THURSDAY, JULY 13, 1893.

ORDER OR CHAOS?

THE question as to how the vast mass of scientific work which is now annually produced can be most readily sifted and utilised is a matter of pressing importance. There are two opposite types of scientific men who fail in achieving all of which they are capable, because they respectively pay too much and too little regard to the work of their predecessors and contemporaries. The one class are pre-eminently students. Masters of the past history of their subject, they are familiar also with its latest developments, but in the effort to know what others have done, they not unfrequently exhaust energies which might have been better spent in adding to knowledge. To such men a well-ordered scheme for bringing the results of research into a small compass would be a most valuable boon. Of the other type are those who declare, "I never read; if I want to know a thing it is easier to find out all about it in the laboratory than in the library." Whether this is so or not is largely a question of temperament, but there is no doubt that as matters now stand the task of repeating work which has already been done is often less distasteful and scarcely more wasteful of time and energy than the effort to discover if the question has been previously attacked, and if so, by whom and with what results.

In providing for the future it must be remembered that the art of scientific investigation is now taught at many educational centres. Students are turned out by the score who are not only capable of using ordinary laboratory instruments to good effect, but who have taken part in original research. Within a year or two they settle down as masters in schools, mechanics' institutes, or "Polytechnics," or are absorbed in some branch of technology. Whether or no they are to spend their lives in a dull routine of teaching or testing, falling gradually further and further behind the times, or whether they are to aid or even to follow the advance of knowledge depends largely upon the facilities for acquiring information which are afforded to them. They leave the University, or the University College, with its well-stocked library, and forthwith their touch or want of touch with the outer world depends almost entirely on the periodic literature of the science to which they have devoted themselves.

Such persons constitute a class which has only lately come into existence, which will increase largely in the future. Their wants must be considered if any improvement in the organisation of our scientific publications is taken in hand. It follows naturally from the spread of scientific education that the results of scientific study must be made more accessible than heretofore. It is not only the leisured amateur or the distinguished Professor who "knows the ropes" who are to be provided with ready access to knowledge. If a man who does not believe that his student days are over when he leaves college has the right of *entrée* to some first-rate library, and is free from the calls of business at the hours when it is open, he may study modern science there. If he remembers or can easily find out in what volume of the "Phil. Trans." or *Wiedemann's Annalen* the paper he requires was published, if he or his bookseller knows who to write to for a separate copy, and lastly, if he can afford the money to buy it, it is no doubt possible even when far from libraries to bring together the literature of any given subject. It is, however, contended that in all this there is an unnecessary waste of time and trouble, that there ought to be a recognised index, in which references to all that was known on any particular point at some given date are collected, and that each science should be served by some single journal or group of journals with clearly defined functions, in which all that is required in the description and publication of the results of later inquiry may be found.

The letter from Mr. Swinburne, which we published recently, thus raises a larger issue than that with which he chiefly dealt. The Royal Society has for some decades published an admirable name index to scientific literature. The task is rapidly growing beyond the powers of a single society, or indeed of a single country. It is only by the munificence of a wealthy and public-spirited Fellow that it can be carried on at all. Has not the time come when there should be an International Bureau, engaged on a full subject-catalogue, divided into separate parts devoted to different sciences so that the student of any one of them might obtain at a moderate cost an index to past research on his subject?

As regards the question chiefly discussed by Mr. Swinburne, viz. the publication of papers on Physics, it may perhaps be laid down that there are three classes of papers which require different treatment. First are those which should be published in full. They are at present found in the Philosophical Transactions and Proceedings of the Royal Society, in the *Philosophical Magazine*, in the Proceedings of the Physical Society, in the Reports of the British Association, and in the Transactions of the Cambridge and the Manchester Philosophical Societies. To these may be added the journals of the principal Scotch and Irish societies, with which for the present we do not deal. The same author not unfrequently publishes the same facts several times over in several of these periodicals, or publishes fragments of what is practically one series of researches in different journals. No greater state of chaos can be imagined.

Where a man publishes depends not upon the convenience of his readers, but upon whether his paper is ready in March for the Royal Society, or in September for the British Association, upon whether he cares more for a discussion at the "Physical" than for the honours of large type and quarto pages in the Transactions; upon whether he dreads anticipation, or is content to make the leisurely announcements which prove that he has the field to himself.

The second class of papers are those which are only worth publication in abstract. The Royal Society occasionally adopts this form of publication, but other societies for the most part either accept or reject a paper *in toto*.

The third class of paper is that which is a criticism or discussion of what is known rather than a description of an original research. At present these appear chiefly in the *Philosophical Magazine* and in our own columns. It is, however, with regard to the first two classes that the need for organisation is most keenly felt, and as Mr. Swinburne points out, the attitude of the Royal Society is of prime importance. Many would regret if the Society to which the "Principia" was communicated ceased to publish physical work, and indeed if we know anything of the feelings of English Physicists, we do not think that such a catastrophe is probable. On the other hand, it is impossible not to recognise the fact that the Royal Society is an obstacle to the realisation of a satisfactory scheme for the publication of English physical papers.

The Physical Society was founded because at that time the Royal Society offered no facilities for the experimental illustration of communications made to it. The meetings of both the elder and the younger society are fully occupied with the work now undertaken, in spite of the fact that the discussions at the meetings of the Royal Society are short.

If to-morrow all English physicists were to agree to send all their work to the Royal Society there would not be time to discuss it, and many of the papers thus offered, though worthy of publication, would be regarded as not of the type which the Society affects. Yet if there is to be organisation, if order is to succeed chaos, it can only be either by a friendly struggle between the Royal and the Physical Societies, which would not be likely to lead to any definite result at present, or by still more friendly co-operation between them, by which all that is desired might be attained in a few months. That going forward or standing still are alike difficult is undeniable. It is obvious that the conditions which apply to physics apply to other branches of natural knowledge. We shall be glad if those most closely interested will try to smooth the way by discussion in our columns.

THE CAUSES OF GLACIAL PHENOMENA.

The Glacial Nightmare and the Flood: a Second Appeal to Common Sense from the Extravagance of some Recent Geology. By Sir Henry H. Howorth, K.C.I.E., M.P., F.R.S., F.G.S., &c., &c. (London: Sampson Low, Marston and Co., 1893.)

IT is not uncommon to find that men who have devoted much time and careful research to the elucidation of complex phenomena have experienced all the phases of thought through which a succession of previous observers have passed in bringing the subject to its then present stage. This is more usual in certain classes of inquiry than in others, and in such it is clearly helpful to dwell upon the history of the development of opinion upon the question. It is giving, as it were, the embryology of an idea in order to enable the reader to understand better the adult form. In the volumes before us Sir Henry Howorth has rendered this good service to students of glacial phenomena.

The title of the book is unfortunate and may prejudice many against what is really a scientific work of great value.

Sir Henry first gives a sketch of the views of the earlier writers who referred all the phenomena in question to the action of water; then he explains how by degrees the agency of icebergs was called in; how it was next considered that larger glaciers would account for most of the facts; and how, after that, it was supposed that they were to be explained only on the hypothesis of great ice-sheets extending south from either pole, even to the tropics, according to some.

These ice-sheets must, of course, be accounted for by exceptional agencies, such as secularly-recurring astronomical combinations, in connection with which the author discusses the obvious inference that there must have been similar combinations and similar results in previous ages. He then devotes almost the whole of another volume to the various incidental theories which have grown up round the theory of circumpolar glaciation, or are necessary to it, and, finally, admitting a moderate extension of glaciers, he sums up in favour of stronger and more widely extended marine action than has of late been generally admitted.

As we read we cannot but learn to admire the shrewd observation of the older geologists, though the true explanation of the phenomena had not yet been put forward. We see how the obvious suggestion that great rushes of water would account for it all, set Von Buch and Hopkins to calculate what depth and velocity of water would be required to obtain force necessary to transport the blocks perched on the hills; and if there were difficult cases which made some of the "Champions of Water," such as Mierotto, De Luc, and Hall call in the aid of icebergs, still there was the fact that a great deal of the drift appeared to be sorted by water, and that, in great floods, boulders several feet in diameter have been hurried along the rocky bed of a stream with a noise like thunder; that large stones are often tossed by the storm waves to the top of precipices on our western rock-bound coast, as may be seen on a smaller scale where single stones are thrown on to a pier or promenade, though the sea-wall may be almost vertical. The gravel carried by a spate over the meadows is just like that found in the Esgairs, and is thrown up on either side of the torrent in long ridges. There is no doubt that a great deal of what is included in the drift, especially in Germany, is just like what is carried by flood water. It would not be comfortable to feel that the great old heroes of geology advocated views impossible in physics and unsupported by observation. Whether better explanations may in many cases now be offered is another question.

When it was once admitted that the glaciers were formerly much more extensive, and the drift round mountain regions was referred to their agency, it is easy to see how the impossibility of accounting for the occurrence of glaciers in North Germany, where what was thought to be similar drift was widely spread, led to speculation as to the possible extension of ice-sheets from high latitudes all over north-western Europe and north-eastern America, and the views of Bernhardi and Schimper, which involved an ice-sheet coextensive with the distribution of the drift began to be received with favour.

After this was given up as the *direct* cause, it was still held that its *indirect* effects would be very potent in producing extremes of climate alternately in the north and south hemispheres. The question now naturally arose whether there were any recurring glacial conditions in past times, and evidence of such action was seen in rounded surfaces and striated stones from various ancient rocks.

But most of the examples were from localities where the included fragments had been crushed against one another by earth movements, the grooves running alike across the included pebbles and the matrix in which they were imbedded. Or they were from the neighbourhood of what had been mountain ranges repeatedly through long ages. Even if we admit that some ancient conglomerates appear to have derived their boulders from glacial debris, that does not make the conglomerates glacial, but only requires glaciers in the adjacent mountains then as now. On the hypothesis of the geographical origin of glacial conditions, seeing that there must have been elevations and submergences over and over again, glacial phenomena should recur near the areas of upheaval, only without that periodicity which is required by the astronomical theory. There is, moreover, in the fossil flora and fauna no evidence of the recurrence of widespread glaciation such as would justify our referring it to a glacial epoch.

The astronomical glacialists further hold that not only were there secularly alternating periods of cold and heat in either hemisphere throughout the ages, but that within each period there were shorter periods of greater and less intensity of cold, of which we find evidence in the so-called interglacial beds of Britain, and in such deposits as those of Dürnten, where glacially striated pebbles underlie lignite which is covered also by morainic debris. But all advocates of the geographical explanation suppose that the earth movements on which it depends were discontinuous and subject to considerable oscillation, while the advance and retreat of glaciers, as a mere weather result, is so marked that we may safely admit that, as a climatic result of oscillations of level, it might be quite as great as required by any of the cases referred to.

Croll says that by far the most important of all the agencies, and the one which mainly brought about the glacial epoch, was the deflection of ocean currents, but he does not show that it is not possible to account for this deflection by earth movements.

There is one very important fact which does not seem to be generally recognised, namely, that the last glacial conditions extended only over a limited area on either side of the North Atlantic, and that this limitation must be referred to geographical causes, so that, if these were sufficiently powerful to determine the area, they may account for the glaciation itself. "What is wanted, however," our author remarks, "is not testimony to sporadic glaciers or local ice action, but to widespread glacial phenomena such as would witness an ice age."

The absurdity of the answer that percolating water must have removed ice markings from the surface of the stones is sufficiently obvious to any one who has had his attention called to the much finer markings on fo)sils, &c., which have been preserved.

The grooved stones of Devonian Age in Victoria are worth about as much as the facetted stones from Gorplitz by Barna, which are supposed to prove the great southerly extension of glacial action in Germany, but which more probably owe their form and condition to blown sand.

Several ingenious explanations have been offered of the occurrence of marine shells in stratified drift on the high ground of southern Sweden and northern England and Wales. The more obvious explanation is, of course, that they were left there as the shingly shore of the receding post-glacial sea. But this would have involved earth movements in comparatively recent times to so great an extent as would lend probability to the theory of such elevations as would account for glaciers in temperate regions, and of such submergences as would explain the widespread post-glacial sands and gravels. Some therefore suggested that these masses had been scraped up from the sea bottom and been pushed up the mountains to their present position; that they were, in fact, part of a great terminal moraine of the polar ice-sheet. : ome got over the difficulty of explaining the even stratification and the ripple marks on the beds, as well as the non-Arctic character of the shells, by supposing that the sand and shells were pushed up in the ice from the sea bed in temperate regions, but that the deposit in which they are now seen was washed from the ice-foot at these several elevations by the fresh water due to the melting of the ice, and bearing away with it the mud, sand, and stones transported so far in the ice.

Too much stress must not be laid upon stratification and lines of boulders in the drift, as this may be produced by iceberg loads being thrown down in deep water; just as when a handful of mixed sand and grit of various form and different coarseness is dropped into a long glass of water, the larger grains will, *cæteris paribus*, reach the bottom first, and a rough stratification will be produced. The contortion of clays and sands can often be explained by the loads of debris carried by icebergs and dropped upon them, squeezing the underlying plastic mass away, and rolling up the surrounding layers in every variety of fold and crumple.

Our author lays great stress on the fact that there is now no polar ice-cap at all, and that all the evidence shows that the pole is not, and never has been, the centre of greatest cold or of greatest glaciation. The ice radiated from Scandinavia, not from the pole, and the pillars and prominent unglaciated rocks of Northern Asia show that there has been no ice sheet there in recent ages.

In his advocacy of a considerable submergence in comparatively recent times our author has the support of Prof. Prestwich, who, in the last number of the Proceedings of the Royal Society, has expressed the opinion that the masses of unstratified rubble commonly found resting on the slopes and terraces along the English Channel seem to be due to a force of propulsion for which the hitherto generally-suggested causes are manifestly inadequate. He extends his generalisation over Western Europe and the coasts of the Mediterranean, and arrives at the conclusion that the loess was a sediment deposited from the turbid sea-waters during the submergence, while the superficial deposits called "head" he refers to the surface debris swept off by divergent currents during the subsequent upheaval. Both of these movements he refers to periods of such short duration that large numbers of animals were simultaneously drowned and the waters were rendered so turbid as to be unsuited for n arine life.

Our author explains many of the phenomena of the later drift by reference to a great submergence, but, wishing apparently to imply that it was of a still more transient nature, speaks of it as a great flood. His flood deposits are not, however, the same as those referred to by Prof. Prestwich.

Sir Robert Ball has pointed out that if the heat received in winter is distributed over thirty-three more days, instead of only over seven more, the result would be glacial conditions in the northern hemisphere, a result which has been somewhat modified by Mr. Hobson, who pointed out that the heat received over the regions within the Arctic circle should be omitted from the calculation.

But the opponents of the astronomical theory are prepared to admit that when we are dealing with operations in which the effects are so obviously cumulative and the reaction of one on the other so important, we may expect in climate, as there are in what we call weather, times of such unstable equilibrium that, for instance, a slight prolongation of the period of cold, which may be small in itself, may yet cause a local change, the effects of which may eventually become very far-reaching—as, in the case of weather, rain may be produced by the explosion of a small quantity of dynamite in the upper regions of the atmosphere. It is useless to deny the existence of such causes as those on which the advocates of the astronomical theory chiefly rely any more than we should deny the possibility of the detection of tidal action in one of the American lakes, because we are convinced that the real cause of the rise of six feet or so of water on one side is due to the gale which we observe blowing across the lake. Nor are we justified in rejecting the possibility of more or less rapid submergences resulting in a rearrangement of surface debris or even in more cataclysmic action of the same kind, as was seen in the earthquake wave that rolled in on Lisbon.

We do seem to require some simpler theory than that of the extreme glacialists to explain the phenomena of the Pleistocene Age.

If the north-eastern portion of America and the north western part of Europe were raised so as to get a snowy mountain range on either side of the Atlantic, sending ice-sheets down to the sea in the intervening depressed trough, and by the convergence of the axes of elevation deflecting the ocean currents and causing glaciers to creep down east and west from the mountain ranges—all the phenomena of the glacial epoch could be explained.

Reverse the process; send up Greenland and lower the North American and Scandinavian chains even to below where they now stand, bringing in again the warm currents from the South, and the post-glacial submergence takes its place. Let the Icelandic volcanic system play its part, and let there be earthquakes and jerks and oscillations, all part of the regular course of operations accompanying such movements, and we have the marine drifts all explained. The forms of life which have been driven away from the centres of ice dispersal will follow the receding glaciers back again. Observers will find in their own district evidence of land ice, or of icebergs, or of sea currents, or of glacier water, but in this less cumbrous theory there will be room for all.

The conflict of views recorded in Sir Henry Howorth's exhaustive work prepares one to believe that the matter may not be finally settled for some time, and, before public opinion comes to rest, we may expect many swings of the pendulum now far on this, now far on that side of the truth. But we welcome this protest against the extravagant views of the extreme glacialists and this valuable encyclopædia of the facts and arguments bearing on glacial phenomena which must be in the hands of every student of the subject. Our author is well known for his scientific treatment of literary subjects and for the literary skill with which he presents his scientific facts. Though he is an uncompromising advocate of what commends itself to him as the right view, he has indulged in no criticism which can be regarded as discourteous to the living or unfair to the dead.

T. MCKENNY HUGHES.

DYNAMO-ELECTRIC MACHINERY.

Original Papers on Dynamo Machinery and Allied Subjects. By J. Hopkinson, M.A., D.Sc., F.R.S. (New York: The W. J. Johnston Company, Limited. London: Whittaker and Co., 1892.)

The Dynamo. By C. C. Hawkins, M.A., A.I.E.E., and F. Wallis, A.I.E.E. (London: Whittaker and Co., 1893.)

THERE is hardly any greater authority on the subject of dynamo-electric machinery than Dr. Hopkinson. It was he who, turning his attention to the Edison machine, first showed how the iron in the magnets should be distributed, how the magnetising coils should be wound, and the machine built up so as to ensure its possessing the highest possible efficiency in every sense of the word.

This he did not attempt to do by mere theoretical speculation, though himself a great theorist, but by instituting a very complete and exhaustive set of experiments on dynamo machines under practical conditions, and graphically representing their results. No device in the whole history of the evolution of the dynamo has been of more general service than his plan of exhibiting the results of experiments in the well-named characteristic curve of the machine. This did for the dynamo what the indicator diagram had long been doing for the steam engine, though not, of course, in the same way.

With the most admirable simplicity this curve of electromotive forces as ordinates, and currents as abscissæ, gave just the information required regarding the action of the machine. Thus, when the ordinates represented the potential differences between the terminals, the inclination to the axis of abscissæ of the line joining the origin to any point gave the working resistance in the external circuit, corresponding to the current and potential difference defining the point to which the line was drawn, or, this resistance being known, gave the current and potential difference which the machine might be expected to develop with this as the working part of the circuit.

