THURSDAY, FEBRUARY 9, 1888.

MESSRS. GOSCHEN AND HUXLEY ON ENGLISH CULTURE.

WITHIN the last few days two noteworthy utterances on the subject of our national prospects have been made by men whose opinions deserve and command attention. Prof. Huxley has told us, in the *Nineteenth Century*, that though the restraints imposed by civilization have altered the methods by which the struggle for existence is carried on, they have not made it less real or less bitter.

"In a real, though incomplete, degree we have attained the condition of peace which is the main object of social organization; and it may, for argument's sake, be assumed that we desire nothing but that which is in itself innocent and praiseworthy—namely, the enjoyment of the fruits of honest industry. And lo! in spite of ourselves, we are in reality engaged in an internecine struggle for existence with our presumably no less peaceful and well-meaning neighbours. We seek peace, and we do not ensue it."

This application of Darwin's great theory to commercial competition is more than a parable. It is the scientific explanation of causes which have wrecked civilizations in the past and may wreck them in the future.

The struggle must go on while men are impelled by the desire for a greater profusion of what sustains life or makes it happier. It often has been, and often is, carried on by the sword, but important victories may be won, and disastrous defeats sustained, by more peaceful means. The discovery of the passage round the Cape transferred the trade of the East from the Mediterranean to London and Amsterdam, and most merchants in the City affirm that the cutting of the Suez Canal has once more deprived England of the advantage of situation. The commercial success of Switzerland, however, proves that national characteristics are at least as important as geographical position, and it is well from time to time to ask if we are doing all that in us lies to train those who shall follow us to maintain what our predecessors have won.

It is from this point of view that the second of the two utterances we have referred to is specially interesting. Mr. Goschen is at one with Prof. Huxley as to the severity of the struggle in which we are engaged. "Our position in the race of civilized nations," he told the undergraduates at Aberdeen, "is no longer what it was. We had a great start in industries and commerce, and by virtue of that start we attained to a station of unprecedented and long unchallenged supremacy. That supremacy is no longer unchallenged. Others are pressing on our heels. We require greater efforts than formerly to hold our own." Theory and experience agree. The biologist tells us that a state of struggle is the normal condition of man as of all other living beings, and that it must become keener as our numbers augment. The Chancellor of the Exchequer, with his hand on the pulse of English trade, is witness that the strife is growing in severity.

And this is not all. Mr. Goschen is not satisfied that we have as a nation all the qualifications for success. In a powerful address, which evidently expressed a matured conviction, he insisted that Englishmen lack "intellectual interest" in their work. They regard their business as a necessary evil, from which they delight to sever themselves as often and as completely as possible. They are ignorant of the general principles which underlie the conduct of trade, or at least are careless in noting their application to particular instances. It is quite in accord with this that they regard education not so much as an essential to fit a man for the battle of life as an ornament for his leisure hours. And here again Professor and politician are at one. The highest intellectual ideal of our University men, says Mr. Goschen in effect, is, or at all events until very lately was, perfection of literary form. Our public schools have aimed chiefly at turning out scholars who could write Latin verse. Our educational systems, echoes Prof. Huxley, were fashioned "to meet the wants of a bygone condition of society. There is a widespread and, I think, well justified, complaint that [our system of elementary education] has too much to do with books and too little to do with things."

To discuss the whole question thus opened—an indictment of University and Board-school alike—would be impossible in the limits of space at our disposal, but regarding it from the point of view in which our readers, like ourselves, are specially interested, we cannot but note a sad corroboration of Mr. Goschen's words. In no trades could a genuine intellectual interest be more easily excited than in those which involve a knowledge of science, and in none have Englishmen more conspicuously failed. It is needless to recapitulate stories like that of the discovery of the aniline dyes in an English laboratory, and the wholesale appropriation of the trade to which that discovery gave rise by German manufacturers. The fact is patent and obvious to all who have studied the question. Science can only be successfully cultivated by men who take an "intellectual interest" in their work; and in trades which depend upon a knowledge of science, it is the foreigner who achieves success. Where does the fault lie? For the masters and foremen, the colleges which are springing up all over the country may do much. They are, we believe, slowly creating a class of men who have a sound foundation of scientific knowledge, and a genuine interest in scientific progress. But for the rank and file, for the clerk and artisan, it is upon evening classes that Prof. Huxley thinks we must chiefly rely, and here the main difficulty seems to be to secure good teachers for classes in science and technology. They are, says Prof. Huxley, "not to be made by the processes in vogue at ordinary training colleges." "As regards evening science teaching"—we quote from the Report of the Royal Commissioners on Technical Instruction—"there seems to be nowhere in Europe any organization for systematic evening instruction comparable, as regards the number of subjects taught, and the facilities afforded for the establishment of classes, and for the examination of the students' work, with that undertaken by the Science and Art Department in this country, and recently supplemented, in the application of science to special industries, by the City and Guilds of London Institute.

