In the latter there will be the perpetual explosions of the meteorites affecting the atmospheres, whereas in a cooling mass of vapour we get the absorption of the highest layers of vapours. The first lines to appear, however, will be the longest low-temperature lines of the various chemical elements.	Taking Sirius as a type of stars in the first stage of decreasing temperature, it is found that its spectrum shows many of the longest lines of iron.
Stage 2.—The hydrogen lines will continue to thin out, and the spectra will show many more of the high-temperature lines of different elements. These will differ from the lines seen in stars of increasing temperature owing to the different percentage composition of the absorbing layers, so far as the known lines are concerned.	The conditions at this stage of cooling are satisfied by such stars as β Arietis and α Persei. In the spectrum of these stars nearly all the solar lines are found, in addition to fairly broad lines of hydrogen.
Stage 3.—With the further thinning out of the hydrogen lines and reduction of temperature of the atmosphere, the absorption flutings of the compounds of carbon should come in.	There is undoubted evidence of the presence of carbon absorption in the solar spectrum and the spectrum of Arcturus, the only star which has yet been investigated with special reference to this point.

The photographs, then, give us the same results as the one formerly obtained from the eye observations.

Comparison is then made between the groups in the classification first suggested by the eye observations, and the various sub-divisions in which the photographs have been arranged.

Geological Society, December 7.—W. H. Hudleston, F.R.S., President, in the chair.—The following communications were read:—Note on the Nufenen-stock (Lepontine Alps), by Prof. T. G. Bonney, F.R.S. In 1889 the author was obliged to leave some work incomplete in this rather out-of-the-way portion of the Lepontine Alps. In the summer of 1891 he returned thither in company with Mr. J. Eccles, F.G.S., and the present note is supplementary to the former paper. The Nufenen-stock was traversed from north to south, and a return section made roughly along the eastern bank of the Gries Glacier. Gneiss abounds on the north side of the Nufenen Pass, followed by rauchwacké and some Jurassic rock. On the flank of the mountain are small outcrops of rauchwacké and of the so-called "Disthene-schists" (both badly exposed), followed by much Dark-mica schist, often containing black garnets. Higher up is a considerable mass of Jurassic rock with the "knots" and "prisms" which have been mistaken for garnets and staurolites, but Dark-mica schists set in again before the summit is reached. They continue down the southern flank of the peak: but rather north of the lowest part of the water-shed, between Switzerland and Italy, the "Disthene-schist" is again found, followed by a fair-sized mass of rauchwacké. The return section gave a similar association in reverse order; and both confirmed the conclusions expressed by the author in 1890 as to the absence of garnets and staurolites from Jurassic rocks (with belemnites, &c.), and the great break between these or the underlying rauchwacké (where it occurs) and the crystalline schists, in which garnets often abound, of the Lepontine Alps The crystalline schists and the Mesozoic rocks are thrown into a series of very sharp folds, which, locally, presents at first sight the appearance of interstratification.—On some schistose "greenstones" and allied hornblendic schists from the Pennine Alps, as illustrative of the effects of pressure-metamorphism, by Prof. T. G. Bonney. The author describes the results of study in the field, and with the microscope, of (*a*) some thin dykes in the calc-schist group, much modified by pressure; (*b*) some larger masses of green schist which appear to be closely associated with the dykes; (*c*) some other pressure-modified greenstone dykes of greater thickness than the first. The specimens were obtained, for the most part, either near Saas Fee or in the Binnenthal. These results, in his opinion, justified the following conclusions:—(1) That basic intrusive rocks, presumably once dolerites or basalts, can be converted into foliated, possibly even slightly banded, schists, in which no recognizable trace of the original structure remains. (2) That in an early (possibly the first) stage of the process, the primary constituents of the rock-mass are crushed or sheared, and thus their fragments frequently assume a somewhat "streaky" order; that is to say, the rock passes more or less into the "mylonitic" condition. (3) That next (probably owing to the action of water under great pressure) certain of the constituents are decomposed or dissolved. (4) That, in consequence of this, when the pressure is sufficiently diminished, a new group of minerals is formed (though in some cases original fragments may serve as nuclei) (5) That of the more important constituents hornblende is the first to form, closely followed, if not accompanied, by epidote; next comes biotite (the growth of which often suggests that by this time the pressure is ceasing to be definite in direction); and, lastly, a water-clear mineral, probably a felspar, perhaps sometimes quartz. (6) That in all these cases the hornblende occurs either in very elongated prisms or in actual needles. The author brings forward a number of other instances to show that this form of hornblende may be regarded as indicative of dynamometamorphism; so that rocks where that mineral is more granular in shape (cases where actinolite or tremolite appears as a mere fringe being excepted) have not been subjected to this process.—On a secondary development of biotite and of hornblende in crystalline schists from the Binnenthal, by Prof. T. G. Bonney. Both the rocks described in this communication come from the Binnenthal, and were obtained by Mr. J. Eccles, F.G.S., in the summer of 1891. They belong to the Dark-mica schists described by the author in former papers, and have been greatly affected by pressure. In each a mineral above the usual size has been subsequently developed. In the rock from near Binn this mineral is a biotite: the dimensions of one crystal, irregular in outline, and having its basal cleavage roughly perpendicular to the lines indicative of pressure, are about $\cdot 175'' \times \cdot 03''$. The other mineral, from the peak of the Hohsandhorn, is a rather irregularly-formed hornblende, the crystals (which lie in various directions) being sometimes more than half an inch long. The exterior often is closely associated with little flakes of biotite. The author discusses the bearing of this fact, and the circumstances which may have favoured the formation of minerals, so far as his experience goes, of an exceptional size. Some remarks also are made on relation of these structures developed in the Alpine schists to the various movements by which those rocks have been affected, and on the general question of pressure as an agent of metamorphism. The reading of these papers was followed by a discussion, in which the President, Mr. Eccles, the Rev. E. Hill, Mr. Rutley, Mr. Teall, and the author, took part.—Geological notes on the Bridgewater District in Eastern Ontario, by J. H. Collins.