Then again, Dr. Hopkinson showed how the characteristic curve could be used to give the conditions under which an arc lamp can be made to work. It is well known that if the generating machine working on an arc lamp be run so as to give an electromotive force below a certain limiting value, the machine cannot be made to "keep" an arc. An explanation had been previously given by Dr. Siemens; but Dr. Hopkinson showed that all that was necessary was to lay down in the characteristic curve of the dynamo as already explained the line representing the *metallic* resistance R in circuit, then draw the tangent parallel to this line, and observe whether the ordinate corresponding to the normal working current of the lamp falls on the right or on the left of the point of contact. If E denote the length of the ordinate in question, and C denote the current, we have in the former case

$$dE < RdC$$

and in the latter

$$dE > RdC$$

Thus in the former case the value of dE is smaller than the increment of electromotive force required to drive the corresponding increase of current through the metallic resistance, in the latter case it is larger than this. Consequently, in the latter case, there will be an excess of electromotive force which will go to increase the length of arc. Thus the arc will continually lengthen until the current suddenly fails and the light goes out.

Hence the mere inspection of the curve settles the question as to whether the machine is running fast enough, or whether there is a sufficient margin of speed to ensure stability.

In the paper on Some Points in Electric Lighting, a large number of facts, now so well known as to have become common places of practical science, are discussed. But ten years ago, when the paper was read, many electricians engaged in supplying electric light were themselves working very much in the dark; and Dr. Hopkinson's paper was to many of them exceedingly useful as supplying facts, and especially hints as to graphical processes of investigating the behaviour of dynamos, whether used as a generator or a motor.

The next paper is that by the author and his brother, Dr. E. Hopkinson, on Dynamo-Electric Machinery, which has become justly famous as that in which the enormously useful idea of the magnetic circuit was first applied in a complete and consistent manner to the discussion of the results of experiment on different types of dynamo. In this a comparison between the characteristic curve of the machine, and the curve of magnetising force and magnetic induction, is made to give important information as to the proper disposition of the magnetic circuit, and the failure of the total induction to pass through the armature. Further, the effect of the lead of the brushes and of the current in the armature is fully discussed and graphically illustrated; and the paper closes with what were most valuable at the time, a description of the author's method of testing the efficiency of dynamos, and numerous results of experiments on machines with armatures wound according to the Hefner Alteneck plan, and the unsymmetrical horseshoe arrangement of magnets, and on others with Gramme armatures and the Siemens rectangular symmetrical arrangement of magnets. In these efficiency experiments the ingenious plan of using two similar machines in the same circuit and having their shafts coupled, one acting as generator, the other as motor, was first adopted. The motor in great measure drives the generator which feeds it, and it is only necessary to supply by means of a belt the balance of driving power required. Thus, uncertainty in dynamometric measurement of power transmitted has effect only on the estimation of this balance. The power developed by the motor can be found electrically, as likewise the electrical energy developed by the generator, and thus all the data are obtained for estimating the efficiency of the machine.

This idea has borne important fruit in the extremely valuable methods which have been invented by others for more conveniently carrying out similar dynamo experiments, and for testing transformers.

Next comes the very valuable continuation of this paper published only last year, which completes the discussion of direct current machines. In this sequel the effect on the electromotive force of the machine of the current in the armature for a given lead of the brushes is experimentally investigated, and compared with its theoretical value as given in the earlier part of the paper.

The remaining portion of the book consists mainly of papers relating to the theory of alternating currents, and the testing of alternate-current machines and transformers, and concludes with an account of the author's arrangements for applying the electric light to the lighthouses of Macquarie and Tino. The first paper on alternating currents is the one which has been so much referred to in recent discussions on the action of alternators, and the possibility of running more than one in the same circuit.

Though the increased use of alternating currents has added much to our knowledge of the behaviour and capabilities of alternators, Dr. Hopkinson's paper is, and will remain, one of the classics of the subject. But the last word of theoretical and practical explanation has not yet been said, and will probably not be said for a long time. In the meantime there is a possibility, now that the behaviour of iron in rapid magnetic cycles can be studied completely in various ways, of our obtaining further information which may clear up some of the outstanding difficulties of the subject.

Some results of a very interesting character as to rapid cycles are given in the paper on the Tests of Westinghouse Transformers. The curves showing the electromotive force and the current at different instants during a half period are plotted and come out very considerably different from the ordinarily assumed curve of series. The harmonic analysis, or the new analysing machine of Henrici and Sharpe, might with advantage be applied to them to reveal their components. From these curves the dissipation loops are plotted and made to give the loss of energy due to local currents and hysteresis in the curves.

Further description of these papers is unnecessary. They have already passed to a considerable extent into electrical literature; but a great service to practical electricians has nevertheless been done by their publication in a collected form.

In Messrs. Hawkins and Wallis's book we have little of originality; but what seems a straightforward, accurate, and fairly full account of dynamo-electric machinery. Beginning with chapters on the Magnetic Field, the Magnetic Circuit, the Production of an E. M. F., and Self-Induction, the authors enter on their main subject with a chapter on the Classification of Dynamos. The principal types of machine are described and well illustrated, so far as the number and general nature of the cuts are concerned. But while the authors have been liberal with carefully made drawings and well considered diagrams, the execution and printing of the illustrations in the text are here and there rather poor, and a higher general standard in this respect might easily have been attained.

After a general analysis, so to speak, of dynamos, in which armatures, magnets, &c., are discussed, we come to matters relating to the action of dynamos, such as series, shunt, and compound winding, and sparking and angle of lead of brushes. Then follow descriptions of typical machines, illustrated by folding sheets, and the book closes with chapters on Dynamo-Designing, and the Working and the Management of Dynamos.

We should have liked to have seen dynamo-testing worked out more fully, and a separate chapter on this important subject might easily have been given without burdening the book with matter properly belonging to works on general electrical measurements.

Considering the compass of the book—520 small 8vo pages—the authors have succeeded in placing before their readers a very great amount of valuable information, well arranged and clearly expressed, and their work will no doubt be appreciated by students and workers in practical electricity. A. GRAY.

OUR BOOK SHELF.

Modern Microscopy: a Hand-book for Beginners. In two parts. 1. "The Microscope, and Instructions for its Use." By M. J. Cross. 2. "Microscopic Objects: how Prepared and Mounted." By Martin J. Cole. (London: Baillière, Tindall, and Cox, 1893.)

THIS book, although only extending to 104 pages, is what it professes to be, and will prove thoroughly useful to beginners. The authors understand practically their respective subjects, and this has given the capacity, never otherwise possessed, to tell the beginner accurately and efficiently what it is needful for him at the outset to know.

It is highly to be commended that they have not rendered their pages incompetent by any pretence at an introduction to the optics of the instrument, or concerned themselves with any attempt at exposition of modern optical theory. They have done what affords a more genuine evidence of their appreciation of the importance of these subjects, having presented the results of the study of them in a practical form to the beginner, so that although his earlier efforts are not complicated with mathematical demonstrations and theory, he is nevertheless taught to work, on the highest results reached through these, so far at least as they apply to his initial endeavours.

The danger of extremely elementary books on microscopy is shallowness. They have often been a mere catalogue of two or three chosen instruments, with brief accounts of the apparatus affected by the author, and descriptions of pretty or pleasing objects. The former part of this book is much more than this; it gives the results of a practical knowledge of how to employ the instrument in such a way as to attain the finest results; always remembering that it is beginners that are receiving the instruction.

There are some thoroughly sensible things said on the microscope-stand. We may differ slightly from some of these, but they are written with a knowledge of the subject, and those who follow them will not greatly err.

We can commend also the chapter on "Optical Construction." It is brief, but puts to the beginner exactly what he requires to know. The pages on "Illuminating Apparatus" are specially commendable because thoroughly experimental. In fact, the fifty-five pages devoted to modern microscopy will be a boon to every one of the many who are every year "beginning" with the use of the microscope.

But the practical character of the book is seen even more clearly in the second part of it, by Mr. Martin Cole. He at once introduces the tyro to the art of preparing and mounting his own objects Here again it is not a mere repetition of what has been obtained from other sources that is presented, but Mr. Cole's long experience as a mounter is given to the reader unostentatiously and with pleasant and useful brevity.

There are some who, glancing at this little treatise, will at once conclude that the thirty-six pages devoted to the subject must leave it inefficiently treated even for beginners. We advise such to read the pages; and after some years of practice in most of the departments of mounting referred to and explained, we can only say that they present in a brief but a very efficient manner the facts required to enable the earliest efforts of an earnest amateur to become so successful as almost certainly to secure his interest in the subject, and cause him to intelligently pursue his pleasure and instruction, if not to aim at scientific work directed by more exhaustive treatises. W. H. DALLINGER.

Lectures on Sanitary Law. By A. Wynter Blyth, M.R.C.S., L.S.A. (Macmillan and Co. 1893.)

THIS work presents a general view of the powers and duties of Local Authorities in relation to public health, and since the material has been compiled by one who, while he is a prominent sanitarian is also a barrister-at-law, the fact that the work is good and trustworthy, and leaves but little to be desired, goes without saying. The only point upon which there is any scope for adverse criticism is that the review of sanitary legislation appears to be, in places, a little too cursory, and in consequence some important material is a trifle too hurriedly passed over. To indicate one such instance:—There is some important material contained in the Dairies, Cowsheds, and Milkshops Orders of 1885 and 1886 which is not given, and with which the health-officer is directly concerned. Sections 10, 11, and 12 of the 1885 Order are omitted; and no one will question their right to be fully included within any serviceable abstract of the Order, since they deal specifically with certain well recognised sources of contamination, against which it is necessary to guard the milk in those places where it is stored or kept for sale.

Nothing need be more inclusive or better expressed than the majority of the work, and when in one or two places the information is a little more extended, and the statutes specially dealing with the inspection and examination of food (which are now given *in extenso* in the appendix) are incorporated in, say, another two chapters, the book will be rendered even more acceptable than it is at present to those desirous of obtaining in a readable and concise form a good knowledge of sanitary legislation.

The scope of the book embraces the entire range of public health legislation, and the volume is largely an embodiment of a series of lectures which have frequently been given by the author. The first chapter treats of the constitution of Sanitary Districts and Authorities, and includes the definitions of certain terms employed in the Sanitary Acts. Lecture ii. deals with the statutory provisions regarding nuisances; and the next three lectures are concerned with the legal aspect of sewerage and drainage, water-supply and sanitary appliances; regulations and bye-laws; port sanitary law, canal boats, Metropolitan sanitary law, the Housing of the Working Classes Act, 1890, are all dealt with in subsequent chapters; and the statutory provisions which deal with the prevention of disease are particularly well and clearly mapped out in Lectures vi. and vii. The book comprises nearly 300 well-printed pages, and it is neatly and serviceably bound.

The author must be congratulated upon having presented a rather heavy and unattractive subject in the most concise and readable form—consistent with general usefulness—of any in which it has hitherto appeared.

LETTERS TO THE EDITOR.

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

The Royal Society.

THE article on the Royal Society, published in NATURE of June 8 by my friend Mr. Thiselton-Dyer, contains very little statement of fact to which I, or any one acquainted with the history and traditions of the Society, could wish to take exception.

It does, however, seem to me to be important to point out (a thing Mr. Thiselton Dyer has omitted to do) that the tendency of the development of the Society has been to restrict its ordinary membership to those who have done valuable work in "the improvement of natural knowledge" either by the exercise of their own mental gifts, or by assisting in some marked way—by the wise application of money or other direct influence—the efforts of others to that end. When, some thirty-five years ago, the annual number of elections of ordinary Fellows was practically restricted to fifteen by the limitation to that number of the list recommended by the Council, the chance of admission to the Society for "a member of the legislature with the keenest sympathy for science" (to quote Mr. Thiselton-Dyer's words) became small; and as the years rolled on, and the number of serious workers in science increased in unexpected proportion, it became less and less. Accordingly, not many years ago, it was determined by the Society, in order to meet this undesirable state of things, that members of the Privy Council should be eligible at any time as Fellows of the Society without reference to the annual list of fifteen prepared by the Council. Apparently the intention of this measure was to relieve the ordinary annual list of fifteen candidates for Fellowship from the presence of a certain number of members of the legislature with keen sympathy for science, and other such aspirants, and to reserve it for those for whom it could be claimed that they had done something tangible for "the improvement of natural knowledge." It seems to me that the selections made by the Council since that date confirm this view. Mr. Thiselton-Dyer makes a mistake in confounding the real services to natural knowledge rendered by Sir John Kirk, Sir George Nares, and Sir Charles Warren, with the "sympathy for science" of amiable members of Parliament.

There is another aspect of the question recently discussed which seems to me to be important. Does the Royal Society propose, or does it not, to include in its annual elections persons eminent in historical study? If it does, surely Freeman, Stubbs and Gardiner would have been Fellows of the Society. The examination and exposition of documents when they relate to an Asiatic race cannot be regarded as more akin to the investigations of the improvers of natural knowledge than is the study of the inscriptions, camps, and pottery of European peoples. Does the Royal Society explicitly or implicitly recognise claims which would give their possessor a first place in an Academy of Inscriptions or of Historical Science? I should venture to reply to this question: "Certainly not; by most definitely expressed intention such studies as those of the historian were excluded by the founders of the Society from their scope. And further, were such studies to be embraced by the Society as a new departure, it would be necessary to make special provision for them by increasing the annual number of elections, and by securing seats on the Council for one or two persons acquainted with those studies and the merits of those who pursue them."

I believe that the Royal Society is honoured and trusted by the British public as being the leading society "for the improvement of natural knowledge." Its original and deliberately chosen motto, "Nullius in verba" is a distinct profession of its purpose to appeal to experiment and the observation of phenomena, rather than to encourage the disquisitions of the bookman and compiler of history.

Though it may well be urged that such a body as "the Royal Society for the Improvement of Natural Knowledge" is wise in offering a kind of honorary membership on special terms to those who are a power in the State, there seems to be no ground for maintaining that the Fellows (as Mr. Thiselton-Dyer declares) "display themselves as reasonable, if hard-headed, men of the world" when they sacrifice one of their fifteen ordinary annual fellowships for the purpose of enrolling among their number an isolated example of the numerous body of historians and essayists who have attained some distinction in subjects and methods remote from those professedly pursued by the Society.[1]

Were the Royal Academy of Arts to assign one of its Associateships to, let us say, a distinguished botanist who is known to have a keen sympathy for Art, the world would, I venture to maintain, consider that the Academicians had not "brought themselves into touch with another field of national life," nor "displayed themselves as reasonable or hard-headed men of the world," but had simply stultified themselves whilst conferring no real honour upon their nominee. The Royal Academy includes a small number of laymen as honorary members, but it is recognised that the Academicians shall only confer their regular membership upon those of whose work they are *competent judges*, and consequently upon those who are really honoured by the selection, namely, artists.

It seems to me that *mutatis mutandis* much the same is true of the Royal Society. The Society has gained in the past, and will retain in the future, public esteem, and increasing opportunities for usefulness by aiming with singleness of purpose at "*the improvement of natural knowledge.*" To confer honour on those who have improved natural knowledge is its privilege and its duty. The appreciation of historians and of "sympathetic legislators" is a function which the Society is incapable of performing, and moreover one which few, if any, persons desire it to attempt, since it must lose dignity by assuming to adjudicate in matters in which it is incompetent.

Oxford, June 26. E. RAY LANKESTER.

ALTHOUGH my friend Prof. Lankester finds that the "tendency of the development" of the Royal Society has been to restrict the area from which its members are selected—a conclusion in which I am not disposed to agree—I do not find that he seriously impugns the account which I attempted to give of what appeared to me to be the traditional practice of the Society in the matter.

In fact in one respect he goes much further than I should myself be inclined to do in admitting as a qualification for membership "the wise application of money." I must confess that I should be disposed to regard this, for obvious reasons, with very close scrutiny.

Apart, however, from this it is evident that Prof. Lankester and those who agree with him would like to make the Royal Society much more professionally scientific (for there are very few scientific men nowadays who are not in some sort or other professional). If they succeed I am disposed to think that it would be a very much less influential body than it is at present. And I find that no inconsiderable body of the existing Fellows are of the same opinion. W. T. THISELTON-DYER.

Kew, July 1.

Ice as an Excavator of Lakes and a Transporter of Boulders.

I HAVE devoted a considerable space in a work I have recently published in which I have criticised the extreme glacial views of some writers to an issue which underlies a great deal of their reasoning, and which, it seems to me, it is absolutely necessary we should determine before we are entitled to make the deductions habitually made by them.

Before a geologist is justified in making gigantic demands upon the capacity and the power of ice as an excavator or as a distributor of erratics and other debris over level plains it is essential that he should first ascertain whether it is capable of the postulated work or not. It is not science, it is a reversion to scholasticism to invoke ice as the cause of certain phenomena unless and until we have justified the appeal by showing that it is competent to do the work demanded from it. This preliminary step is not a geological one at all. It is a question of physics, and must be determined by the same methods and the same processes as other physical questions. So far as we know the mechanical work done by ice is limited to one process. The ice of which glaciers are formed is shod with boulders and with pieces of rock which have fallen down their crevasses. These

[1] I have addressed my remarks mainly to the contentions of Mr. Dyer's article. I should wish to avoid discussing the merits of a particular election which in my opinion cannot now and never could legitimately be a subject for public comment. I wish, however, to state that I am not unacquainted with the interesting essays on the history of geological theory which we owe to the hero of that election.

pieces of rock abrade and polish and scratch the rocky bed in which they lie when they are dragged over it by the moving ice. Without this motion they can of course effect nothing either as burnishers or as excavators.

This motion has been shown by recent experiments to be very largely if not entirely a differential motion due to the viscous nature of ice, as Forbes long ago argued on *à priori* and other grounds that it was. The viscosity of ice is different at different temperatures. It differs also greatly when it is in the form of granulated ice, such as a glacier is composed of, from ice formed in a laboratory or directly frozen from water in a pond, but in any case it is slight, and it needs a considerable and a long-applied force to make it shear. The consequence is that when it rests on a level or nearly level surface, where gravity does not work, it ceases to move at all. In order that it should acquire motion sufficient to drag stones, &c., along, it is necessary that there should be some *vis a tergo*. Either the ice must rest on a slope sufficiently inclined to generate a gravitating movement in it, as a whole, or the slope of its upper surface must be sufficiently great to cause the movement of its surface layers to be continued down to and to remain effective in its nethermost parts. Every attempt made by Croll and others to invent for, and assign to, ice molecular movements capable of causing lateral motion in the stones beneath it other than those induced by gravity, seems to me to have utterly failed. The cause—the only cause which is competent to make it move is gravity acting either in one or the other way above specified.

This seems to be the inevitable conclusion whenever the problem is tested as it ought to be tested, by empirical tests. If so, it seems to put out of court the continual appeals made to ice as the distributor of debris over hundreds of miles of level plains, and as the excavator of basins and lakes at a considerable distance from mountain slopes.

In the first place, the modulus of cohesion of ice being what it is, it has been shown by Mallet, Oldham, and Irving that thrust cannot be conveyed through it for more than a short distance, since it must yield and eventually crush.

This *à priori* view is supported by the actual observation of glaciers in which we find that the rate of motion is very largely a function of the slope of the bed, and when a glacier leaves the slope on which it rests and gets on to level ground it very soon ceases to move altogether.