"At the same time it must be borne in mind that in many towns visited by the Commissioners the evening science teaching was conducted by Professors of higher standing than, and of superior scientific attainments to, the ordinary science teachers who conduct courses in some of the largest and most important of the manufacturing centres of this country."

Here, then, appears to be at all events one weak point.

The Science and Art Department has a flexible system, capable of application to the wants of town and country. Students are examined by the thousand every May, but though the standard of attainment is rising, there is a general opinion—which is supported by the statements of the Royal Commissioners—that the instruction given by the teachers falls far short of an ideal which might be and ought to be reached. And yet this matter of good or bad teaching is vital. "It is absolutely essential," says Prof. Huxley, "that the mind [of the teachers of scientific subjects] should be full of knowledge and not of mere learning, and that what he knows should have been learned in the laboratory rather than in the library." "This," according to Mr. Goschen, "is the first test of the value of an educational system, whatever its curriculum may be. Is it intelligent? Is it thorough? Above all, is it rousing? Does it excite intellectual interest in those who come under its influence? Does it develop in them the temper which always asks for a reason and struggles to arrive at a principle?"

Teachers competent to work an educational system which satisfies these requirements must be themselves highly-finished educational products. They must have risen above the vulgar pocket-filling ambition of passing so many students per annum. Risen above it, not in the sense of ignoring it, for in this prosaic world a livelihood must be earned, but in the sense that the mere drudgery of bread-winning is for them lit up with a glow of the enthusiasm of the student who has knowledge to impart which he himself values for its own sake.

We want as science teachers not men who have crammed just enough to enable them to cram their pupils in turn, but men—and we believe there are many, though far too few of them—who have learnt to regard themselves as members of the great scientific army the advance of which is the most remarkable movement of the age.

How are they to be got? They cannot be obtained in the requisite numbers without a systematic search and preparation. It may be, as Prof. Huxley hints, that additional pecuniary inducements must be held out to secure them. This is a question on which the Chancellor of the Exchequer may have an opportunity of giving practical aid to English science and education. Or, if this is Utopian, let us suggest to Mr. Goschen that it would be well if his great influence were used to urge the Government to make the most of the machinery it already possesses.

Prof. Huxley has been for years the Dean of the Science Schools which are the centre of the system of evening teaching which the Royal Commission on Technical Instruction has pronounced to be in many respects the best in Europe. Among the highest rewards given to the successful candidates in the May Examinations are free passes for more or less prolonged courses of study at South Kensington.

Teachers in training attend the classes, and year by year batches of science teachers are brought together to receive special instruction in the subjects they are engaged in teaching. One of the great difficulties to be encountered by a provincial College is the fact that the calls upon the Professors are too multifarious. Students of all classes—would-be engineers, doctors, electricians, and a dozen similar groups—all desire courses of instruction designed to meet their particular wants. It has been rightly decided that this obstacle shall not impede the progress of the State-aided system of evening instruction. A special institution is provided to meet the special requirements of those who are engaged in it. The union of the Normal School of Science with the Royal School of Mines has not interfered with the attainment of this end, while it has secured the advantages which result from the mingling of students who are studying the same subjects with different aims.

The State, then, has recognized the need for trained science teachers, just as it feels the necessity for providing properly-educated officers for the Navy. It is admitted that both classes can best receive the instruction they need at special institutions. The Royal Naval College at Greenwich has been provided for the one, the Normal School of Science for the other.