PARIS.

Academy of Sciences, January 2.—M. d'Abbadie in the chair.—M. Lœwy was elected Vice-President for 1893. MM. Fizeau and Fremy were elected into the central committee of administration. The President gave a list of the members, associates, and correspondents deceased and elected during 1892. The new members were MM. Appell, Perrier, Guyon, and Brouardel. Foreign associates, MM. von Helmholtz, and van Beneden. Correspondents, MM. Sophus Lie, Considère, Amsler, Auwers, Rayet, Perrotin, de Tillo, and Manen.—Observations of Brooks's comet (November 19, 1892) made with the *equatorial coudé* of the Lyon Observatory, by M. G. Le Cadet.—On a new method of approximation, by M. E. Jablonski.—On the movements of systems whose trajectories admit of an infinitesimal transformation, by M. Paul Painlevé.—On the general form of vibratory motion in an isotropic medium, by M. E. Mercadier.—On thermo-electric phenomena between two electrolytes, by M. Henri Bagard. The thermo-electric force between two portions of the same electrolyte in different stages of dilution was determined by experiments performed at the physical laboratory of the Faculty of Sciences at Nancy. The diaphragm employed consisted of goldbeater's skin, which has the advantage of closely adhering to the glass. The results are given in the case of zinc sulphate. With a 5 per cent. and a 45 per cent. solution the difference of potential ranged from 78 at 17·9° to 155 at 73·5°, the unit being 1/10000th of the E.M.F. of a Daniell cell. The law of intermediate bodies was strictly fulfilled, as shown by opposing a couple of 5 and 25 per cent. in series with another of 25 and 45 per cent. to a third of 5 and 45 per cent., when no deflection of the electrometer was observed between 0° and 73·3°.—On the age of the most ancient eruptions of Etna, by M Wallerant. The first eruptions of Etna have been variously estimated to have occurred in the later quaternary or in the upper pliocene periods. These conclusions were based on the study of the prismatic basalt laid bare by the sea round the foot of the cone. The pliocene deposits found in conjunction with part of the basalt appear from palæontological evidence to be contemporaneous with the sub-Appenine blue marls, which belong to the lower pliocene. In the Cyclopean Isles the basalt is covered with a layer of clay, which is also found interpenetrated by the basalt. The identity of age of the two formations is evidenced by lenticular patches of sand interstratified in the clay, whose particles consist of fragments of pyroxene, peridote, and triclinic felspar, proving that when the sub-Apennine marls were being deposited Etna was the scene of eruptions accompanied by the emission of ashes.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, JANUARY 12.

MATHEMATICAL SOCIETY, at 8.—On the Application of Clifford's Graphs to Ordinary Binary Quantics, 2nd Part, Seminvariants: The President.—On the Evaluation of a Certain Surface-integral and its Application to the Expansion of the Potential of Ellipsoids in Series: Dr. Hobson.

SOCIETY OF ARTS, at 4.30.—Upper Burma under British Rule: H. Thirkell White.

INSTITUTION OF ELECTRICAL ENGINEERS at 8.—Experimental Researches on Alternate-Current Transformers: Prof. J. A. Fleming, F.R.S. (Discussion.)

LONDON INSTITUTION, at 6.—Electric Lighting (1) Generation of Electric Currents: Prof. Silvanus Thompson, F.R.S.

FRIDAY, JANUARY 13.