It has been argued that in the Ice Age the ice was piled up in dome-shaped ice sheets, and that the distribution of the boulders and the excavation of mountain lakes was due to the results of the efforts of the viscous mass to reach a state of equilibrium by hydrostatic movement, or by rolling over itself. But this ignores the very slight viscosity of ice which would require a very high slope in its upper layers to induce movement in its lower ones at all. It is impossible to see how this high slope could be secured, since the effort to restore equilibrium would be continuous, and the potential movement involved in every fresh fall of snow would at once be dissipated instead of being accumulated.

I cannot see, therefore, how under any circumstances it is possible for ice either to travel over long distances of level ground, or to excavate hollows such as the great majority of mountain lakes are.

I have not in this letter referred to the geological difficulties of such an hypothesis, which are manifold. I have limited myself to the physical difficulties alone. They seem to me to underlie the whole problem, and it is useless to discuss it until they have been solved, yet they are persistently ignored by the ardent champions of ice. That ice can do a good deal when allied with gravity is true enough, but the problem, as presented by Mr. Wallace, Prof. James Geikie and others requires that it should continue to do portentous work when no longer allied with gravity. Is it too much to ask that some justification should be offered (and nowhere better than in your catholic pages) for such an enormous unverified postulate?

Athenæum Club, July 1. HENRY H. HOWORTH.

Abnormal Weather in the Himalayas.

On May 26 I walked from Changla Gali (about 9000 feet) to Dungar Gali (under 9000 feet) by the "pipe" road. On the way we passed (the road is cut along the side of the steep mountains) a narrow valley filled with snow to about a height of 100 feet. The width of the hard snow on the road was 20 feet. On the 28th I walked back to Changla Gali by the main road. Here we saw a great deal of snow. A bridge spanned a narrow valley, a mass of flat snow, perhaps 15 feet thick, filled the valley to the bridge. No snow ran up the valley. Then we came on two valleys converging into one at the point where the road passed. Both valleys above and the valley below were filled with snow, and the road for 150 feet was cut on the face of the snow.

In the first week of May terrific storms burst over Murree; we had constant storms at Dungar on the night of the 26th up to 12 a.m. on the day of our leaving, the 28th. On the 28th the last two miles of the road into Changla were simply carpeted with leaves and twigs broken off by a violent hailstorm. The sides of the road, sometimes the road itself (four hours after the storm), were covered with drift and massed hailstones of the size of big marbles (ice with the usual whitish centre).

This continuance of snow and this stormy weather is stated to be altogether abnormal. F. C. CONSTABLE

Changla Gali, May 29.

Peculiar Hailstones.

A FRIEND of mine writes me from Peshawar about a very curious phenomenon which I think is worth notice in your columns. The monsoon has set in this season earlier than for some years past. A few days ago in a village named Daduzai (a tehsil in the Peshawar district) rain fell, preceded by a wind storm, and with the rain came a shower of hailstones which lasted for a few minutes. The most curious part of this occurrence is that the hailstones when touched *were not at all cold*, and when put in the mouth (as is the custom in this hot country) tasted like sugar. I am further told that these hailstones were extremely fragile, and as soon as they reached the ground they broke in pieces. These pieces when examined looked like broken sticks of crystallised nitre. My informant tasted them, and was struck with their purity and sweetness. A few pieces were also sent to the Deputy Commissioner of the district. The phenomenon has been duly reported in the leading newspapers of the province, and the *Akhbar-i-Am* has noted it in its leading columns. KANHAIYALAL.

Lahore, June 20.

Crocodile's Egg with Solid Shell.

DURING the year 1885 I was stationed at Trincomalee, when it was my luck to find a large crocodile's egg near Kantalay tank. On showing the specimen to several friends who knew more about natural history than I did, they expressed their astonishment at seeing a hard-shelled egg, as the concensus of opinion was that such eggs were invariably surrounded with a soft parchment-like covering.

I made a hole in the top and bottom of the egg and blew out the contents. The shell is still in my possession, and resembles more the hard enamelled-like egg of the ostrich than anything else I have seen.

The above facts may interest those who take a pleasure in objects of natural history. J. BATTERSBY.

Murree Hills, June 7.

UNIVERSITY AND EDUCATIONAL ENDOWMENT IN AMERICA.

THE statements in the following extract are so remarkable that I think they deserve a wider publicity than they will probably receive in the pages of a Parliamentary paper.

One may hope that the reconstructed University of London will make provision for post-graduate study and the advancement of knowledge in the greatest city of the world. It must be admitted that this cannot be done without the expenditure of a good deal of money. May one hope further that the cause of the higher education will find friends amongst us in London as munificent as university and technological studies have found in one of the newest of the world's cities?

Kew, June 30.

W. T. THISELTON-DYER.

Extract from "Report for the year 1892 *on the Trade of the Consular District of Chicago." (F.O. Annual Series,* 1893, *Diplomatic and Consular Reports, No.* 1233.)

FIVE years ago the University of Chicago was not thought of, and now there are twelve fine buildings of English Gothic architecture, either finished and occupied or in course of construction, on twenty-five acres of land owned by the University in the neighbourhood of Jackson Park, near the Exhibition grounds, where three years ago was a marsh. The University has now a large staff of professors, selected from other institutions in the country and Europe, and about 1000 students. Its origin and rapid growth are greatly owing to the generosity of Mr. Rockefeller, who in 1889 offered an endowment of £120,000 if a committee could raise the sum of £80,000; this sum was quickly raised, and about the same time a merchant of Chicago presented the University with twelve acres of the ground on which the buildings now stand. Further gifts came in, and up to the present time the total donations amount to £1,284,000, of which Mr. Rockefeller alone has contributed £754,000. The sums given in 1892 amounted to £711,500, and among the gifts was the offer of a telescope, to be the largest and most powerful in the world, which, with the observatory in which it will be placed, will cost more than £150,000. The University was opened last October with a faculty of 115 professors, men and women. One of the features of its regular work will be university extension and a system for the education of the masses.

A magnificent gift was last year presented to the city, and entitled the Armour Institute, after the patriotic and public benefactor of that name. It consists of a large and handsome building already completed, and fitted interiorly with marble wainscoting on every floor, marble arches and marble bath rooms, and the gift was accompanied with an endowment of £289,000. It is to be used as a manual training school and an institute for every branch of science and art; it is fitted with laboratories, forges, gymnasium, and library, and contains electrical, lecture, and other rooms for domestic sciences. It is intended as a benefit to young men and women of every class to be within the range of the poorest, and is taking the form of a school of technology.

ANTIPODEAN RETRENCHMENT.

LAST week a brief reference was made in these columns to the decrease in the grant to the University of Melbourne—a curtailment only justifiable under very special circumstances, and one that may bring reproach on the Colony that adopts it. Since then we have seen a letter in the *Journal of Education* for July by Dr. E. A. Abbott, late Headmaster of the City of London School. The letter is as follows:—

I venture to ask space for the following extract from a letter I received to-day from the Professor of Mathematics in Auckland College, New Zealand. Prof. W. S. Aldis was Senior Wrangler and First Smith's Prizeman in 1861, and subsequently, for several years, Principal of the College of Physical Science in Newcastle-on-Tyne. The failure of his wife's health induced him, about ten years ago, to accept the Auckland Professorship, at some sacrifice of income, on the understanding, of course, that he was irremovable as long as he could do the work. After nearly ten years of service, here is the result, as stated in the extract, which bears date May 19. I give it with the mere suppression of the name of the chief mover in this business.

> "Last Monday —— succeeded in getting a majority of the Council to give me six months' notice of the termination of my engagement, on the ground that the amount of work I did could be perfectly well performed by plenty of men who could be got for a much lower salary. . . . No charge of incompetence or neglect of duty has been made against me, unless by slander behind my back. I have never been asked to meet the Council; the debates were held with closed doors; and, before I even knew what was being proposed, I was allowed to read the result of their discussion in the *New Zealand Herald.*"

Those who know my old schoolfellow, Prof. Aldis, as a man incapable of dereliction of duty or exaggeration of fact, will think that the only way of meeting the necessities of the case is to rescind the resolution. Others may reasonably defer their final judgment till they hear what is to be said on the other side; but meantime I would appeal to all University men to defer applying for the professorship. For the present, to succeed a professor thus arbitrarily dismissed by the Council involves not only the possibility of being similarly treated, but also the certainty of contributing to what Sir Robert Stout has justly described as "a grievous injury to higher education." Many teachers, and many University men who are not teachers, will, perhaps go with me still further, and agree that, if Prof. Aldis's statements cannot be denied, no one can take the post without some forfeiture of self-respect.

Dr. Abbott puts the case plainly and fairly enough, and, lacking an explanation from the Council concerned, we conclude that this is another example of the reactionary policy of retrenchment which now fills the minds and dictates the deeds of Colonial officials. Let them retrench by all means, but in the right direction. There could hardly be a more short-sighted and mistaken policy than that of curtailing educational grants in order to redeem a position lost by extravagant expenditure. Wealth-producing power and facilities for obtaining knowledge go hand in hand. In the past many of the Colonies have proved that they recognised the prime importance of their Universities and similar establishments. Indeed, they have often shown the way to the authorities at home. Apparently, however, this wisdom is departing from Colonial Councils, for healthy branches are being lopped off indiscriminately, while obtrusive suckers at the roots of the constitution are left untouched. However, it is not too late to rescind the measures that have been taken—measures that are derogatory both to the good sense and dignity of Colonial Governments. We trust that the next mail will bring us news of the reinstatement of Prof. Aldis and the restoration of University grants.

SCIENCE IN THE MAGAZINES.

THE July magazines contain a few papers of scientific interest. In the *New Review* Mr. E. R. Spearman writes on "Criminals and their Detection." This article is a vigorous protest against the crude methods of identification employed at Scotland Yard. In spite of the thousands of blunders that have been made, our police authorities are stolidly indifferent to their imperfections, and look upon the Bertillon system as a "scientific fad." But this is the way in which the official mind usually views matters of scientific importance. To show the absurdity of the position taken up, Mr. Spearman gives a full description of the Bertillon process o measurement, with the results obtained since the method was adopted in France, and compares it with the haphazard system of identification used in our prisons. But for the fact that officialism never acknowledges itself to be in the wrong, *bertillonage* would have been established in England long ago.

The Bertillon system, says Mr. Spearman, is fast circling the globe. Our great Indian Empire has taken it up, the whole province of Bengal being recently put under its protection, and still more recently the island of Ceylon. Even in still more Eastern Asia, Japan has borrowed M. Bertillon's scheme. In Eastern Europe, Russia (St. Petersburg and Moscow) and Roumania are using the system, which is also practised in Norway and Switzerland. In North America the United States Government has successfully applied anthropometry to deal with deserters in the army and navy; while Chicago not only uses the system for its own purposes, but is the centre of a large field of operations in the States and in the adjoining portions of the Dominion of Canada. Beside this, on the Pacific coast it was successfully used to enforce the Chinese immigration law, the Celestials being able to use each other's permits with impunity, all being alike as two peas to the casual Caucasian glance, but not to the Bertillon compasses. In South America the Bertillon system has also penetrated, the Argentine Confederation making use of it.

The anthropometric system could be established in England at the present time, for Mr. Spearman points out that in the Penal Servitude Act, 1891, it is enacted that

The Secretary of State shall make regulations as to the measuring and photographing of all prisoners who may for the time being be confined in any prison, and all the provisions of section six of the Prevention of Crimes Act, 1871, with respect to the photographing of prisoners, shall apply to any regulations as to measuring made in pursuance of the section.

Dr. S. S. Sprigge has an article on "The Poisoning of the Future." He says:—

There are two directions which the poisoner of the future may take in an intelligent attempt to use superior knowledge in the accomplishment of undetected crime. One of them is the bringing of the older methods of poisoning to perfection by the exhibition of subtler drugs. The other, and by far the more terrifying, is the employment by the poisoner of the results of recent biological research.

Neither of these methods is likely to be very successful, for those who understand the power of such deadly essences as strychnine, atropine, digitalin, and aconitine, or know how to isolate, cultivate, preserve, and inoculate the germs of a malignant disease, will be comparatively marked men, inasmuch as they will belong to a limited class.

The *Humanitarian* appears this month for the first time as a magazine. In it M. A. Bertillon gives a description of the anthropometrical measurements made in France under his direction. The measures taken are (1) height, (2) length of head, (3) maximum breadth of head, (4) length of middle finger of left hand, (5) maximum length of left foot, (6) maximum length of arms extended, (7) colour of the eyes. M. Bertillon describes in detail all the operations, and shows how the measures are classified so that the question as to whether a prisoner has been arrested before or not can be irrevocably settled in a few minutes.

In the *Contemporary Review* Mr. G. J. Romanes, F.R.S., furnishes a postscript to his article in the April number in support of Weismannism against Mr. Herbert Spencer. The points touched upon are (1) the principle of Panmixia, or cessation of selection; and (2) the influence of a previous sire on the progeny of a subsequent one by the same dam. Mr. Spencer briefly replies to Prof. Romanes, and Prof. Marcus Hartog follows with a short description of the works of Weismann, from the publication of the essay on "Heredity" in 1883 to the last conception of the germ-plasm and the theory of variation at present held by the great zoologist of Freiburg.

Prof. Thorpe, F.R.S., contributes to the *Fortnightly Review* a descriptive account of the recent solar eclipse in the form of a reprint of a discourse delivered at the Royal Institution. As the article contains no information of scientific moment that has not been chronicled in these columns, further comment upon it is unnecessary.

The *Century Magazine* contains an article by Dr. Allan McLane Hamilton on "Mental Medicine," or the treatment of disease by suggestion. Though a vast amount of quackery is carried on in connection with hypnotism and mesmerism, there is no doubt that many cases have been successfully treated.

It is only within the past few years that scientific men have really adopted suggestion in a rational way, and the advances in phychology and psychopathology have paved the way for the use of a most potent agent. Our knowledge of disorders of motility and the disturbance of the governing coordinating faculties permits us to determine the pathology of certain convulsive and spasmodic conditions, which until recently were simply looked upon as vague symptomatic states. Writer's cramp, which is a diseased automatism, has been repeatedly cured by suggestion made during the hypnotic state. I have seen forms of persistent tremor, chorea, speech defects, and other motor disturbances very much ameliorated, if not always cured, by the methods of Luys and Bernheim. In England and elsewhere suggestion has been used for the correction of certain mental states manifested in moral perversion, among which dipsomania and certain varieties of infantile viciousness figure; and my own experience has convinced me that in some insanities it is certainly a most valuable means for combating the development of delusions, and in restoring the equilibrium of an unbalanced nervous system.

"The Galaxy" (seen through a telescope) forms the subject of a short poem by Mr. Charles J. O'Malley. He finely describes the Milky Way in the lines—

"Luminous archipelago of heaven!
Islands of splendour sown in depths of night."

In *McClure's Magazine* Dr. H. R. Mill describes the Arctic Expeditions of Nansen and Jackson under the title "The Race to the North Pole." The former expedition started from Christiania a few days ago, but Mr. Jackson will not leave England with his companions until about the middle of July, or perhaps the beginning of August. He intends to approach Franz-Josef Land, which will be a comparatively easy task, and then to advance over the ice in sledges, trusting that the land-ice stretches northwards to the immediate neighbourhood of the Pole. If, however, Franz Josef Land proves not to have a great northerly extent, an advance may be made on the sea-ice, carrying boats for crossing open water. Mr. C. Moffett summarises the programme of Lieut. Peary's expedition, pointing out several important considerations which make it probable that the expedition will attain a considerable measure of success. It remains to be seen whether any or all the explorers will reach the goal. The race is a long one, and will tax to the utmost the energies and pertinacity of those who have elected to run.

"An Expedition to the North Magnetic Pole" is the theme of an article by Colonel W. H. Gilder. About three years ago Prof. Mendenhall wrote to the Secretary of the United States Treasury as follows:—

"The importance of a redetermination of the geographical position of the North Magnetic Pole has long been recognised by all interested in the theory of the earth's magnetism or its application. The point as determined by Ross in the early part of this century was not located with that degree of accuracy which modern science demands and permits, and, besides, it is altogether likely that its position is not a fixed one. Our knowledge of the secular variation of the magnetic needle would be better increased by better information concerning the Magnetic Pole, and, in my judgment, it would be the duty of the Government to offer all possible encouragement to any suitably organised exploring expedition which might undertake to seek for this information."

Acting upon a further recommendation, the Secretary of the Treasury requested the President of the National Academy of Sciences to appoint a committee of its members "to formulate a plan or scheme for the carrying out of a systematic search for the North Magnetic Pole and kindred work," and such a committee was subsequently appointed, with Prof. S. P. Langley, Secretary of the Smithsonian Institution, as Chairman.

The observers will be selected from among the officers of the United States Navy attached to the Coast Survey, who have had special training in magnetic field work, and a scheme of the observations to be made has been drawn up by Prof. C. A. Schott.

It is proposed to charter a steam whaler to take the party from St. John's, Newfoundland, to the northern part of Repulse Bay, which, being directly connected with Hudson's Bay, is the nearest point to the Pole, containing area that is accessible any year. There a permanent station is to be erected, where regular observations will be continued all the time, and from which each spring a field party (perhaps two) will start to locate the geographical position of the Pole.

NOTES.

THE annual meeting of the Institution of Naval Architects commenced at Cardiff on Tuesday, when an important paper upon "Fast Ocean Steamships" was read by Dr. Elgar. Owing to the rough weather, Lord Brassey, the president, was unable to be present, his yacht being prevented from reaching the fort.

THE forty-second meeting of the American Association for the Advancement of Science will be held during August at Madison, Wisconsin. The local secretary is Prof. C. R. Barnes, of the State University.

THE second annual meeting of the International Union of Photography will be held in Geneva from August 21 to 26. The headquarters of the Union are at 33, Rue Rembrandt, Antwerp.

ARRANGEMENTS have been made for a visit of the Geologists' Association to Ireland from July 24 to 29. The directors of the excursion are Profs. W. J. Sollas, F.R.S., and Grenville A. J. Cole, and a very attractive programme has been provided. In addition to the serious work, more than one social gathering is promised, so the trip will doubtless be enjoyed by all who undertake it. A geological map of the district to be visited, prepared by Prof. Cole, is printed in the special circular issued for the excursion by the Association, and Prof. Sollas's paper on the geology of Dublin and its neighbourhood, read before the Association on the 7th inst., is now in the press, and will be published the day before the party leaves London. As it is important to obtain an early estimate of the probable number of the party, all members who propose joining the excursion should apply at once to the Secretary, Mr. Thos. Leighton, Lindisfarne, St. Julian's Farm Road, West Norwood, S.E.

A COPY of the report of the Zoological Society that has just been printed has been received. Its contents will be summarised next week.

THE fifth Congress of Archæological Societies in union with the Society of Antiquaries was held on Tuesday at Burlington House, Sir John Evans, K.C.B., F.R.S., being in the chair. About forty delegates were present, including Lord Hawkesbury, Mr. Stanley Leighton, M.P., Profs. Flinders Petrie, and E. C. Clark, &c. It was announced that progress had been made with the archæological maps of Essex, Derbyshire, Sussex, and Surrey. Several papers were read, one on "A Photographic Record of Archæological Objects" exciting an interesting discussion.