The school gives evidence of vitality and success. Within the last five years the number of students has doubled. A very considerable amount of original research is done in its laboratories. Now, however, its very efficiency is a danger. It has outgrown the buildings which have been assigned to it. By permission of the Commissioners of the 1851 Exhibition, classes are carried on in what was the Colonial Exhibition. But duty to the interests with which they are primarily charged will, before long, compel them to withdraw this hospitality. Driven from the holes and corners in which it has been compelled to seek refuge, the Central School for the training of teachers of evening science classes may be compelled to reduce its numbers, and to limit its usefulness at the very moment when Mr. Goschen, Prof. Huxley, and all competent educationalists are agreed that one of our most pressing national wants is the elevation of our teachers, and of their type of teaching.

We have chosen this as a single example which serves to illustrate the wide generalization which we have been discussing. Is the interest of the average Member of Parliament in the dangers which threaten our trade sufficiently intellectual to lead him to sanction the cost of necessary precautions? In these democratic days the fate of the English people is in their own hands. If they choose that the education of their bread-winners shall be conducted on the principles on which the "accomplishments" were taught in an old-fashioned ladies' school—if they choose to send competent Commissioners all over Europe, and, when they tell them that one of the chief defects of their educational system is the comparative inefficiency of their teachers, they nevertheless deliberately half-close the doors of the school specially provided to remedy this defect—there is no help for it, and but little hope for them.

Wars may be caused by race hatreds which have taken centuries to gather, but success or failure often depends on the placing or misplacing of a few thousand men. Commercial competition may be, as Prof. Huxley tells us, due to causes which affect all living things. The progress or decadence of England will depend upon how it adjusts itself to the altering character of the strife; and we confess that we shall watch with interest to see what amount of practical support the Chancellor of the Exchequer is prepared to give to the views of the Lord Rector of Aberdeen. The test will be applied when the Technical Education Bill is again brought forward, and when the particular need which we have chosen as an illustration has to be met.

THE PROPOSED TEACHING UNIVERSITY FOR LONDON.

WE printed last week the petition which has been presented to the Privy Council by the Association for Promoting a Teaching University in London. We have now before us the petition of University College and King's College, to which is appended a proposed draft charter for the University, under the name of the Albert University of London. If, as seems probable, the promoters have been well advised in claiming no less a surname than that of the Metropolitan district for which the University is to serve, the prefixed name of the late Prince Consort, to whom England is undoubtedly indebted for the encouragement his influence gave to educational and scientific work, is perhaps as good a way as could have been hit upon for avoiding confusion with the existing University. For the rest, the charter appears to be an adaptation to the circumstances of that granted to the Victoria University; the principal differences being—the place reserved for the Royal College of Physicians and Royal College of Surgeons in the University, which is one of complete equality with the governing bodies of the University Colleges themselves; the power conferred upon the legally recognized medical schools of London, as such, to claim, as of right, admittance to the University, on equal terms with the Medical Faculties of University College and King's College; and the greater simplicity of the governing body. In the case of the Victoria University a complicated division of authority was resorted to, with the view of obviating mutual jealousies between the various cities and towns in which, in that case, the several Colleges were to be situated. The Senate proposed for the Albert University consists of three members chosen by the governing body of each College associated with the University; the College of Physicians and College of Surgeons being reckoned among associated Colleges, if willing to accept the position, but the twelve medical schools not being so reckoned; of four members representing the assembly of each Faculty, such assemblies being composed of the teaching staffs of all Colleges or medical schools admitted in respect of the Faculty; and of six representatives nominated by the Crown in the first instance, of whom three are eventually to be replaced by representatives of the graduates in Convocation.

Compared with this body, the composition of the Senate of Physicians and Surgeons proposed in the petition of the two Royal Colleges presents an even greater degree of simplicity. No provision is made for the representation of any other interest than that of the petitioners themselves; and the two Colleges divide the representation equally between their respective governing bodies. It is understood, however, that in the case of the College of Surgeons this proposal has not given satisfaction, even within the limits of the College; and that some representation will be claimed for Fellows of the College other than those who constitute the Council which governs it.