PHYSICAL SOCIETY, at 5.—Upon Science Teaching: F. W. Sanderson.
SOCIETY OF ARTS, at 8.—The Development and Transmission of Power from Central Stations: Prof. W. Cawthorne Unwin, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 7.30.—Description of the Design and Construction of a Roadway Bridge over the River Cam: Edwin Hulme.

AMATEUR SCIENTIFIC SOCIETY, at 8.—Geology in 1892: A. M. Davies.—Recent Developments in the Metallurgy of Gold: T. K. Rose.

SATURDAY, JANUARY 14.

ROYAL BOTANIC SOCIETY, at 3.45.

SUNDAY, JANUARY 15.

SUNDAY LECTURE SOCIETY, at 4.—Some Invasions of India and their Results" (with Oxyhydrogen Lantern Illustrations): R. W. Frazer.

MONDAY, JANUARY 16.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30 (at the University of London, Burlington Gardens, W.)—Journeys in Sarawak, Borneo (Illustrated by the Oxy-hydrogen Lantern): Charles Hose.
VICTORIA INSTITUTE, at 8.—Why the Ocean is Salt: Prof. Hull, F.R.S.
LONDON INSTITUTION, at 5.—The Spanish Armada (Illustrated): F. L. S. Horsburgh.

TUESDAY, JANUARY 17.

ZOOLOGICAL SOCIETY, at 8.30.—A Proposed Classification of the Hesperiidæ, with a Revision of the Genera: E. Y. Watson.—Descriptions of New Species of Dipterous Insects of the Family Syrphidæ in the Collection of the British Museum, with Notes on the Species described by the late Francis Walker: E. E. Austen.—On Two New Species of Copepoda from Zanzibar: Gilbert C. Bourne.

MINERALOGICAL SOCIETY, at 8.—On a Discovery of Oriental Ruby and Margarite in the Province of Westland, New Zealand: Prof. G. H. F. Ulrich.—On the Isomorphism of the Red Silvers: H. A. Miers.—On the Occurrence of Baddeleyite (Native Zirconia) in Brazil: L. Fletcher, F.R.S.

ROYAL STATISTICAL SOCIETY, at 7.45.—The Reorganization of our Labour Department: David F. Schloss.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Gas Power for Electric Lighting: J. Emerson Dowson. (Discussion.)—Reception by the President and Council.

ROYAL INSTITUTION, at 3.—The Functions of the Cerebellum, and the Elementary Principles of Psycho-Physiology: Prof. Victor Horsley F.R.S.

WEDNESDAY, JANUARY 18.

ROYAL METEOROLOGICAL SOCIETY, at 7.15.—Annual Meeting.—The High Altitudes of Colorado and their Climates: Dr. C. Theodore Williams.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Annual Meeting.—Presidential Address: Dr. R. Braithwaite.

ENTOMOLOGICAL SOCIETY, at 7.—Election of Council and Officers for 1893: Report of the Council, and Address by the President, F. D. Godman, F.R.S.

THURSDAY, JANUARY 19.

ROYAL SOCIETY, at 4.30.—The Bakerian Lecture: The Rate of Explosion in Gases: Prof. H. B. Dixon, F.R.S.

LINNEAN SOCIETY, at 8.—The Plants of Malanji, collected by Mr. A. Whyte, and described by Messrs. Britten, Baker, and Rendle: W. Carruthers, F.R.S.—Report on the District traversed by the Anglo-French Sierra Leone Boundary Commission: G. F. Scott Elliot.

CHEMICAL SOCIETY, at 8.—The Determination of the Thermal Expansion of Liquids: Prof. T. E. Thorpe, F.R.S.—The Thermal Expansion and Specific Volumes of Certan Paraffins and Paraffin Derivatives: Prof. Thorpe, F.R.S., and Lionel M. Jones.—The Hydrocarbons formed by Decomposition of the Citrine Dihydrochlorides: W. A. Tilden, F.R.S., and Sidney Williamson.—Camphorsulphonic Derivatives: F. S. Kipping and W. J. Pope.—Note on the Decaphanes formed from Terpenes and Camphor: Henry E. Armstrong.

INSTITUTION OF CIVIL ENGINEERS, at 2.30.—Students' Visit to the Works of Messrs. Maudslay, Sons, and Field, Westminster Bridge Road, S.E.

ROYAL INSTITUTION, at 3.—Tennyson: Rev. Canon Ainger.

LONDON INSTITUTION, at 6.—Electric Lighting (2) Electric Lamps: Prof. Silvanus Thompson, F.R.S.

FRIDAY, JANUARY 20.

ROYAL INSTITUTION, at 9.—Liquid Atmospheric Air: Prof. Dewar, F.R.S.

SATURDAY, JANUARY 21.

ROYAL INSTITUTION, at 3.—Expression and Design in Music (with Musical Illustrations): Prof. C. Hubert H. Parry.

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