THE Laboratory of the Marine Biological Association at Plymouth has still a few tables unoccupied for the summer vacation. Applications for permission to work there should be sent in without delay to the Director.

WRITING from Murree, on June 7, Mr. F. C. Constable says that, during a recent hailstorm, corrugated iron roofs were in many cases perforated by the hail. He measured one hailstone four hours after the storm, and found it to be 4½ inches round.

A VIOLENT thunderstorm occurred on Ben Nevis last week from 11 p.m. of Friday to 2 a.m. of Saturday, St. Elmo's fire appearing there at the same time. During another thunderstorm on Saturday afternoon flashes came off from the telegraph wire connections inside the observatory; and about the same time a fire-ball was seen to strike the ground near the foot of the hill. The hygrometric fluctuations at the time were remarkable.

DURING the past week sharp thunderstorms have occurred in many parts of the British Islands, accompanied by hail and very heavy rain. Between the 7th and 9th the fall within twenty-four hours exceeded an inch at several places in the north of England and in parts of Scotland, and in the north of Ireland on Sunday it amounted to 2·81 inches, a fall more than double the total for the month of June this year. The temperature was also exceptionally high in the southern parts of England during the first part of the period, the maximum reading being 89°·9 at Greenwich on Friday and Saturday, a temperature which was not equalled in any part of the summer during the five years 1888–92, and at Cambridge the shade reading on Saturday registered 92°.

SINCE February, 1892, a Richard thermograph has been installed on the summit of the Obir, at a height of 2140m., or about 1000m. below the level of the Sonnblick Observatory. The records of temperature up to February, 1893, as shown by this thermograph, were communicated and discussed by Director J. Hann at a recent meeting of the Vienna Academy (June 12). They afford a valuable contribution to the knowledge of the daily changes of temperature in the higher regions of the atmosphere. A comparison with the corresponding temperatures registered on the Sonnblick shows an almost identical course of changes, except that in summer the range on the Obir was perceptibly larger. During eight months, from October to May, hardly any daily variation is recorded in the decrease of temperature with height between the Obir and Sonnblick. In the summer months, the most rapid decrease was found to occur at 1 p.m., being 0°·74 per 100m., he least rapid at 11 p.m., being 0°·61 per 100m. The mean decrease per 100m. for the summer months was 0°·67, for winter 0°·54, and for spring and autumn 0°·56.

A NEW determination of the mass and the density of the earth has been made by M. Alphonse Berget, who describes his method in the current number of the *Comptes Rendus*. It consisted in altering the level of a lake by 1 m., and noticing the effect produced upon a hydrogen gravimeter such as was used by Boussingault and Mascart to determine the diurnal variation of gravity. The lake was that of Habaz-la-Neuve, in Luxemburg, of 79 acres area, belonging to M. François de Curel. The level could be raised or lowered in a few hours. The variation of the column of mercury was minutely observed by means of Fizeau's interference fringes, produced *in vacuo* between the surface of the mercury and a piece of plane-polished glass at the bottom of the observing tube. Two series of readings were taken, the one on lowering the level of the lake by 50 cm. and 1 m., the other on raising it by the two corresponding amounts. The displacement of the column for a change of level of 1 m. was $1·26 \times 10^{-6}$ cm. The value for K, [the constant of gravitation, *i.e.* the attraction in dynes produced by a mass of 1 gr. upon another placed 1 cm. from it in air, was found to be $6·80 \times 10^{-8}$. The mass of the earth was found to be $5·85 \times 10^{27}$ grammes, and its density 5·41, which is in fair agreement with results hitherto obtained.

DURING the cruise of the *Manche* in the neighbourhood of Jan Mayen and Spitzbergen, M. G. Pouchet made some interesting observations of the various kinds of ice to be found on those barren Arctic islands. In the northern lagoon of Jan Mayen, which was partly covered with ice on July 27, the ice, according to a description in the *Comptes Rendus*, was formed of irregular vertical prisms about 10 mm. thick separated by spaces of about 1 mm. and joined at the upper surface by a uniform layer of semi-transparent ice 1 to 2 mm. thick. At

Research Bay, Spitzbergen, the gigantic front of the two glaciers which flow into the sea presented three different tints. At the base some parts were quite dark, suggesting deep caves, but really consisting of pure homogeneous, compact ice. The middle region was greenish-blue, and the upper, consisting of snow-ice, was white. The ice-floes were either white or greenish-blue, or of an extremely intense emerald green. On taking one of the latter out of the water it was found to consist of homogeneous limpid ice, absolutely colourless to the thickness of 1 m. or so. The deep green colour was due to its illumination by the green water of the bay, which, like that of the Isfjord, is of an intensely green colour.

AN important paper by Messrs. Sarasin and De la Rive is published in the *Archives des Sciences Physique et Naturelles* and contains an account of a series of experiments on the interference of electrical waves after reflection from a metallic screen. The authors being of opinion that the results obtained by Hertz and themselves in a former investigation were vitiated on account of the reflecting surface being too small, undertook this series of experiments, using as a reflecting surface a sheet of zinc 16 metres long and 8 metres high. The arrangement employed was almost the same as that used by Hertz, the spark-gap of the oscillator, however, being surrounded by oil. The resonators were circular, and had been used in a previous series of experiments on the propagation of electrical waves along conducting wires, in which it had been found that each resonator responds to waves of a definite wave-length, and to these only. A series of observations, made with a view of ascertaining the minimum size of mirror, which gives consistent results with resonators of different sizes, showed that for a resonator of 75 cm. in diameter the reflecting surface must have a length of from 12 m. to 14 m. and a height of 8 m., while for a resonator of 35 cm. in diameter a mirror 5 m. long and 3 m. high is sufficient. The results obtained may be summed up as follows:—(1) A circular resonator has a constant wave-length to which it responds, whatever be the dimensions of the oscillator, the strength of the induced spark only varies, attaining a maximum value for a certain length of the oscillator, which gives waves in unison with the resonator. (2) The quarter wave length of a circular resonator is approximately equal to twice its diameter. (3) In the case of normal reflection from a metallic mirror the first node coincides exactly with the surface of the mirror. (4) The velocity of propagation of the electrical waves is the same in air as along conducting wires.

WE have received a copy of a calibration curve of one of Prof. Perry's new electric current meters, which are now being constructed for practical work by Messrs. Johnson and Phillips. This meter, as some of our readers may know, consists of a copper bell (with open neck) which rotates about its axis in a radial magnetic field formed between an inner cylinder and an outer surrounding cylinder, both of iron, and magnetised by a coil surrounding the inner. As the surfaces of these cylinders are furnished with teeth projecting towards one another, leaving just sufficient clearance space for the bell, there are, alternating with one another round the bell, places of maximum and minimum field intensity. The bell is immersed in mercury, and being covered with varnish, except at the lip and at the neck, where it receives and gives out current, is the seat of a current sheet running from the lip to the neck. Thus the bell rotates about its axis with a speed depending on the current flowing and the intensity of the magnetic field. By the ingenious device of rendering the field non-uniform, the resisting couple due to solid and fluid friction is made small in comparison with that due to Foucault currents; and as the latter is proportional to the square of the maximum field intensity multiplied by the speed of rotation, and the driving couple to the product of the field intensity and the current, a working formula is obtained in which the current is proportional to speed and to field intensity. By making the field sufficiently intense, the speed can be made as slow as may be desired, and error from neglect of friction proportionately diminished. The meter is thus very simple, and unlikely to get out of order, or to be inconstant or untrustworthy in action. It is claimed, further, that the temperature errors balance one another, and this is borne out by the fact that the calibration curve is a straight line from the first current marked, 2·5 ampères, to the highest, 60 ampères. The instrument must therefore, within the range of currents for which it is designed, work with great accuracy.

THE *Philosophical Magazine* for July contains a note by Messrs. Harvey and Hird on some differences they have observed in the behaviour of positive and negative electricity in high frequency discharges. They find that, when a brush discharge takes place in air between a point and a plate, the plate is always positively charged, although the discharge is oscillatory. In the case of hydrogen, however, the plate becomes negatively electrified. Thus in the case of a brush discharge in air or oxygen the positive electricity passes more readily than negative from a point into any neighbouring conductor, while in hydrogen the reverse takes place, negative electricity passing more readily.

WEBER showed some years ago that the eggs of the common pike could be caused to produce double monstrosities if the recently fertilised ova were violently shaken. Mr. John A. Ryder has recently communicated a paper to the Academy of Natural Sciences of Philadelphia, which leads to the belief that the Japanese produced their singular breeds of double-tailed goldfishes by taking the eggs of the normal species of goldfishes and shaking them, or disturbing them in some way, as Prof. Weber did with the eggs of the pike. They would thus obtain some complete double monsters, some with two heads and a single tail, and some with double tails. Those most likely to survive would be those with only a duplication of the tail. These being selected and bred would probably hand down the tendency to reproduce the double tail, a tendency which could become fixed and characteristic if judicious selection were maintained. Mr. Ryder thinks that his investigation warrants the conclusion that the regenerative power of organisms disappears as we rise in the scale of organisation, last of all in the peripheral extremital parts. He further observes that the power to produce monstrosities or cogenital aberrations of development due to external disturbances of segmentation, during growth, diminishes in the higher forms *pari passu* with the advance in development.

IN a number of papers communicated to the American Philosophical Society, the American Academy of Arts and Sciences, and the Boston Society of Natural History, Mr. A. S. Packard gives the results of studies on the life-history of some Bombycine moths. He has worked out the transformations of several of the lower Bombyces, and has arrived at some valuable results. He has treated the larvæ as though they were adult, independent animals, and has worked out their specific and generic as well as family characters. The origin of mimetic and protective characters has been traced, and the time of larval life when they are assumed ascertained. This involves a study of the development of the more specialised setae, spines, tubercles, lines, spots, and other markings. Facts have also been obtained with regard to the ontogeny of American species and genera, which, when compared with the life-histories of European, Asiatic, and South American Bombyces, may lead to a partial comprehension of the phylogeny of the higher Lepidoptera.

THE *Essex Naturalist*, No. 4, contains an address on periodicity in organic life, delivered by Mr. Henry Laver as retiring President of the Essex Field Club. Reasons are given for the belief that plant and animal life periodically fluctuate in richness and scarcity.

AT Trenton, and the Delaware Valley, and Ohio, flints have been found in ice-age drift and described as implements of palæolithic man. In three papers received from Mr. W. H. Holmes this interpretation is disputed, and the "finds" are said to be of Indian manufacture—a view which, if accepted, tells against the existence of glacial man in America.

PROFS. L. CICCONE and F. CAMPANILE have prepared a set of tables showing the intensity of gravity, in C.G.S. units, for every ten minutes of latitude (*Rivista Scientifico-Industriale*). They also give the value of g at all the principal observing stations in the world.

OWING to the delay in the publication, by the U.S. National Museum, of a "Monograph of the North American Bats," by Dr. Harrison Allen, the introduction to the Bulletin has been issued in advance. Judging from it, the coming memoir will be of an important character.

MESSRS. FRIEDLANDER AND SON, Berlin, have issued their *Natural History News*, No. 10.

THE "Transactions of the Leicester Literary and Philosophical Society," vol. ii., part 12, contains a paper on stings and poison fangs, by Mr. G. T. Mott, and a number of notes on some East Anglian birds, by Mr. L. Creaghe-Haward.

A VOLUME has just been published containing the results of rain, river, and evaporation observations made in New South Wales during 1891, under the direction of Mr. H. C. Russell, C.M.G., F.R.S., the Government Astronomer of the colony.

IN *Das Wetter* for May G. Falkenhorst gives an account of the various plants which are affected by weather, including the paternoster pea (*Abrus precatorius*), or "weather plant," the claims of which as a prognosticator of coming weather were shown to be groundless in the *Kew Bulletin* of January 1890. He points out that the indications of these hygroscopic plants, however worthy of study from a botanical point of view, only refer to simultaneous changes of weather.

THE Royal University of Ireland has issued its calendar for the year 1892. The papers set at the examination held during the year are published in a separate volume as a supplement to the calendar.

THE "Matriculation Directory" has been published by the University Correspondence College Press. It contains solutions to the questions set at the matriculation examination of London University last month, and articles on the special subjects for January and June next year.

"DIE MEDICINISCHE ELECTROTECKNIK," by Dr. J. L. Hoorweg, is a little book, dealing chiefly with elementary facts and principles more or less connected with medical electricity. Magnetism, statical electricity, voltaic electricity, and electrical measurements are the subjects of four separate chapters, and the remaining three chapters are devoted to a study of the action of electricity upon the human body, electro-medical apparatus, and various methods of electrification. The text is illustrated by seventy-seven figures and diagrams.

THE second number of Alembic Club Reprints can now be obtained from Messrs. Simpkin, Marshall and Co. It is entitled "Foundations of the Atomic Theory," and contains reprints of papers by Dalton and Wollaston, and an extract from Dr. Thomas Thomson's "System of Chemistry," in which book the earliest printed account of Dalton's views was given.

A NEW acid containing chromium and sulphuric acid, possessing somewhat remarkable properties, is described by M. Recoura in the current number of the *Comptes Rendus*. It is related to pyrosulphuric acid, $H_2S_2O_7$, in a manner somewhat similar to that in which the chromosulphuric acid, $(SO_4)_2Cr_2(SO_4H)_2$, previously prepared by M. Recoura, is related to ordinary sulphuric acid. Its constitution is represented by the formula $(S_2O_7H)_4Cr_2(OH)_2$. Its most remarkable property is that the two atoms of hydroxylic hydrogen are readily replaceable by metals to form salts, the whole of which, even those yielded by the introduction of the metals of the alkalies and of ammonium, are completely insoluble in water, although the acid itself is readily soluble. It has been termed chromopyrosulphuric acid. In order to prepare it a solution containing one molecular equivalent of chromic sulphate, $Cr_2(SO_4)_3$, and five molecular equivalents of sulphuric acid is evaporated over a water-bath, when a syrupy liquid of a deep green colour is eventually obtained. This liquid is then further heated to a temperature of 110–115° for a couple of days, which treatment induces a complete change of character and transparent tabular crystals of the new acid, possessing a vitreous lustre and a bottle-green colour, are deposited. Its formation is represented by the following equation:—

$$Cr_2(SO_4)_3 + 5H_2SO_4 = (S_2O_7H)_4Cr_2(OH)_2 + 2H_2O.$$

THE properties of chromopyrosulphuric acid differ widely from those of chromosulphuric acid. It is readily soluble in water, forming an opaline yellowish-green solution. This solution yields precipitates with the solutions of all commonly occurring salts, those of the alkalies not excepted. It may be generally stated that upon the addition of the solution of any metallic salt whatever to a solution of chromopyrosulphuric acid, a flocculent precipitate, more or less green in colour, is obtained. The precipitate, however, is not chromopyrosulphuric acid in which merely the hydroxylic hydrogen is replaced by the metal of the salt employed. One half of the pyrosulphuric acid is detached, and in contact with the water present produces four molecules of free ordinary sulphuric acid. The salt precipitated is thus derived from the acid $(S_2O_7)_2Cr_2(OH)_2$. For instance, when a solution of potassium chloride is added to a solution of chromopyrosulphuric acid the following change occurs:—

$$(S_2O_7H)_4Cr_2(OH)_2 + 2KCl + 2H_2O = (S_2O_7)_2Cr_2(OK)_2 + 2HCl + 4H_2SO_4.$$

Similarly copper sulphate solution produces a pale green precipitate of the salt $(S_2O_7)_2Cr_2\langle{}^{O}_{O}\rangle Cu$.

Solutions of caustic alkalies act like salts. Thus, when a solution of caustic soda of known strength is slowly added a precipitate of the sodium salt $(S_2O_7)_2Cr_2(ONa)_2$ is thrown down, and the solution attains its neutral point when ten molecular equivalents of soda have been added, the amount required to form the above salt and to neutralise the four molecules of sulphuric acid liberated. M. Recoura has also isolated the acid itself from which these salts are derived, and promises a description of its properties in a subsequent memoir.

NOTES from the Marine Biological Station, Plymouth.—Last week's captures include the Nemertines *Prosorhochmus Claparedii* and *Carinella linearis*, numbers of the Polychæte *Myzostomum* on *Antedon rosacea*, various species of the Pantopod genera *Phoxichilus*, *Nymphon* and *Ammothea*, the Isopod *Apseudes talpa*, the Schizopod *Heteromysis formosa*, the Brachyuran *Achæus Cranchii*, and the Nudibranchiate Mollusca *Æolidiella glauca* and *Galvina cingulata*. The chains of the

Salp *Thalia democratica-mucronata* have now for the most part broken up, and the detached sexual forms, each with a contained embryo, have been taken in considerable numbers. The floating fauna has also included Cirripede and Copepod Nauplii, Polychæte trochospheres and Molluscan veligers. Among Leptomedusæ *Clytia Johnstoni* and small *Obeliæ* have been abundant; and among Anthomedusæ *Sarsia eximia* has been observed, together with numbers of an apparently undescribed species of *Dysmorphosa*, resembling *Rathkea octopunctata* in its power of budding from the manubrium. The Mollusc *Galvina cingulata* and the Tunicate *Thalia democratica-mucronata* are now breeding.

The additions to the Zoological Society's Gardens during the past week include an American Black Bear (*Ursus americanus*) from Canada, presented by Mr. Joseph Politzer; a Hawk's-billed Turtle (*Chelone imbricata*) from the West Indies, presented by Mr. C. Melhado; two Common Buzzards (*Buteo vulgaris*) European, deposited; two Australian Crows (*Corvus australis*) from Australia, purchased; a Thar (*Capra jemlaica*, ♀), a Triangular-spotted Pigeon (*Columba guinea*), a Cardinal Grosbeak (*Cardinalis virginianus*), two Hybrid Pied Wagtails (between *Motacilla lugubris*, ♂, and *M. melanope*, ♀) bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

A New Comet.—A telegram received from Prof. Krueger announces that a comet with a bright tail was discovered by M. Quenisset at M. Flammarion's observatory, Juvisy, on July 9, its approximate place being R.A. 7h. 50m., N. Decl. 48° 10′. The comet is therefore in the constellation Lynx.

In *Edinburgh Circular* No. 38, Mr. Heath says that a second telegram from the same source states that the comet was again seen on the 10th, at 12h. 59·3m. M.T. at Kiel, its place being then R.A. 8h. 29m. 45·7s., N. Decl. 46° 59′ 29″; daily motion, + 34m. 48s. and − 1° 24′.

Comet Finlay (1886 VII.).—A continuation of M. Schulhof's ephemeris for the ensuing week is as follows:—

12h. M.T. Paris.

1893		R.A. app. (h m s)		Decl. app. (° ′ ″)
July 13	...	3 59 23·84	...	+18 54 32·8
14	...	4 3 57·65	...	19 10 20·2
15	...	8 30·28	...	19 25 35·4
16	...	13 1·69	...	19 40 18·4
17	...	17 31·83	...	19 54 29·3
18	...	22 0·65	...	20 8 8·3
19	...	26 28·11	...	20 21 15·4
20	...	4 30 54·16	...	20 33 51·0

In the above ephemeris we have corrected the error made in the *Astronomische Nachrichten* (No. 3171), where the 16th is inadvertently printed 14th.