From the point of view which is especially our own, the quarrel about degrees, and the interests of rival institutions, occupy a place secondary in importance to considerations affecting the promotion of knowledge and science, and only important in so far as they are concerned. If the proposal of the Royal Colleges is carried into effect, and a committee of eminent physicians and surgeons is intrusted with the power of examining for and giving medical degrees, there can be little doubt that the great building on the Thames Embankment, and the space behind it shortly to be covered with building, will speedily develop into a teaching institution, with provision for research; and thus knowledge will be increased, and science promoted, by the addition of one more to the number of efficient schools for special purposes which are now open in London. The promoters of the Albert University do not offer us any immediate addition of this nature to the resources which are now available. We have examined the draft charter with care, in order to detect, if possible, the traces of a design to check the foundation or perfecting of new institutions, in the interest of those already existing. But the promoters, we are bound to say, appear to have guarded against all objection, by following, in this respect, the charter of the Victoria University. The appeal which is given to the Privy Council, in case of the refusal of the University to admit a new College, is a satisfactory provision against the spirit of monopoly. In the absence of danger from this point of view, the Teaching University promises more than is offered by the Senate of Physicians and Surgeons, in the interests of science. The prospect of establishing, as a qualification for admission to the University, a general standard of efficiency for Colleges professing to do the work of scientific teaching, has greater attractions for us than that of the opening of a single new school of medical and surgical research. Moreover, by the institution of the Teaching University, we shall secure the first, without rendering it less probable that in time the second also may follow.

We notice that the right of admission offered to all the London medical schools, though absolute so far as the Medical Faculty is concerned, is, in regard to the Faculty of Science, made conditional on efficiency. This is as it should be. Probably some of the smaller hospitals will regard with equaminity the extinction of their pretensions to be recognized as efficient schools of science. Others will be incited to render themselves efficient. In both cases the result to science will be a pure gain. One matter of importance appears omitted in the programme of the Albert University: the position to be assigned within the University, if its admission is contemplated, to the Royal School of Mines and Normal College of Science. It would appear proper that this point should be further considered, if the project ever reaches a more definite stage.

Upon the matters in dispute between the University of London and the University Colleges we desire to maintain an attitude of impartiality. On the one hand, it is urged that the credit of a degree will not stand the strain consequent on the creation of a second degree-giving body in London; and that all the reform desirable, in the interests of education, is the introduction of a larger number of teachers on the governing body of the existing University. On the other, stress is laid upon the importance, for educational purposes, of the independence of teachers from irresponsible external control, and upon the necessity of an organization of teaching for London more thorough than can be afforded by any constitution or reconstitution of an examining body. But whether

the desired reforms are carried out by changing the constitution of the University of London, or by instituting a new University, two things appear in any case to be incontestable: that the open examinations conducted by the existing University shall continue to be conducted by an impartial authority; and that the Colleges shall be allowed to organize their work in the manner best suited to promote their own efficiency.

Sir Philip Magnus, in a letter which appeared in the *Times* on Thursday, appears to consider the dispute as one between the efficiency of "lectures" on the one hand, and of "reading" on the other; and he cites the now well-known dictum of Darwin, in favour of reading, and against lectures. But it would be to mis-read, in a strange manner, the lesson of Darwin's life, if from it were to be drawn a conclusion against the existence of Universities for teaching purposes, and in favour of examinations. If Darwin carried from Edinburgh a profound dislike to unintelligent lecturing, of the epideictic sort, he was at Cambridge known as "the man who walks with Henslow." In Sir W. Hamilton's famous analysis of the work of Universities, examination holds the first place only among no less than seven "exercises" by which study, in a teaching institution, can be promoted; the others being "disputation, repetition, written composition, the practice of teaching, conversation with and interrogation of the learned, and social study." To these must be added, by the student of science, the practice of experiment under competent supervision. Some of these appear to us of more value than examinations, some of less; but it is obvious that an institution which is solely concerned with examinations does not cover the whole ground of institutional aid to study; and it is of no avail, as between one institution and another, to exalt the benefits of "reading," which is not peculiar to either. In conclusion, we trust all parties to the controversy will bear constantly in mind that degrees and examinations, lectures and colleges, are, after all, but means to an end. The end is the spread and advancement of knowledge, through educational methods and research.