Meteor Showers this Month.—In the list of the radiants of the principal meteor showers which Mr. Denning gives in the companion to the *Observatory* the following are visible this month, that occurring on the 28th being defined as "most brilliant":—

Date.		Radiant. α (°)	δ (°)		Meteors.
July 19	...	314	+48	...	Short, swift.
20	...	269	+49	...	Swift.
22	...	16	+31	...	Swift, streaks.
25	...	48	+43	...	Swift, streaks.
28	...	**339**	**−12**	...	Slow, long.
30	...	6	+35	...	Swift, streaks.

L'Astronomie for July.—The current number of this journal commences with an article by M. Tisserand on the inauguration of the statue of Arago, which was referred to in these pages last week. M. Deslandres briefly refers to some of his results as shown by the photographs taken by him at the late total solar eclipse, to which are added the observations of several other observers, and several illustrations of the instruments employed. M. Denning contributes three drawings of comet Holmes (made on November 9, 16, and 19 last), showing its change of shape from the circular to the pear-shaped form. Other articles of interest refer to meteorological statistics, atmospheric phenomena, earth tremblings, &c. In the notes some recent measures are given of the diameter of Mars, and of the snow caps, the former made by M. W. W. Campbell at the Lick Observatory, and the latter by M. Asaph Hall at the Washington Observatory.

Himmel und Erde for July.—In this number Dr. W. Luzi concludes his interesting article on the diamond, having covered the ground between the first observations made at Florence in 1694, and M. Moissan's recent researches. Dr. Wilhelm Meyer continues his chapters on the physical condition of the planet Mars after the evidence of eminent observers, while Herr Gingel gives us his fourth chapter on the mechanics of the heavens, dealing with the new researches by G. H. Darwin on the influence of tides on the movements and form-proportions of the heavenly bodies, embracing particularly the earth-moon system. Among the notes that on variable stars calls for attention.

MUSEUMS ASSOCIATION.[1]

II.

These are the principles of what may be called the New Museum idea as applied to national museums of natural history. It is a remarkable coincidence that since they were first enunciated, and during the time of their discussion, but before they had met with anything like universal acceptance, the four first nations of Europe almost simultaneously erected in their respective capitals—London, Paris, Vienna, and Berlin—entirely new buildings on a costly, even palatial scale, to receive the natural history collections, which in each case had quite outgrown their previous insufficient accommodation. In the construction of neither of these four edifices can the guardians of the public purse be accused of want of liberality. Each building is a monument in itself of the appreciation of the government of the country of the value and interest of the natural history sciences. So far this is most satisfactory. Now that each is more or less completed, at all events for the present, and its contents in a fair way towards a permanent arrangement, it may not be without interest on the present occasion to give some comparative account of their salient features, especially with a view to ascertain whether and to what extent their construction and arrangement have complied with the requirements of the modern idea of such institutions.

It may seem ungrateful to those who have so liberally responded to the urgent representations of men of science by providing the means of erecting these splendid buildings, to suggest that if they had all been delayed for a few years the result might have been more satisfactory. The effects of having been erected in what may be called a transitional period of museum ideas is more or less evident in all, and all show traces of compromise, or rather adaptation to new ideas of structures avowedly designed for old ones. In none, perhaps, is this more strikingly shown than in our own, built, unfortunately, before any of the others, and so without the advantages of the experience that might have been gained from their successes or their shortcomings. Though a building of acknowledged architectural beauty, and with some excellent features, it cannot be taken structurally as a model museum, when the test of adaptation to the purpose to which it is devoted is rigidly applied. But to speak of its defects is an ungracious and uncongenial task for me. If it were not taking me too far away from my present subject I would rather speak of the admirable manner in which the staff are endeavouring to carry out the new idea under somewhat disadvantageous circumstances.

The new zoological museum in the Jardin des Plantes at Paris is a glorification of the old idea pure and simple. It consists of one huge hall, with galleries and some annexes, in which every specimen is intended to be exhibited, more or less imperfectly, on alternate periods to students and to the general public. The building and cases are very handsome in style, and there are endless rows of specimens of all kinds neatly mounted in a uniform manner. There are no storerooms, no laboratories, no workrooms connected with the building. These are all in

[1] Continued from p. 236.

other more or less distant parts of the establishment, separated from it in most cases by the whole breadth of the garden. Of course this can only be looked upon as a temporary condition of affairs. Fortunately there is still room on the site of the old museum behind the new building, and if this is utilised by erecting upon it a commodious set of workrooms, laboratories, rooms for reserve collections and administrative offices directly in connection with each other and with the main building, which might then be emptied of a considerable portion of its contents, an extremely good working museum may be evolved. But if this space, as I believe was the original design, is used for the further extension of the already over large public galleries, the opportunity will be lost.

The new museums at Vienna, the one for natural history, the other for art, placed one on each side of a handsome public garden in one of the most important quarters of the city, exactly alike in size and architectural features, are elegant buildings, and present many excellent features of construction. The natural history museum, which was alone finished when I visited Vienna three years ago, is a quadrilateral structure with a central court, and consists of three stories and a basement. Each story is divided into a number of moderately-sized rooms, opening one into another, so that by passing along in the same direction, the visitor can make an inspection in systematic order of all the collections arranged in each story, returning to the point from whence he started; or, if need be, breaking off at the middle where a passage of communication runs across the central court. An admirable feature in the design of this museum, is that the public galleries of each story, lighted by windows from the outside of the building, have on their inner side other rooms communicating with them, and lighted from the court within, which are devoted to the private studies of the curators and to the reserve collections belonging to the same series as the exhibited collections in the public galleries with which they are in connection. Thus the public collections, the reserve collections, and the officers in charge are are in each section of the museum brought into close relation—a most advantageous arrangement—and one greatly facilitating the new museum idea. The only drawback is that these rooms, occupying the inner side of the quadrangular range of galleries, are necessarily small, and as the collections grow, will be found insufficient for the purpose. This has, in fact, already proved to be the case in several departments, and a remedy has been found by devoting the whole upper story of the building to the reserve collections of insects, shells, and plants, and the working library of the institution, an arrangement which gives excellent accommodation for these important departments, at all events for the present. Another great future difficulty will arise, owing to the building being externally architecturally complete and visible on all four sides from the public grounds in which it stands; it therefore admits of no extension, and the public galleries already contain as many specimens as can possibly be placed in them with any advantage. These are in most sections, especially the invertebrata, displayed in an extremely tasteful and instructive manner, but the series is by no means over large for a national museum. The limitation of space is partly due to the somewhat singular division which has been made between the art and the natural history collections. Instead of taking the dividing line adopted at the British Museum between specimens in a state of nature, and those fashioned by man's hand, the pictures, the splendid collection of European mediæval armour, the classical and Egyptian antiquities are treated as works of art; but the so-called ethnological collection, containing the specimens of Mexican, Peruvian, Japanese, Chinese, Polynesian, African, and prehistoric European art, are placed in the Natural History Museum, taking up a large portion of the space, which the curators of the zoological, mineralogical, and geological departments hoped to have had at their disposal for the display of their specimens. Whether room could be found for them in the Art Museum or not I cannot say; but certainly their actual position is incongruous, and it is difficult to understand why a Peruvian mummy should find its place in a building professedly devoted to natural history, while the preserved remains of an ancient Egyptian are treated as works of art.

Before leaving Vienna I should like to refer to the splendid specimens of taxidermy by the artist Hodek, the choicest examples of whose work are contained in a special collection, occupying a small separate room, consisting of sporting trophies of the late Crown Prince Rudolph. Otherwise the general level of the specimens in the galleries is in no wise remarkable. The birds have the advantage of being mounted, not upon turned wooden stands of uniform pattern as in Paris, but upon pieces of natural tree branches, fixed in square or oblong oak stands. The exhibited specimens of vertebrate zoology include skeletons, but no other anatomical preparations, of which there is a distinct collection in the University Museum. The exhibited fishes and reptiles are exceedingly well preserved and mounted in spirit. In the Mollusca, Articulata, Echinoderms and Corals great care has been taken in setting the specimens off to advantage by selecting appropriate colours for backgrounds. Specimens in spirit are interspersed in their proper places. All have printed labels. The cases in which they are displayed are of oak, and of very handsome and even ornamental construction.

The arrangement of all these collections displays a most intelligent appreciation of the needs of the ordinary visitor. Thus in the room appropriated for the exhibition of insects there are three distinct series, a general systematic series, a morphological series, and a very fine special collection of the insects of the neighbourhood of Vienna. The other rooms are arranged more or less on similar principles The main collection of insects, is, as I have mentioned before, entirely apart in rooms very well adapted to the purpose in the upper floor of the building, and kept as usual in drawers in cabinets.

The zoological portion of the new museum for "Naturkunde," in Berlin, situated in the Invaliden Strasse, is a remarkable illustration of the complete revolution of ideas on museum arrangement, which took place between its commencement and its completion. The building, entirely designed upon the old system, came empty into the hands of the present director, who has arranged the contents absolutely upon the new method. It consists of a fine glass covered hall, and three stories of galleries, all originally intended for a uniform exhibition of all the various groups of specimens which had accumulated in the crowded rooms of the old museum in the University. When Dr. Möbius succeeded to the directorate he conceived the bold plan of limiting the public exhibition to the ground floor, and devoting the two upper stories entirely to the reserve or working collections. This was a step which required some courage to take, especially as the two great staircases, which are the principal ornamental architectural features of the building, have by it become practically useless. Except, of course, for certain inconveniences always resulting from adaptation of a building to purposes not originally contemplated, especially local disjunction of different series of the same groups, the result has been eminently satisfactory, and if the arrangement is completed upon the lines laid down by the Director, as explained to me on my last visit, this will be the most practical and conveniently arranged museum of natural history at present existing. As much attention appears to be bestowed upon making the exhibited portion attractive and instructive, as on making the reserve collections complete and accessible to workers. In the former, the characteristics of the native fauna were being specially developed. For instance, the fish collection (of which the individual specimens are beautifully displayed, fastened on to glass plates in flat-sided bottles) consists of a general representative systematic series, and three special faunistic collections, one of the German fresh-water fishes, one of the north and east sea fishes, and one of the Mediterranean fishes. One room is devoted to German mammals and birds, and the recently added specimens show indications of an improvement in taxidermy which would have been impossible in the old days of wholesale bird-stuffing. Excellently prepared anatomical specimens, diagrams, explanatory labels, and maps showing geographical distribution, are abundantly introduced among the dried specimens of which such collections are usually composed, and a commencement has been made of illustrations of habits and natural surroundings. On the other hand, in marked contrast to Vienna, everything in the way of architecture and furniture and fittings is severely plain and practical, and a uniform drab colour is the pervading background of all kinds of specimens. All danger from fire seems to have been most carefully guarded against. The floors are of artificial stone, the cases, and even the shelving, are constructed of glass and iron. Wood is almost entirely excluded, both in the structure and fittings. The ground floor, as I have said, is entirely devoted to the public exhibition, the first story to the reserve collection of vertebrates, and the upper story to the invertebrates; and the basement contains commodious rooms for unpacking, mounting, preparing skeletons, &c. The construction of the building allows of considerable extension backwards, whenever more space will be needed, at small cost and with little interference with existing arrangements. I should also mention that the zoological department of the University, with its admirably appointed laboratories and lecture-rooms, and excellent working collection for teaching purposes, is in immediate contact with the museum, and the two institutions, though under different direction, are thus brought into harmonious cooperation.

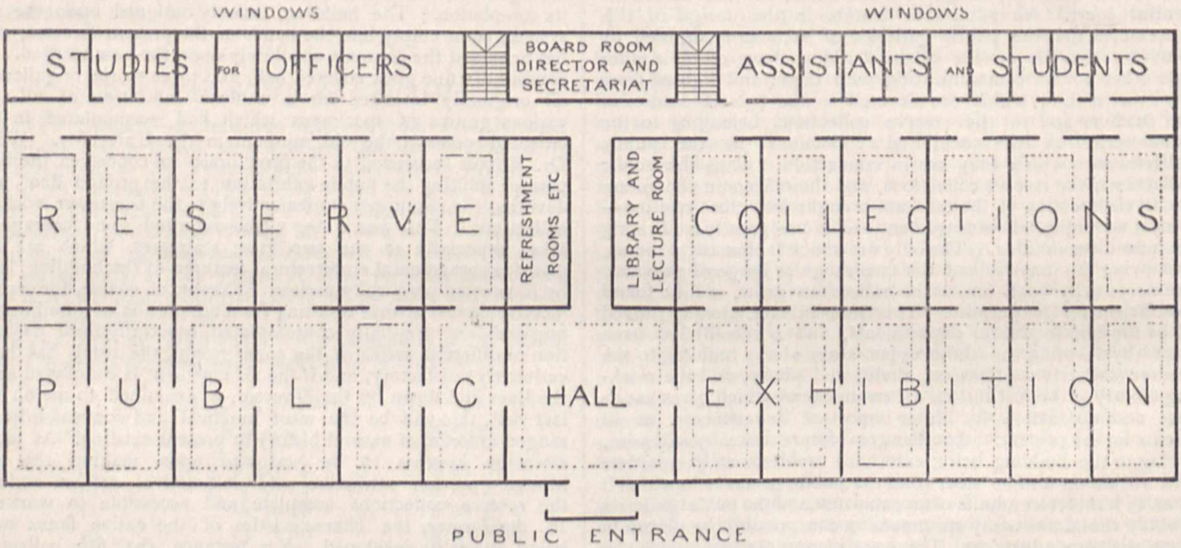
Any one who wishes to compare and contrast the two systems upon which a national zoological museum may be arranged cannot do better than visit Paris and Berlin at the present time. He will see excellent illustrations of the best of both.

Of the museums of the United States of America much may be expected. They are starting up in all directions untrammelled by the restrictions and traditions which envelope so many of our old institutions at home, and many admirable essays on museum work have reached us from the other side of the Atlantic, from which it appears that the new idea has taken firm root there. In Mr. Brown Goode's lecture on "The Museums of the Future" (Report of the National Museum, 1888-89) it is said "In the National Museum in Washington the collections are divided into two great classes. The exhibition series, which constitutes the educational portion of the museum and is exposed to public view with all possible accessions for public entertainment and instruction, and the study series, which is kept in scientific laboratories and is scarcely examined except by professional investigators. In every properly constructed museum the collections must from the very beginning divide themselves into these two classes, and in planning for its administration, provision should be made not only for the exhibition of objects in glass cases, but for the preservation of large collections not available for exhibition to be used for the studies of a very limited number of specialists."

The museum of comparative zoology at Harvard, founded by the late Louis Agassiz and now ably administered and extended by his son, Alexander Agassiz, is a conspicuous example of the same method of construction and arrangement. But as I can say nothing of these from personal knowledge, I am obliged to leave out any further reference to them on the present occasion.

From what has just been said it will be gathered that in Europe at least an ideal natural history museum, perfect in original design, as well as in execution, does not exist at present. We have indeed hardly yet come to an agreement as to the principles upon which such a building should be constructed. But as there are countries which have still their national museums in the future, and as those already built are susceptible of modifications, when the right direction has been determined on I should be glad to take this opportunity of putting on record what appears to me, after long reflection on the subject, the main considerations which should not be lost sight of in such an undertaking.

In the first place, I have endeavoured to work out in detail, in its application to natural history, that most original and theoretically perfect plan for a museum of exhibited objects in which there are two main lines of interest running in different directions and intersecting each other, which we owe to the ingenuity of General Pitt-Rivers. This was explained in his address as President of the Anthropological Section of the British Association at Bath in 1888, and again in a lecture given about two years ago before the Society of Arts. Upon this plan the museum building would consist of a series of galleries in the form of circles, one within the other, and communicating at frequent intervals. Each circle would represent an epoch in the world's history, commencing in the centre and finishing at the outermost, which would be that in which we are now living. The history of each natural group would be traced in radiating lines, and so by passing from the centre to the circumference, its condition of development in each period of the world's history could be studied. If, on the other hand, the subject for investigation should be the general fauna or flora of any particular epoch, it would be found in natural association by confining the attention to the circle representing that period. By such an arrangement that most desirable object, the union of palæontology with the zoology and botany of existing forms in one natural scheme, could be perfectly carried out, as both the structural and the geological relations of each would be preserved, as indicated by its position in the museum. Such a building would undoubtedly offer difficulties in practical construction, but even if these could be got over, our extremely imperfect knowledge of the past history of animal and plant life would make its arrangement with all the gaps and irregularities that would become evident, so unsatisfactory, that I can scarcely hope to see it adopted in the near future.



I have therefore brought before you a humbler plan, but one which, I think, will be found to embody the practical principles necessary in a working museum of almost any description, large or small.

The fundamental idea of this plan is that the whole of the building should be divided by lines intersecting at right angles, like the warp and the woof of a piece of canvas.

The lines running in one direction divide the different natural sections of which the collection is composed, and which it is convenient to keep apart; the lines crossing these separate the portions of the collection according to the method of treatment or conservation. Thus, the exhibited part of the whole collection will come together in a series of rooms, occupying naturally the front of the building. The reserve collections will occupy another, or the middle, section, and beyond these will be the working rooms, studies, and administrative offices, all in relation to each other, as well as to the particular part of the collection to which they belong. A glance at the plan will show at once the great convenience of such a system, both for the public, and still more for those who work in the museum.

This plan, of course, contemplates a one-storied, top-lighted building as far as the main rooms are concerned, although the workrooms and studies will be in two or more stories. The main rooms should all have a good substantial gallery running round them, by means of which their wall space is doubled. There is no question whatever that an evenly diffused top light is far the best for exhibition rooms. Windows not only occupy the valuable wall-space, but give all kinds of uncomfortable cross lights, interspersed with dark intervals. On the other hand, for doing any kind of delicate work, a good north light from a window, as provided in the plan, is the most suitable. The convenience of having all the studies in relation with each other, and with the central administrative offices, while each one is also in close contiguity with the section of the collection to which it belongs, will, I am sure, be appreciated by all who are acquainted with the capriciously scattered position of such rooms in most large museums, notably in our own. Among other advantages would be the very great one that when the daily hour of closing the main building arrives, the officers need no longer, as at present, be interrupted in whatever piece of work they may have at hand, and turned out of the building, but as arrangements could easily be made for a separate exit, they could continue their labours as long and as late as they find it convenient to do so, without any fear for the safety of the general collections.

It will be observed that provision is made for a central hall, which is always a good architectural feature at the entrance of a building, and which in a museum is certainly useful in providing for the exhibition of objects of general interest not strictly coming under any of the divisions of the subject in the galleries, or possibly for specimens too large to be conveniently exhibited elsewhere. There is also provision in the central part of the building for the refreshment-rooms, and also for the library and a lecture room; the first being an essential, and the latter a very useful adjunct to any collection intended for popular instruction, even if no strictly systematic teaching should be part of its programme.