MANUAL OF BRITISH DISCOMYCETES.

A Manual of the British Discomycetes. By William Phillips, F.L.S. 8vo, 446 pages, 12 plates. International Scientific Series. (London: Kegan Paul, Trench, and Co., 1887.)

IT is by no means an uncommon misfortune to find that text-books are not written by persons the most competent, or with the widest experience; hence the results are very far from satisfactory, and no one expresses much gratification. Now and then notable exceptions to this rather general rule may be discovered, to the delight of all who are interested in that special branch of science to which the book is devoted, and the great edification of the student. It is beyond our province to inquire why the most suitable men are so seldom engaged in the production of "manuals," or why the most skilful manipulator, with a few months' study and much "coaching," cannot compete successfully with the practical hand well steadied with a twenty years' experience. It will be enough to intimate that no one acquainted with British Cryptogamic botany would for a moment hesitate to pronounce that the most suitable person to undertake a manual of the Discomycetes would be Mr. W. Phillips, of Shrewsbury, if practical knowledge, and persistent investigation, extending over at least two decades of years, are to be accepted as qualifications.

With these preliminary observations it will be at once evident that, in general terms, and as a whole, we feel bound to give this little volume our heartiest commendation; and if, in the course of our remarks, we indicate any weak places, it will be with the desire to act with the tenderness of a friend, and to point out how, in our conception, an admirable manual may be rendered more perfect or more useful.

No apology is needed for restricting a book like the present to a small controllable group of some 600 species, especially when the limits are so well defined that a student may devote himself exclusively to it, with advantage to himself, without any special acquaintance with outside groups. It is generally admitted that the entire British Fungi, with its thousands of described species, is become too unwieldy and extensive for any ordinary individual, not content to become a slave to his subject and a martyr to science. The Discomycetes present an admirable group, capable of isolated study; and for this purpose a careful and trustworthy manual, at a moderate price, is now ready at the student's hands.

"The subject of classification," the author says in his preface, "will not fail to awaken some controversy." "To adhere as closely as possible to the long-accepted Friesian system has been the practice of English authors, but this has been carried a little too far, owing to our 'insular prejudices,' and the time has come when a new departure must be made." We are prepared to accept this paragraph—exclusive of "insular prejudices," which we cannot admit—and with it the "new departure." To our mind this is a most moderate concession, and we doubt not that, if controversy there should be, its direction will be in favour of far greater innovation than Mr. Phillips or ourselves would approve. The details of the new arrangement must be subjected to closer examination and the test of experience, but at present we see no reason to take exception to them. We have long been of opinion that some such modification of the old classification was desirable.

There is, nevertheless, one point on which we have always uttered a protest, and repeat it again, since in two or three instances in the present volume the error has been committed. We allude to the addition to, or alteration of, a generic description, and the appending of the original author's name, with the word "amended" after it. We protest against *amended genera*, because they are nobody's genera; they are not the genera of the original author, but a "thing of shreds and patches." A genus should not be altered or amended, in order to fit any subsequent species which a later author may desire to incorporate. He should keep the new species outside, and accommodate it in other ways, rather than modify or "tinker" the work of a predecessor, and assume the change to be an "amendment," whereas it *may* be something very different, and probably *would* be to the old author himself, if he could be resuscitated to gaze on the freaks of his successors.

As for the number of species described in this volume,

we may remark that it is more than double that which the "Hand-book of British Fungi" included in 1871. One of the many valuable features of the book is, that, wherever possible, measurements are given of the sporidia of the various species, in micromillimetres, in addition to the dimensions of the fungus in its entirety. We specially allude to this feature in order to have an opportunity of adding that in our experience we have never met with a more careful or expert hand at microscopical measurement than the author of the present work, an opinion based on hundreds of observations made in concert during a series of years. Yet we must urge that, however useful the micromillimetre undoubtedly is in spore-measurement, it is not so well to use it for larger bodies, such as the cup of a *Peziza*, when the millimetre or its decimal part would appeal more directly to the eye and experience. 500 μ may be equal to half a millimetre, but the mind more quickly and readily conceives the half millimetre than the 500 μ. We observe a lack of uniformity in dimensions appreciable by the naked eye, which is avoided in measurements under the microscope. For instance "¼ to ½ line broad" (p. 249), "cups 200 to 500 μ" (p. 257), "cups 500 to 800 μ" (p. 321). What relation does the "line" bear to the micromillimetre? If half a line is about 500 μ, why use the two units of measurement? Would it not have been better to follow Stevenson in his "British Fungi," and to reduce all measurements to the centimetre, millimetre, and micromillimetre, which would have been much more consistent, and far better than the mysterious "line," and had the merit of being more intelligible to the foreigner than a unit of which he has no knowledge or experience.