I may point out, lastly, as a great advantage of this plan, that it can be, if space is reserved or obtainable, indefinitely extended on both sides on exactly the same system without in any way interfering with the existing arrangements, a new section, containing exhibition and reserve galleries and studies can be added as required at either end, either for the reception of new departments, or for the expansion of the old ones. With a view to the latter it is most important that the fittings should be as little as possible of the nature of fixtures, but should all be so constructed as to be readily removable and interchangeable. This is a point I would strongly impress upon all who are concerned in fitting up museums either large or small.

The modifications of this plan to adapt it to the requirements of a municipal, school, or even village museum will consist mainly in altering the relative proportion of the two sections of the collection. The majority of museums in country localities require little, if anything, beyond the exhibition series. In this the primary arrangement to be aimed at is first, absolutely to separate the archæological, historic, and art portions of the collection from the natural history, if, as will generally be the case, both are to be represented in the museum. If possible they should be in distinct rooms. The second point is to divide each branch into two sections: 1, a strictly limited general or type collection, arranged upon a purely educational plan; 2, a local collection, consisting only of objects found within a certain well-defined radius around the museum, which should be as exhaustive as possible. Nothing else should be attempted, and therefore reserve collections are unnecessary. Even the insects and dried plants can be exhibited on some such plans as those adopted for the Walsingham collection of Lepidoptera in the Zoological Department, or the collection of British plants in the Botanical Department in our Natural History Museum.

I have elsewhere indicated my views as to the objects most suitable for, and the best arrangement of them in, school museums,[1] so I need say nothing further on the subject now. Indeed I fear I have exhausted your patience, so I will conclude by expressing an earnest hope that this meeting may prove a stimulus to all of us to continue heartily and thoroughly at our work, which I need not say is the only way to ensure that general recognition of it which we all so much desire.

[1] NATURE, vol. xli. p. 177, December 26, 1889.

At the close of the address a vote of thanks was moved by Sir James Paget and seconded by Sir Henry H. Howorth. The meeting was largely attended by delegates from various provincial museums, as well as by representatives of a number of museums and scientific societies in the metropolis. Among those present were Sir Joseph Fayrer, Dr. Jonathan Hutchinson, General Festing, Lady Flower, Dr. Günther, Dr. Sclater, Dr. Henry Woodward, Mr. L. Fletcher, Mr. and Mrs. Cuthbert Peek, Mr. W. Topley, Mr. E. F. Newton, Prof. Jeffrey Bell, Mr. Osbert Salvin, Mr. F. W. Rudler, and others. The following museums were represented:—

Bootle, Bolton, Brighton, Cardiff, Chester, Dublin, Glasgow, Maidstone, Manchester, Nottingham, Parkes Museum, Saffron Walden, Sheffield, Southampton, Stockport, Sunderland, Warrington, and York.

At the conclusion of the proceedings Sir William and Lady Flower held a reception in the library of the Zoological Society.

July 4, 5, and 7 were occupied by the business of the Association. As on previous occasions, papers were read and discussed and general business transacted during the mornings; while the afternoons were devoted to the inspection of museums. The Association owes a debt of gratitude to several societies and individuals for courtesy and hospitality. The convenient rooms of the Zoological Society, at 3 Hanover Square, were kindly placed at the disposal of the Association by the Council of the Society, and the Anthropological Society kindly gave the use of its library. The Council of the Royal College of Surgeons invited the members of the Association to the conversazione held at the Museum on July 5. The Royal Society and the Geological Society allowed members of the Association the privilege of inspecting their collections, and the officers of the British Museum (both at Bloomsbury and at Cromwell Road), and of the Museum of Practical Geology, conducted the members over the departments under their charge. Dr. and Mrs. Woodward held a reception at 129, Beaufort Street on July 6, and Mr. Jonathan Hutchinson entertained a party at Haslemere on July 8, and exhibited his educational museum to his guests.

THE DISTRIBUTION OF MARINE FLORAS.

IN *Phycological Memoirs*, Part II., May 1893, Mr. George Murray gives a comparative table, showing the marine floras of the warm Atlantic, Indian Ocean, and the Cape of Good Hope.

Preceding the comparison, he says:—"In delimiting the above regions I have been guided by what may fairly be taken to be their natural boundaries. The warm Atlantic is the tropical Atlantic, with a slight northward extension, to include Florida, the Bahamas, and Bermuda in the track of the Gulf Stream, and also Madeira and the Canary Islands, washed by that branch of the same stream which trends off backward to the south, the north equatorial current. I have not included the Azores, since they are not sufficiently under this influence, and their marine flora, so far as we know it, appears to be more akin to that of the north temperate Atlantic. On its southern boundary on the African coast the Cape region is permitted to come slightly within the tropics, so far as Wallfisch Bay, on account of this coast being swept by a cold current from the south, bringing with it up to this point at all events such temperate forms as *Laminaria*, recently recorded from that place. The Indian Ocean similarly is the tropical Indian Ocean, but including the whole of the Red Sea, and extending to the south slightly outside the tropics down the coast of Africa, and including the whole of Madagascar. I am justified in this by the course of the warm Mozambique current. I do not include on the east Sumatra, which appears to belong to another region, though I have included a few forms from the Andaman Islands and Mergui. The Cape of Good Hope region has already been indirectly described, and, as has been said, extends for the reasons given, slightly into the tropics on the west coast, and recedes slightly from that boundary on the east coast."

The table shows that the warm Atlantic has the largest recorded flora, viz. 859 species in 162 genera. I may explain that, out of this total, no less than 788 species in 150 genera occur in the West India region, and that the rest of the warm Atlantic furnishes only 71 species in 12 genera not occurring in the West Indies out of a much smaller total flora. Allowing for the undoubted fact that a large number of West Indian species are bad species, there still remains a large balance in its favour. It has been better examined than any other part of the warm Atlantic, but still we may attribute this preponderance mostly to the favourable natural conditions, principally the coral formation of large portions of its island shores. On the coast of Africa there is not only no coral, but league after league of muddy shore, making a marine desert so far as Algæ are concerned. The Indian Ocean comes next, with 514 species in 139 genera. It possesses an enormous coast line, to a considerable extent favourable to the growth of Algæ (though including long desert stretches); but the bulk of the records are from Ceylon, Mauritius, and the Red Sea, while a very large proportion of the region is unexamined. As in the West Indies, there is also here a considerable proportion of bad species, principally *Sargassa*, from the Red Sea. From the Cape we have 429 species in 141 genera. This remarkable total, from so short a coast line, is obtained from Miss Barton's list in the *Journal of Botany*, 1893. The flora previously recorded in books amounted only to 242 species in 99 genera, and this addition to its flora has resulted from her examination of the British Museum Herbarium, and her naming of the admirable collection made by Mr. Boodle, and also those made by Mr. Scott Elliot and Mr. Tyson. The most noteworthy observation on these aggregates is the proportion of species to genera. In the warm Atlantic the genus averages well over 5 species; in the Indian Ocean the proportion is nearer 4 than 3 species to the genus; while at the Cape it is almost exactly 3. This is instructive when we remember, as I have elsewhere pointed out (Trans. Biol. Soc. Liverpool, vol. v. p. 177), that while the Arctic Algæ average slightly more than 2 species only to the genus, the West Indies and Australia average rather more than 5 and less than 5 respectively. I estimate that the north temperate Atlantic yields an average of about 4½ species to the genus, and the difference between this and 3 species per genus found at the Cape is to be attributed primarily to the short coast line of the Cape, and in a less degree to its Algæ being less known. The calculation of such averages and proportions appears to me to be justified only when applied to the whole flora, and becomes more dangerous and apt to mislead when applied to portions of it, since particular groups in all the floras have been subjected to unequal treatment by collectors and describers, and we may perhaps trust to these personal errors neutralising each other when the complete totals are compared.

The warm Atlantic and Cape have 85 genera and 114 species in common, while the Indian Ocean and Cape have 86 genera and 89 species in common. That the number of genera in common should be so nearly exactly similar is interesting, and to discover whether they are the same genera in many cases it is only necessary to turn to the last table, where the Algæ common to all three regions are given to find that 72 genera are common to all three. Some years ago I hazarded the speculation that, while the genera of the tropical Atlantic and those of the Indian Ocean were largely the same, the species were, in a high proportion, different ("Catalogue of Marine Algæ of the West Indian Region"). We can now see that they have no less than 103 genera in common out of a total of 139 occurring in the Indian Ocean and 162 in the warm Atlantic. They have certainly more species in common, viz. 173, but these must be considered relatively to the two totals of 514 in the Indian Ocean and 859 in the warm Atlantic, when my expectation will appear to be fairly borne out. Nevertheless, I confess to having anticipated an even greater diversity of species. That the absolute number of genera occurring at the Cape should be by two greater than those of the Indian Ocean completely puzzles me. I cannot fully account for it on any theory. While the number of species in common between any two of the floras is greater than the number of genera (though in one case only three more), the number of species, as might be expected, in common to all three—viz. 59—is less than the genera—viz. 72. Again I should have expected to find relatively fewer species in common.

When one comes to analyse these totals, the process must be carried on in a more guarded fashion. One expects, as shown above, to find fewer species to the genus at the Cape than in the tropical floras, but one hardly expects to find that the genera of *Florideæ* at the Cape are by five more numerous than in the warm Atlantic, and by 15 more than in the Indian Ocean. There are no less than 95 genera of *Florideæ* at the Cape, with 295 species, while the 90 of the warm Atlantic contain nearly 200 more species! Matters are much the same in the case of the *Phæophyceæ*, and we have come to the *Chlorophyceæ* to redress the balance in the case of the warm Atlantic. They just fail to bring it level in the case of the Indian Ocean. It has been remarked above that the genera which the two tropical floras have in common with the Cape are almost identical in number. The analysis shows that the figures are very steady, viz. 58 each of *Florideæ*, 14 and 15 of *Phæophyceæ*, 11 each of *Chlorophyceæ*, and two each of *Protophyceæ*. The table shows the tropical character of such a group as the *Siphoneæ* very markedly. There are 99 species in 23 genera in the warm Atlantic, 72 species in 16 genera in the Indian Ocean, and only 20 species in 7 genera at the Cape. It is interesting to observe that the whole of the 16 genera of *Siphoneæ* in the Indian Ocean are represented in the warm Atlantic. It has no peculiar generic type of its own in this tropical group. While the genera of this tropical order are thus practically identical, the species are in a very high proportion different. Only 29 are possessed in common out of the two totals of 99 and 72. In the comparison of the two tropical floras there is the coincidence that the genera and species of *Siphoneæ* agree exactly in numbers, viz. 16 and 29, with the total of all the *Phæophyceæ*—a thing without significance, however.

The interest that is attached to the above comparison is mainly this. We have here two tropical marine floras cut off from each other by a permanent continental area, and communicating only *viâ* the Cape. That these floras have been periodically mingled at the epochs of warmer climate at the Cape seems a reasonable conclusion with regard to a group of such antiquity as the Algæ, and the proportions of species in common and genera in common between the different regions, and among all three may have a significance in this respect to students of distribution (*cf.* the totals of *Siphoneæ*, a peculiarly tropical order). I have elsewhere (Trans. Biol. Soc. Liverpool, vol. v. p. 178) commented on the fact that, "while in the Arctic and Australian regions the *Phæophyceæ* far outnumber the *Chlorophyceæ*, in the tropical West Indian flora the proportion is very markedly reversed, and the green Algæ outnumber the olive-brown. One is tempted to put this down to the strong illumination of the tropical sea, but another reason is to be found in the fact that a number of the Antilles richest as regards Algæ are subject to irruptions of fresh and brackish water from the Orinoco floods—a condition that would operate in the same direction." We can now check this speculation by a comparison with the figures for the Indian Ocean, mainly derived from such localities as the Red Sea, Ceylon, Mauritius, &c., in no case affected by the question of fresh-water floods. The figures for the Indian Ocean are very nearly the same for both groups—24 genera and 117 species of *Phæophyceæ*, and 26 genera and 121 species of *Chlorophyceæ*—thus showing indirectly that the irruptions of fresh water are, in all probability, potent in the case of the West Indian Algæ. One is much struck by the strength of illumination of the bottom in a shallow coral sea, but the filtering action by sea water of the rays of light, and the interception first of those rays that are most efficient in the work of assimilation—conditions modifying the pigments of Algæ—are the same in all seas.[1] The practically tideless character of the Antilles would also make for a preponderance of green over olive-brown forms.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Bristol Medical School, which was established early in this century, has, since the establishment of University College, Bristol, about seventeen years ago, been affiliated to it, but remained under the direction of a separate governing body. Within the last few months the two institutions have been amalgamated and placed under one Council, and the Medical School now constitutes the faculty of medicine in the College.

THE Council of University College, Bristol, have raised to the status of Professor, in the Faculty of Arts and Science, Mr. F. R. Barrell, Lecturer in Mathematics, and Mr. A. P. Chattock, Lecturer in Physics, and have also appointed Dr. Edward Fawcett, late Senior Demonstrator of Anatomy in the Yorkshire College, Leeds, to the Professorship of Anatomy in the Faculty of Medicine.

[1] Recent research on other pigments by Prof. Marshall Ward makes it appear to me more probable that, in the case of the marine Algæ, the pigments are rather shields against the excess of blue rays than adaptations to heighten the susceptibility of chlorophyll to the diminished supply of the others.

HER Majesty's Commissioners for the exhibition of 1851 have made the following appointments to science research scholarships for the year 1893, on the recommendation of the authorities of the respective Universities and colleges. The scholarships are of the value of £150 a year, and are tenable for two years (subject to a satisfactory report at the end of the first year), in any University at home or abroad, or in some other institution to be approved of by the Commissioners. The scholars are to devote themselves exclusively to study and research in some branch of science, the extension of which is important to the industries of the country. The list of scholars and of the nominating institutions is as follows:—Herbert William Bolam, University of Edinburgh; George Edwin Allan, University of Glasgow; James Wallace Walker; University of St. Andrews; Arthur Lapworth, Mason College, Birmingham; John Ellis Myers, Yorkshire College, Leeds; Arthur Walsh Titherley, University College, Liverpool; Edward Chester Cyril Baley, University College, London; John Cannell Cain, Owens College, Manchester; Ella Mary Bryant, Durham College of Science, Newcastle-on-Tyne; James Darnell Granger, University College, Nottingham; Mary O'Brien, University College of Wales, Aberystwyth; Frederick George Donnan, Queen's College, Belfast; James Alexander M'Phail, M'Gill University, Montreal; Norman Ross Carmichael, Queen's University, Kingston, Canada; William Henry Ledger, University of Sydney.

MISS MARIA M. OGILVIE, daughter of Dr. Ogilvie, of Gordon's College, Aberdeen, has passed the final examination for the degree of Doctor of Sciences of London University. The subject of her thesis was the "Geology of the Wingen and St. Cassian Strata in Southern Tyrol," published in the *Quarterly Journal* of the Geological Society for February.

THE electors to the Savilian Professorship of Astronomy will proceed to the appointment of a successor to the late Prof. Pritchard, in the couse of the ensuing Michaelmas Term. The duties of the Professor are defined by the following provisions of the statutes:—The Savilian Professor of Astronomy shall lecture and give instruction on theoretical and practical Astronomy. "Ne alia quapiam professione eodem tempore fungatur professor; nec munus observatoris Radcliviani, nec officium prælectoris alicujus in quovis collegio publice legentis cum munere suo conjungat." The Professor shall reside within the University during six months, at least, in each academical year, between the first day of September and the ensuing first day of July. He shall lecture in two at least of the three University terms. His lectures shall extend over a period not less in any term than six weeks, and not less in the whole than fourteen weeks, and he shall lecturetwice at least in each week. The University Observatory shall be open for eight weeks in each term, and at such other times and for such hours as the University may by statute determine. The Savilian Professor of Astronomy shall have the charge of the University Observatory, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there. The emoluments of the Professorship as determined by statute are as follows:—He shall be entitled to the emoluments now assigned to the Professorship and derived from the benefaction of Sir Henry Savile, Knight, or from the University Chest; and shall receive in addition the emoluments appropriated to the Professorship by the statutes of New College. The total amount of all these emoluments is at present £850 a year. Applications, together with such papers as the candidate may desire to submit to the electors, must be sent to the Registrar of the University, Clarendon Building, Oxford, on or before October 31, 1893.

ARRANGEMENTS have been completed for the seventh session of the Edinburgh Summer Meeting, which begins on July 31, and lasts throughout August. Among the better known lecturers are:—M. Edmond Demolins, M. Paul Desjardins, Prof. Patrick Geddes (who will treat of contemporary social evolution), Prof. Lloyd Morgan (giving a course of comparative psychology—perhaps the first of its kind in Britain), and Mr. Arthur Thomson, discussing bionomics and evolution. A course on the history and principles of the sciences will be conducted by Prof. Cargill Knott, Dr. Charles Douglas, and others. A characteristic feature will be the series of studies entitled "A Regional Survey of Edinburgh and Neighbourhood." Among other subjects are Physiology, Modern History, Education and Elocution, and there will be practical classes in Botany, Zoology, and Geology. Work will be continued in the seminars and the studios, and a new departure is the course of Sloyd. While the student is obviously invited to serious work, a pleasant relief is promised in the shape of excursions.

THE New York *Nation* says that on June 14, at the University of Virginia, for the first time in its history, a certificate of attainment qualifying for graduation (in the School of Pure Mathematics) was given to a woman, Miss Caroline Preston Davis. Miss Davis, while excluded from the lectures, had taken successfully the same examinations on the same day with the male students, but "in a separate room"; and, at the request of the Chairman of the Faculty, the graduating class in a body handed the certificate to her.

SOME years ago (writes the Allahbad *Pioneer Mail*), the Senate, or the Syndicate, of the University of Madras promulgated a rule that any examiner who failed to send in his marks by a certain fixed date would be fined 20 rupees for each day's delay. The Syndicate, however, refrained from acting on this remarkable rule until this year, when its sense of humour was too strong for it, and it determined to carry its little joke to its conclusion. A number of examiners were accordingly fined. One gentleman earned a fee of 210 rupees, but he was fined 200 rupees, and received a pay bill for 10 rupees. Entering into the spirit of the thing, he returned this amount to the Registrar as a present to the University, and possibly it will be invested, and the proceeds devoted to the purchase of an infinitesimal medal, as the custom is. But, seriously, it is most regrettable that the Syndicate should deliberately degrade its examiners in this way. Surely it is possible to find a sufficient number of gentlemen who can be trusted to do their work with such promptness as is compatible with fairness to the candidate, and more than this the Senate cannot desire. If an examiner is guilty of great delay, the remedy is simple—do not appoint him again. But to treat an examiner like a careless domestic is as insulting to him as it is undignified on the part of the University.

MR. F. W. GAMBLE, B.Sc. (Victoria), formerly Bishop Berkeley Research Fellow in Zoology, has been appointed to the post of Assistant Lecturer and Demonstrator in Zoology in the Owens College, Manchester

BISHOP BERKELEY Research Fellowships has been awarded by the council as follows:—H. B. Pollard, M.A. (Oxon.), in Zoology; Albert Griffiths, M.Sc. (Vict.), in Physics; J. A. Harker, D.Sc. (Tübingen), in Physics; Bevan Lean, B.A., B.Sc. (Lond.), in Chemistry; and a Fellowship has been renewed to Stanley Dunkerley, M.Sc. (Vict.), in Engineering.

SCIENTIFIC SERIALS.

Bulletin of the New York Mathematical Society, Vol. ii. No. 9, June, 1893.—The mechanics of the earth's atmosphere is a collection of translations by Cleveland Abbe (published by the Smithsonian Institution, 1891, 324 pp. 8vo). An account of it is furnished by R. S. Woodward (pp. 199-203). The volume contains twenty papers, all but two of which were published originally in the German language. The opening paper is by Hagen (1874), then follows the classic memoir by Helmholtz (1858), with five others by the same author. Then comes the extension of one of the last cited papers by Kirchhoff (1869); we then have five memoirs by Oberbeck, a paper by Hertz (1884), three papers by Bezold (1888-1889), a paper by Lord Rayleigh (1890, on the vibration of the atmosphere), and papers by Margules (1890) and Ferrel (1890). It will be readily inferred from this outline that Mr. Abbe has performed a work of prime importance to mathematical meteorologists. Dr. T. S. Fiske (pp. 204-211) also gives an outline sketch of mathematical investigations in the theory of values and prices, by Dr. I. Fisher (reprinted from the Transactions of the Connecticut Academy, July, 1892). The number closes with a few brief notes and a list of recent publications.

Wiedemann's Annalen der Physik und Chemie, No. 6.—On the determination of electrical resistances by means of alternating currents, by F. Kohlrausch. This is a minute study of the errors involved in measuring liquid resistances with alternate currents and the telephone. For potassium chloride solution between clean platinum electrodes, the error by which the resistance of the liquid was found too great remained below 1 per cent. so long as the product of the resistance in ohms and the surface of the electrode in sq. cm. did not fall below 250. In cases of high resistance, say 100,000 ohms, where M.M.

Bouty and Foussereau failed altogether to obtain consistent results, these may be secured by using certain precautions, such as placing the induction coil at a sufficient distance (1 m. at least) from the bridge, directing its axis perpendicular to that of the rheostat, and placing the telephone perpendicular to the lines of force of the induction coil. In the case of water and very dilute solutions the electrostatic capacity of the containing cell is a source of disturbance, which may, however, be obliterated by introducing a small condenser of adjustable capacity.—The temperature coefficient of the dielectric constant of pure water, by F. Heerwagen. This was investigated with a kind of differential electrometer, in which two needles were suspended by one wire in two electrometers arranged vertically one above the other. The needles, the vessel, and one pair each of the quadrants were joined to one point in a constant voltaic circuit, and the other pairs to two other points. The lower electrometer was alternately empty and filled with pure water. Under these circumstances the ratio of the sensibilities was inversely as the ratio of the squares of the differences of potential. The value obtained for K was $80{\cdot}878 - 0{\cdot}362\,(t - 17)$, where t is the temperature of the water in degrees centigrade.—Polarising effects of the refraction of light, by K. Exner. Glass gratings, necessary in order to obtain a sufficiently large angle of diffraction, have the disadvantage of producing polarisation effects due to change of medium in addition to those due to diffraction. This difficulty was overcome by attaching the cut surface to a semi-cylindrical lens by a drop of oil of the same refractive index. The polarisation effects show a fair agreement with Stokes's cosine law.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 8.—"The Process of Secretion in the Skin of the Common Eel," by E. Waymouth Reid, Professor of Physiology in University College, Dundee.

By special attention to the condition of the fish at the time of fixation of their skins for histological investigation, the author has succeeded in obtaining pictures of the various phases of secretory action. The *lowest* phase of activity was obtained by rendering hybernating fish suddenly motionless by a successful transfixion of the medulla, and then removing skin before recovery from "shock" admitted of reflex secretion. The *highest* phase of secretory action was produced by artificial stimulation of the intact animal by the vapour of chloroform, by faradisation, or by simply allowing a pithed summer eel to "slime" after recovery from the primary "shock." The following are the main conclusions:—

(1) The secreting elements of the epidermis of the common eel consist of goblet cells and club cells, both direct descendants of the cells of the palisade layer. The former supply a mucin, the latter threads and a material appearing as fine granules in the slime.

(2) The goblet cells contain mucin granules, and, after reaching the surface and discharging their load, are capable of undergoing regeneration by growth of the protoplasmic foot and re-formation of mucin.

(3) The threads of the slime resemble those of *Myxine glutinosa*, but are usually of finer texture. As in *Myxine*, they are developed from the club cells, but there are no special glandular involutions of the epidermis. The club cells of *Petromyzon fluviatilis* also supply slime threads.

(4) The granular material of the slime is the contents of vesicular spaces developed in the club cells in the immediate neighbourhood of their nuclei, and is set free enclosed in a lattice work developed by vacuolation of the surrounding material, and finally extruded, carrying with it the original nucleus of the club cell.

(5) The remainder of the club cell, after extrusion of its vesicle and nucleus, becomes a spirally coiled fibre, which finally breaks up into the fine fibrils of the slime.

(6) Severe stimulation, especially by the vapour of chloroform applied to the intact animal, causes so sudden a development of the coiled fibres from the club cells that the surface of the epidermis is thrown off and the secretory products set free *en masse*. This process is of reflex nature, for similar excitation applied to excised skin is without effect.

(7) A system of connective tissue cells, distinct from chromatophores, exists in the epidermis developed from cells which are direct descendants of leucocytes, and which can be traced from the blood vessels of the corium through the basement membrane into the epidermis. The number of these wandering cells in the epidermis is greatly increased by stimulation, probably with a view to providing subsequent support to the secretory elements during regeneration.

The paper was illustrated by photo-micrographic lantern slides.

June 15.—"On the Ratio of the Specific Heats of the Paraffins and their Monohalogen Derivatives." By J. W. Capstick, D.Sc. (Vict.), B.A. (Camb.), Scholar and Coutts-Trotter Student of Trinity College, Cambridge. Communicated by Prof. J. J. Thomson, F.R.S.

The object of the experiments was to throw light on an obscure point in the kinetic theory of gases, viz. the distribution of energy in the molecule.

From the ratio of the specific heats we can calculate the relative rates of increase of the internal energy and the energy of translation of the molecules per degree rise of temperature, by the well-known formula, $\beta + 1 = \frac{2}{3(\gamma - 1)}$, where γ is the ratio of the specific heats and β the ratio of the rate of increase of the internal to that of the translational energy.

In order to make the results comparable it was decided to keep the translational energy constant by working at a constant temperature—the temperature of the room.

The ratio of the specific heats was calculated from the velocity of sound in the gases. This was determined by Kundt's method, a double-ended form of apparatus similar to that described in *Pogg. Ann.* vol. cxxxv. being used.

The calculation requires the density of the gas to be known, a circumstance which makes the method very sensitive to small amounts of impurity. Regnault's value of the density was used for methane and the theoretical value for ethane, an analysis of the gas being made after each experiment to determine the correction for the air that was unavoidably present. All the other gases were freed from air by liquefaction immediately before being admitted into the apparatus, and the vapour density of the material in the state in which it was used was determined by a modified form of Hofmann's apparatus, which gave results concordant to one part in a thousand.

The formula used in calculating the ratio of the specific heats was

$$\gamma = 1{\cdot}408 \times \rho \times \left(\frac{l}{l'}\right)^2 \left(1 + \frac{1}{p}\frac{d}{dv}(pv)\right),$$

the last factor being added to the ordinary formula to correct for the divergence of the gas from Boyle's Law.

The correction is obtained at once by putting in the equation

$$u^2 = -\gamma v^2 \left(\frac{dp}{dv}\right)_t$$ the value of $\left(\frac{dp}{dv}\right)_t$ given by the equation

$$\left(\frac{dpv}{dv}\right)_t = p + v\left(\frac{dp}{dv}\right)_t.$$

From the vapour density determinations a curve is constructed giving pv in terms of v, and the slope of this curve at any point gives the value of $\frac{d}{dv}(pv)$ in arbitrary units. Dividing by the corresponding value of p in the same units, we obtain the amount of the correction.

The correction increases the ratio of the specific heats by from 1 to 2 per cent. in most cases.

Observations varying in number from three to nine were made on each gas, the extreme range of the values being 2 per cent. for marsh gas, 1½ per cent. for methyl iodide, and 1 per cent., or less, for the rest.

The mean values of the ratio of the specific heats are shown in the following table:—

Methane	CH_4	1·313
Methyl chloride	CH_3Cl	1·279
Methyl bromide	CH_3Br	1·274
Methyl iodide	CH_3I	1·286
Ethane	C_2H_6	1·182
Ethyl chloride	C_2H_5Cl	1·187
Ethyl bromide	C_2H_5Br	1·188
Propane	C_3H_8	1·130
Normal propyl chloride	nC_3H_7Cl	1·126
Isopropyl chloride	iC_3H_7Cl	1·127
Isopropyl bromide	iC_3H_7Br	1·131

From this table we have the result that the gases fall into four groups, the members of any one group having within the limits of experimental error the same ratio of the specific heats.

These groups are—

I. Methane.
II. The three methyl compounds.
III. Ethane and its derivatives.
IV. Propane and its derivatives.

If the members of a group have the same ratio of the specific heats, we know that the ratio of the internal energy absorbed by the molecule to the total energy absorbed, per degree rise of temperature, is the same for all. Hence we have the result that, with the single exception of marsh gas, the compounds with similar formulæ have the same energy-absorbing power, a result which supplies a link of a kind much needed to connect the graphic formula of a gas with the dynamical properties of its molecules.

From the conclusion we have reached, it follows with a high degree of probability that the atoms which can be interchanged without effect on the ratio of the specific heats have themselves the same energy-absorbing power, their mass and other special peculiarities being of no consequence. Further, the anomalous behaviour of methane confirms what was clear from previous determinations, namely, that the number of atoms in the molecule is not in itself sufficient to fix the distribution of energy, and suggests that perhaps the configuration is the sole determining cause.

If this is so, it follows that ethane and propane have the same configuration as their monohalogen derivatives, but that methane differs from the methyl compounds, a conclusion that in no way conflicts with the symmetry of the graphic formulæ of methane and its derivatives, for this is a symmetry of reactions, not of form.

"On Interference Phenomena in Electric Waves passing through different Thicknesses of Electrolyte." By G. Udny Yule. Communicated by Prof. G. Carey Foster, F.R.S.

In the spring of 1889 Prof. J. J. Thomson published [1] a description of some experiments made by him for comparing the resistances of electrolytes to the passage of very rapidly alternating currents, the method consisting in comparing the thicknesses of layers of different electrolytes which were equally opaque to Hertzian radiation. During last winter I made trial of an arrangement identical in principle but more completely analogous to Hughes' induction balance. The method seemed, however, to offer several difficulties and disadvantages, and finally I adopted another, also, one may say, analogous to Prof. Thomson's, inasmuch as it measures transparencies, but in outward appearance completely different from his.

The wires B, F, D, about 1 mm. diameter, were spanned 6 cm. apart. If these wires be made too short, a wave-train emitted from B, B' may reach the electrolyte x_1, or the bridge D, be reflected, and return to B before the primary has practically done oscillating. If this occur, the state of the secondary may affect the primary as in an alternate current transformer. If, however, Bx_1 be made longer than half the effective length of the wave-train, the reflected waves will not reach B until the primary oscillations have practically come to rest, and under these circumstances the latter will know nothing about any alternations in the secondary at or beyond x_1. This reaction of the secondary on the primary had been first noticed, and to a serious extent, by Herr J. Ritter von Geitler [1] with an exciter of the type used by Blondlot. [2]

In the actual apparatus the wires were at F_1 run out through a window in a loop of about 50 m. circumference round the laboratory garden. They re-entered the room at F_2 and were then run vertically through the vessel for containing the electrolyte. The circuit was completed by another loop, F_3F_4, 50 m. long, round the garden, re-entering the room at F_4, connecting to the electrometer at E, and bridged at D, 2·25 m. $= \frac{1}{4}\lambda$ from the electrometer. According to the researches of Bjerknes (*loc. cit.*) these dimensions should be sufficient, with the present apparatus, to prevent any sensible reaction.

The electrometer was the same one as that used by Bjerknes in his researches in the same laboratory. It is a simple quadrant electrometer with only one pair of quadrants and an uncharged aluminium needle of the usual shape suspended by a quartz fibre. One quadrant is connected to each wire. The needle taking no account of sign, elongations are simply proportional to the time integral of the energy: first throws, not steady deflections, are read.

Various glass jars were used for holding the electrolyte. The wires were run vertically through holes drilled in the bottom of the jar, into which they were cemented.

Several trials were made of this apparatus with dilute solutions of copper sulphate. Readings were taken in pairs alternately, with no solution in the jar and with some given thickness; usually about ten readings at each point. The ratio of the transmitted intensities so obtained was determined for several points and plotted as a curve. Some 5 or 6 cm. of electrolyte was the maximum thickness that could be used in these first experiments. The curves so obtained for these badly-conducting solutions always differed sensibly from the log-arithmic, and the more so the more the solution was diluted. If the mean log. dec. over the whole thickness was taken, the corresponding value of the specific conductivity appeared extremely high.

It appeared likely that these irregularities might be due to interference effects analogous to Newton's rings (by transmission), or the phenomena of "thin plates," particularly in view of the

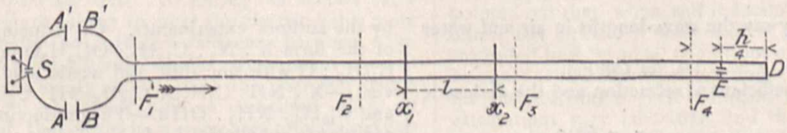


FIG. 1.

Let ASA' be a Hertz exciter, and B, B' secondary conductors similar to the primary from which a pair of long wires, stretched parallel to each other, are led off to a considerable distance. One may regard the wires simply as guides for the radiation, which then travels straight up the space between them. If we run these wires for a certain length, *l*, through an electrolyte, the radiation will have to traverse this and will be partly absorbed. If an electrometer be connected at E, a quarter wave-length from the bridge at the end of the wires, readings taken with various thicknesses of electrolyte should, according to my expectations, give a logarithmic curve, from which the specific resistance would be at once calculable.

The actual dimensions of the exciter, &c., erected were the same as those use by Bjerknes. [2]

A, A', B, B' circular zinc plates, diameter .	40 cm.
Distance from A to B	30 ,,
Length of wire ASA (2 mm. diameter) . .	200 ,,
Wave length, λ	900 ,,

[1] "Roy. Soc. Proc.," vol. xlv. p. 269, 1889.
[2] *Wiedemann's Annalen*, vol. xliv. p. 513, 1891.

results obtained just previously by Mr. E. H. Barton in the same laboratory. I consequently desired to investigate for such interference phenomena over as great a thickness of electrolyte as the absorption would permit of using. Distilled water offered itself naturally as the best electrolyte for this purpose.

For the containing vessel a glass cylinder 114 cm. high was used; the internal diameter varied somewhat, but was about 12 cm. at the narrowest.

With this apparatus a series of observations were made for various thicknesses of distilled water. To cover, as far as possible, irregularities in sparking, readings were now taken in pairs alternately at the point to be determined and some other point taken for the time as the standard; it would have caused too great delay, and consequent irregularity in the effectiveness of the sparks, were all the water to be siphoned out between each pair of readings. As before, ten or twelve readings were usually taken at each point. The throw obtained with no liquid was also always taken as unity.

As a specimen of the usual spark variations, the following

[1] Doctor-Dissertation, Bonn, Jan. 1893, p. 22.
[2] *Compt. Rend.*, vol. cxiv., p. 283, Feb. 1892.

series of readings for the determination of the throw with 55 cm. water with reference to 40 cm. will serve. The series is taken quite at random from the others.

40 cm.	55 cm.
4·6	11·4
4·9	11 4
5·0	11·0
4·2	11·9
4·3	11·5
3 9	11·2
4·0	11·6
4·3	11·4
4 6	10·4
4·4	11·2
4·5	10·4
4·6	10·0

The readings are grouped separately, but it will be understood that they were taken in pairs alternately.

The complete results are given in the curve (Fig. 2). It is seen that for such a poor conductor as distilled water the interference completely masks the absorption effects. The intensity of the transmitted ray does *not* steadliy decrease; on the contrary, far more may be transmitted through a thick than through a thin layer of the absorbent medium. The transmission follows the same general law as for light with a thin plate; we are, in fact, dealing with a "thin" plate—a plate whose thickness is comparable with the wave-length. The intensity of the transmitted ray is a minimum for a plate $\frac{1}{4}\lambda$ thick, a maximum for $\frac{1}{2}\lambda$ thick, a minimum again for $\frac{3}{4}\lambda$, and so on.

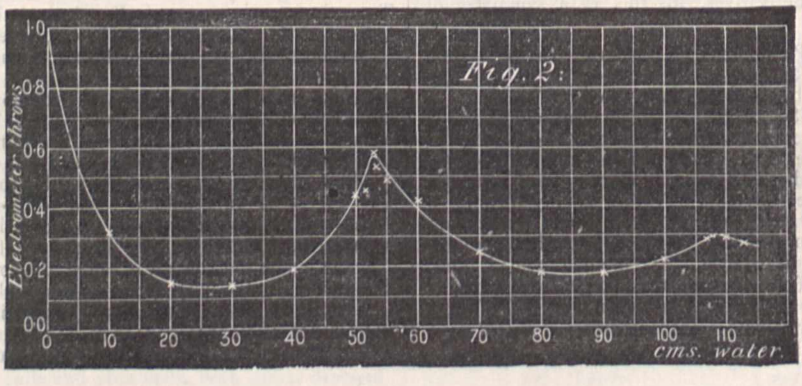
The points on the curve round the maximum at $\frac{1}{2}\lambda$ are somewhat irregular, and the two maxima do not absolutely agree.

Excluding the Russian physicist as a negligible majority, it will be seen that my value of κ is somewhat low. The cause may lie in the fact that not the whole of the field surrounding the wires lies in the water.

The uncertainty due to this stray field might be easily avoided in one way, namely, by making one wire into a tube surrounding the other, and using this tube also as the jar for the electrolyte. This was, in fact, the arrangement originally intended to be adopted. Several disadvantages attended it, however, and led to its final rejection in favour of the simple wires and glass jar. First, such a condenser reflects under all circumstances a considerable portion of the incident energy.[1] Secondly, the variation of the position of the top surface of the electrolyte relatively to the top of the jar would introduce fresh interference phenomena. This appeared directly from the work of Mr. Barton to which I have already had occasion to refer. Lastly, the large surface of metal in contact with the liquid would render distilled water rapidly impure.

This investigation was carried out in the Physical Institute of the University of Bonn. I desire particularly to express my thanks to Prof. Hertz for his most useful advice and suggestions.

Chemical Society, June 1.—Dr. Armstrong, President, in the chair. The following papers were read:—On azo-compounds of the ortho-series, by R. Meldola, E. M. Hawkins, and F. B. Burls. The constitution of the orthazo-compounds is still unsolved owing to the contradictory results obtained by different investigators using different methods. The azo-β-naphthols have been represented by the formulæ X . NH . N : $C_{10}H_6$: O and X . N_2 . $C_{10}H_6$. OH. The principal evidence in favour of the former hydrazone formula was furnished by Goldschmidt and Brubacher; it is, however, rendered invalid



Taking the mean, we may say the wave-lengths in air and water are respectively:—

$$\lambda_a = 900. \qquad \lambda_w = 108 \text{ cm.}$$

This gives us for the coefficient of refraction and the dielectric constant—

$$n = 8{\cdot}33. \qquad \kappa = 69{\cdot}5.$$

The following are the values of K found by previous investigators, all that are known to me:—

Method used.	Authority.	κ
Alternated currents	Heerwagen[1] ...	79·56
	Rosa[2]	75·70
	Rosa[3]	70·00
Ruhmkorff coil ...	Cohn and Arons[4]	76 00
	Tereschin[5]	83·80
Hertz oscillations ..	Cohn[6]	73·50
	Ellinger[7]	81·00
	Itschegtiaeff[8] ...	1·75

[1] *Wied. Ann.*, vol xlviii. p. 35, 1893.
[2] *Phil. Mag.*, vol. xxxi. p 200, 1891.
[3] *Ibid.*, vol. xxxiv. p. 344. 1892.
[4] *Wied. Ann.*, vol. xxxiii. p. 13, 1888.
[5] *Ibid.*, vol. xxxvi. p. 792, 1889.
[6] *Ibid.*, vol. xlv. p. p. 370, 1892.
[7] *Ibid.*, vol. xlvi. p. 513, 1892.
[8] *Phil. Mag.*, vol. xxxiv. p. 388, 1892.

by the authors' experiments. On reducing an acetyl derivative of the form X . N_2 . $C_{10}H_6$. OC_2H_3O or X . $N(C_2H_3O)$. N : $C_{10}H_6$: O with zinc dust and acetic acid, four products result, viz.:—X . NH . C_2H_3O, $C_{10}H_6(NH . C_2H_3O)$. OHβ, X . NH_2 and $C_{10}H_6$. NH_2 . OHβ.—The production of a fluorescein from camphoric anhydride, by J. N. Collie. On heating camphoric anhydride with resorcinol and a small quantity of zinc chloride at 180°, a fluorescein is obtained having the composition $C_{22}H_{22}O_5$; it is a reddish powder with a greenish lustre and shows a beautiful green fluorescence in dilute aqueous solutions.—Researches on the terpenes, III. The action of phosphorous pentachloride on camphene, by J. E. Marsh and J. A. Gardner. Camphene and phosphorus pentachloride interact at ordinary temperatures, yielding a compound of the composition $C_{10}H_{15}PCl_4$; on treatment with water a product is obtained from which two crystalline isomeric camphenephosphonic acids, $C_{10}H_{15}PO_3H_2$, have been isolated. On heating camphene with phosphorus pentachloride, a crystalline substance, $C_{10}H_{14}PCl_3$ is obtained; on treating this with sodium carbonate, a salt of the composition $C_{10}H_{14}ClPO_2NaH$ results, whilst on oxidation it yields chlorocamphenephosphonic acid, $C_{10}H_{14}ClPO_3H_2$.—The composition of a specimen of jute fibre produced in England, by A. Pears, junr.—Note on the combination of dry gases, by W. Ramsay. In connection with the results recently obtained by Baker, the author states that in 1886 he recorded the fact that dry hydrogen chloride does not combine with dry ammonia, even in presence of solid ammonium chloride.—Ortho-, para-, and peri-disulphonic derivatives of naphthalene, by H. E. Arm-

[1] J. Ritter von Geitler, Doctor-Dissertation, Bonn, Jan., 1893.

strong and W. P. Wynne. By displacing the amido-group in a naphthylamine derivative by SH and oxidising the resulting thioderivative, a sulphonic group enters the position previously occupied by the amidogen. By means of this reaction the authors have prepared and characterised the 1 : 1′, 1 : 2 and 1 : 4 naphthalenedisulphonic acids; nine out of the theoretically possible ten of these isomerides are hence now known. The 2 : 2′ : 3′ naphthalenetrisulphonic acid has been prepared by a similar method. The corresponding sulphonic chlorides and other derivatives of the above acids are also described.—Supplementary notes on madder colouring matters, by E. Schunck and L. Marchlewski. In 1853 Schunck obtained from madder a yellow colouring matter which he termed rubiadin; it is now shown that madder contains a glucoside of rubiadin, having the composition $C_{21}H_{20}O_9$. It yields a pentacetyl derivative, and on hydrolysis, is converted into rubiadin and dextrose. $C_{21}H_{20}O_9 + H_2O = C_{15}H_{10}O_4 + C_6H_{12}O_6$.—The constitution of rubiadin glucoside and of rubiadin, by L. Marchlewski. The author proposes a formula for rubiadin glucoside, and notes that on heating a mixture of symmetrical metadihydroxybenzoic acid, paramethylbenzoic acid, and sulphuric acid, he has obtained a substance isomeric with and closely resembling rubiadin, but melting at a lower temperature.

Physical Society, June 23.—Prof. A. W. Rücker, F.R.S., President, in the chair.—Mr. F. H. Nalder exhibited a bridge and commutator for comparing resistances by Prof. Carey Foster's method, the chief features of which are simplicity, compactness, long range, and great accuracy. The commutation of the coils to be compared is effected by mercury cups, the eight holes necessary for this purpose being arranged in a circle. An ebonite disc carrying the four connectors is mounted on a spindle in the middle of the circle, and the positions of the coils are interchanged by rotating the disc through 180°. A large range is secured by providing a number of interchangeable bridge wires, and a fine adjustment for the galvanometer key enables great accuracy to be attained.—Mr. W. R. Pidgeon and Mr. J. Wimshurst each read a paper on an influence machine, and exhibited their machines in action. In designing his machine, Mr. Pidgeon has endeavoured—first, to make the capacity of each sector large when being charged, and small when being discharged; second, to prevent leakage from sector to sector as they enter or leave the different fields of induction; and third, to increase the capacity of the machine by making the sectors large and numerous. The first object is attained by arranging fixed inductors of opposite sign to the sectors near the charging points, and of the same sign near the places of discharge. Objects 2 and 3 are secured by embedding the sectors in wax, run in channels in the ebonite discs which form the plates of the machine, and carrying wires from each sector through the ebonite, each wire terminating in a knob. In this way the sectors can be placed much nearer together than otherwise without sparking back. By setting the sectors skew with the radius they are caused to enter the electric fields more gradually, consequently the potential difference between adjacent sectors is kept comparatively small. Experiment showed that the use of the stationary inductors at the charging points increased the output threefold, and as compared with an ordinary Wimshurst, the output for a given area of plate passing the conductors was as 5·6 : 1. The recovery of the machine after a spark had occurred was particularly rapid. Mr. Wimshurst's new machine consists of two glass discs 3 feet 5 inches diameter, mounted about ⅜″ apart on the same spindle. Both plates turn in the same direction. Between the discs are fixed four vertical glass slips over 4 feet long, two on each side, and each covering about ⅛th of a disc. Each slip carries a tinfoil inductor, which has a brush touching lightly on the inside of the adjacent disc on its leading edge. Collecting and neutralising brushes touch the outsides of the discs, and the few metallic sectors attached thereto. An account of some experiments made to determine the efficiency of the machine was given. The author also showed that when all the circuits of the machine were broken, it still continued to excite itself freely, and sparked from the discs to the hands when brought near. In a written communication, Prof. O. Lodge said his assistant, Mr. E. E. Robinson, constructed a machine on lines similar to Mr. Pidgeon's a few months ago, and had now a large one nearly completed. Mr. Robinson's fixed inductors are carried on a third plate fixed between the two movable ones. The sectors are quite small, and neither they nor the inductors are embedded. On close circuit the machine gives a large current ($\frac{1}{10000}$ ampère), and on open circuit exceedingly high potentials. In Dr. Lodge's opinion, Mr. Pidgeon attaches too much importance to his sectors and their shape. Mr. J. Gray wrote to say that stationary inductors enclosed in insulating material would probably give trouble at high voltages, because of the surface of the insulator becoming charged with electricity of opposite sign to that on the inductor. He suggested that this might explain why Mr. Pidgeon could not obtain very long sparks. Prof. C. V. Boys inquired as to how far the wax made insulating union with the ebonite, for if good, glass might possibly be used instead of ebonite. He greatly appreciated the design of Mr. Pidgeon's machine. After some remarks by the president on the great advances which had been made, Mr. Pidgeon replied, and Mr. Wimshurst tried some further experiments with a small experimental machine.—A paper on a new volumemometer, by Mr. J. E. Myers, describing the developed form of Prof. Stroud's instrument, was, in the absence of the author, taken as read.—Mr. R. W. Paul exhibited a compact form of sulphuric acid voltameter of small resistance. The voltameter is a modification of a pattern designed at the Central Institution, in which the rate of decomposition is determined from the time required to fill a bulb made in the stem of a thistle funnel. He also showed a handy form of Daniell cell devised by Prof. Barrett. When not in use, the porous pot containing the zinc is removed from the copper sulphate solution and placed in a vessel containing zinc sulphate or sulphuric acid. A paper on long-distance telephony, by Prof. J. Perry, F.R.S., assisted by H. A. Beeston, was read by Prof. Perry. The case of a line of infinite length, having resistance capacity, self-induction, and leakage, is taken up, and the state of a signal as it gets further and further away from the origin is considered. Taking the shrillest and gravest notes of the human voice to have frequencies of about 950 and 95 respectively, the distance from the origin at which the ratio of the amplitudes of these high and low frequency currents is lessened by $1/m$th of itself, has been determined when $m = 4$ for different values of leakage and self-induction; and under similar conditions the distances at which the relative phase of the two currents become altered by $1/n$th of the periodic time of the most rapid one, have been worked out for $n = 6$. The results are given in the form of tables, from which it appears that if there was no self-induction, increasing the leakage increases the distance to which we can telephone, whilst if there was no leakage increasing the self-induction increases the distance. When self-induction and leakage are not too great, increasing either increases the distance, and for particular values the distances become very large. At the end of the paper tables of general application are given, from which the limiting distances for any line can be readily found by multiplying the numbers by simple functions of the constants of the line. Mr. Blakesley said that some ten years ago he discussed the subject, when capacity and resistance were alone considered, and now pointed out that when self-induction and leakage were introduced the equations were still of the same form. He also suggested how terminal conditions on lines of finite length might be easily taken into consideration. Prof. Perry, in reply, said the introduction of self-induction and leakage rendered the calculations very laborious, and that the terminal conditions were much more complicated than Mr. Blakesley supposed.

Zoological Society, June 20.—Sir William H. Flower, K.C.B., F.R.S., President, in the Chair.—The Secretary exhibited and made remarks on two eggs of the Cape Coly (*Colius capensis*) laid in the Society's Gardens.—A head of a rhinoceros from Northern Somali-land was shown by Mr. Walter Rothschild; also a Caspian seal, believed to be the only specimen of this seal in England; and a series of skins of parrots of the genus *Cyanorhamphus* from New Zealand and other islands of the South Pacific. Mr. Rothschild proposed to refer the specimens of this group from the Auckland Islands to a new species to be called *C. forbesi*.—Other objects exhibited and remarked upon were a specimen of the foot of a calf, in which there were three toes springing from a single cannon-bone, by Mr. W. Bateson, some teeth of a ray (*Myliobatis*) from the Lower Tertiaries of Egypt, remarkable for their enormous size, by Mr. A. Smith-Woodward, and a fragmentary skull of a lemuroid mammal from south-east Madagascar with very remarkable characters, by Dr. Forsyth-Major.—A communication was read from Messrs. Hamilton H. Druce and G. T. Bethune-Baker, containing a monograph of the butterflies of the genus *Thysonotis*. This included a revision of the synonomy of the species, descriptions of several new species and varieties, a complete table showing the distribution of the genus, and descriptions of the genitalia.—Among other communications was one from the Rev. H. S. Gorham, containing a list of the Coleoptera of the family *Cleridæ* collected by Mr. Doherty in Burmah and Northern India, with descriptions of new species; and an account of some species of the same family from Borneo, Perak, and other localities, in the collection of Mr. Alexander Fry. Twenty-eight species were described as new.—Prof. G. B. Howes read a paper on the coracoid of the terrestrial vertebrates. Prof. Howes first spoke of the terminology of the bone commonly called "the coracoid," and then proceeded to the discussion of the mammalian coracoid in particular. He came to the conclusion that it would be best to call the whole ventral coracoidal bar the "coracoid," and to distinguish the doubly ossified type as "bicoracoidal" from the singly ossified or "unicoracoidal" type.—Lieut.-Col. H. H. Godwin-Austen, F.R.S., read the descriptions of some new species of land-shells of the genus *Alycæus* from the Khasi and Naga Hill countries, Assam, Munipur, and the Ruby Mine district, Upper Burmah.—This meeting closed the present session. The next session (1893-94) will commence in November.

PARIS.

Academy of Sciences, July 3.—M. Lœwy in the chair.—Tidal and atmospheric waves due to the action of the sun and of the moon, by M. Bouquet de la Grye. The results are given of a series of determinations of the tides, barometric pressures, and winds made by a French commission at Orange Bay, Cape Horn, ranging at half-hourly intervals from November 1, 1882, to August 31, 1883. A first study of these results confirms the facts, announced previously, relating to luni-solar influence upon the atmosphere. This action is very apparent at Cape Horn, since the water and air at lat. 56° south have a uniform temperature at any given date, and the annual range of temperature is very small.—On the successive deformations of the front of an isolated air wave, during the propagation of the wave along an indefinitely long empty water-pipe, by M. J. Boussinesq.—On birational transformations of algebraic curves, by M. H. Poincaré.—On the observation of the total eclipse of the sun of April 16, made at Joal (Senegal), by M. A. de la Baume Pluvinel.—On a self-registering hydrokinemometer, by M. Clerc. This consists of two vertical cylinders communicating with the water at the stem and the stern of the vessel respectively. The difference of level in the two cylinders is proportional to the square of the velocity with which the boat is travelling. The cylinders are provided with floats, each of which takes a share in actuating the recording pencil, with which they are connected by strings passing over pulleys, disposed in such a manner as to let the record be unaffecting by any heeling or plunging of the boat.—Experimental researches on shipbuilding material, by M. F. B. de Mas.—Radiation of different refractory bodies, heated in the electric furnace, by M. J. Violle.—Auto-conduction, or a new method of electrifying living beings; measurement of magnetic fields of high frequency, by M. A. d'Arsonval.—Additional remarks by M. Cornu.—On chromopyrosulphuric acid, by M. A. Recoura. After showing that the molecule of chromic sulphate can be combined with one, two, or three molecules of sulphuric acid, M. Recoura has succeeded in combining the sulphate with a larger quantity of acid, and has obtained new compounds presenting properties completely different from those of the three former acids, and characters not found in any other chromium compounds. One of these, "chromopyrosulphuric acid," contains five molecules of sulphuric acid.—Constitution of the colouring matters of the fuchsine group, by MM. Prud'homme and C. Rabaut.—On cinchonibine, by MM. E. Jungfleisch and E. Léger.—On mercuric salicylates, by MM. H. Layoux and Alexandre Grandval.—On metallic combinations of Gallanilide, by M. P. Cazeneuve.—On topinambour carbohydrates, by M. Ch. Tanret.—On essence of lavender (*Lavandula Spica*), by M. G. Bouchardat.—Heat of combustion of oil-gas and its relation to illuminating power, by M. Aguitton.—On the genus *Homalogyra*, a type of gasteropod prosobranch molluscs, by M. Vayssière.—On certain physiological effects of unipolar faradisation, by M. Ang. Charpentier.—Experiments on the transmission and evolution of certain epithelial tumours in the white mouse, by M. Henry Morau.—Observations on the preceding note, by M. Verneuil.—Laws of evolution of the digestive functions, by M. J. Winter.—On the histological structure of yeasts and their development, by M. P. A. Dangeard.—On a new process of *Champignon de couche* culture, by MM. J. Costantin and L. Matruchot.—On the glaciers of Spitzberg, by M. Charles Rabot.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Royal University of Ireland Calendar for 1893 (Dublin, Thom).—The Law of Cremation: A. Richardson (Reeves and Turner).—Ostwald's Klassiker der Exakten Wissenschaften, Nos. 41 and 42 (Leipzig, Engelmann).—The Points of the Horse: M. H. Hayes (Thacker).—The Life of a Butterfly: S. H. Scudder (New York, Holt).—Brief Guide to the Commoner Butterflies of the Northern United States and Canada: S. H. Scudder (New York, Holt).—Katechismus der Meteorologie: Dr. Bebber (Leipzig, Weber).—Results of Rain, &c., Observations made in New South Wales during 1891: H. C. Russell (Sydney, Potter).—Results of Meteorological Observations made in New South Wales, 1890: H. C. Russell (Sydney, Potter).—Prodromus Faunæ Mediterraneæ, Vol. 2, Pars 3—Vertebrata: J. V. Carus (Stuttgart, Koch).—Manual of Bacteriology: Dr. S. L. Schenck, translated by W. R. Dawson (Longmans).—Researches on the Zodiacal Light, &c.: Prof. Pickering (Cambridge, Wilson).

PAMPHLETS.—Erster Jahres-Bericht des Sonnblick-Vereines für das Jahr 1892 (Wien).—Transactions of the Astronomical and Physical Society of Toronto for the Year 1892 (Toronto).—Studies on the Life-History of some Bombycine Moths, &c.: A. S. Packard (New York).—Life-Histories of certain Moths of the Families Ceratocampidæ, Hemileucidæ, &c.: A. S. Packard (New York).—Life History of certain Moths of the Family Cochliopodidæ, &c.: A. S. Packard (New York).—Studies on the Transformations of Moths of the Family Saturniidæ: A. S. Packard (New York).—The Migrations and Habits of the Pilchard; M. Dunn (Falmouth, Lake).

SERIALS.—Engineering Magazine, July (New York).—Geographical Journal, July (Stanford).—Natural Science, July (Macmillan).—Gazzetta Chimica Italiana, Anno xxiii., 1893, Vol. 1, Fasc. vi. (Palermo).—The Observatory, July (Taylor and Francis).—Geological Magazine, July (K. Paul).—Journal of the Chemical Society, July (Gurney and Jackson).—Encyklopædie der Naturwissenschaften, Dritte Abthg. 14 und 15 Liefg (Williams and Norgate).—Goldthwaite's Geographical Magazine, May–June (New York).—Journal of the Anthropological Institute, May (K. Paul).—Mind, July (Williams and Norgate).—Essex Institute Historical Collections, October to December, 1891, January to September, 1892 (Salem, Mass.).—Records of the Geological Survey of India, Vol. xxvi., Part 2 (Calcutta).—Journal of the Royal Statistical Society, June (Stanford).—American Journal of Science, July (New Haven).—Quarterly Journal of Microscopical Science, July (Churchill).—Bulletin de la Société Impériale des Naturalistes de Moscou. 1893 No. 1 (Moscow).—Physical Review, No. 1 (Macmillan).—Bulletin of the American Museum of Natural History, Vol. 4, 1892 (New York).

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