It would be useless to assume that the work is absolutely free from errors, but these are mostly of a trivial character, although more numerous than we could have wished. We doubt whether "conidia" would not have been a better term than "spermatia" in such a connection as *Calloria fusarioides;* and we also doubt whether our author accurately appreciates the value of the terminations in such words as *violascens*, *virescens*, *fuscescens*, *nigrescens*, &c.

As for the general scope of the work, we may say that each species begins with the diagnosis, then follows its synonymy, especially in British works, references to figures, and published specimens. If these are in the main accurate, as we have no reason to doubt, they will be exceedingly valuable, but manifestly only experience can prove this, and figures are very liable to become displaced or transposed. The habitat succeeds the synonymy, which is followed by special notes or comments; then the derivation of the specific name, now and then hardly successfully interpreted, as for instance on pp. 291, 325, and 369, where *ater* would have been better rendered "dark" instead of "black"; and finally a list of localities.

At page 358, *Ephelis* is inserted as a genus of Fries's. The same genus is claimed by Saccardo ("Sylloge," iii. p. 691) for a genus of Sphæropsideæ, and we fear that Phillips will have to give way to Saccardo, as both cannot stand, and there is no evidence that Fries regarded his genus as ascigerous.

Forty pages at the end are most useful appendages to the work, consisting of a glossary of terms, full titles of the various works quoted, and an exhaustive index. To the last page Mr. Phillips has spared no trouble to make his work as complete and useful as practicable, and we trust that he may be rewarded for his labour of love (for such it undoubtedly has been) by being called upon speedily to correct the verbal errors in preparation for a new edition. M. C. C.

OUR BOOK SHELF.

Physiography: an Elementary Text-book. By W. Mawer, F.G.S. (London: Marshall and Co., 1888.)

THIS is another addition to the steadily increasing number of text-books adapted to the elementary stage of physiography. The usual plan of dividing a book into chapters is not adhered to, but probably the author is of opinion that he is working according to the true spirit of physiography in drawing no hard and fast lines.

In the majority of cases the author has succeeded in his endeavours to explain everything in the simplest way, but in a few cases his anxiety to do so has led him astray. The following may be quoted as examples, and the obvious shortcomings need no further comment:—

"Work is the moving of matter" (p. 8); "Energy, when active—when actually doing work—is in the condition called *kinetic*; when it is passive and only ready to do work, it is *potential*" (p. 9).

With a few exceptions of this kind, the book is admirably adapted to the syllabus which it is intended to cover. That it is not a mere cram-book is evidenced by the mass of useful information which is given. A good general outline of the nebular hypothesis is presented, in so far as it concerns the history of our globe, and there is also an outline of the classification of animals and plants. The astronomical portion of the syllabus also receives a fair share of attention. One omission, however, has been made, and that is the use and meaning of the term "stress": the word apparently does not occur even once in the whole book; this is rather unfortunate now that modern physicists are beginning to regard gravitation, magnetism, &c., as stresses.

Apart from its use as a class-book, it can be recommended to the general reader as an outline of science. A. F.

Early Christian Art in Ireland. By Margaret Stokes. (Published for the Committee of Council on Education, by Chapman and Hall, 1887.)

THIS is one of the South Kensington Museum Art Handbooks, and it deserves to rank among the best of the series. The Christian antiquities of Ireland are in their own way as remarkable as any group of antiquities in the world, and a satisfactory account of them, such as ordinary readers might understand and appreciate, was greatly needed. In undertaking to supply what was wanted, Miss Stokes devoted herself to a task for which she was well equipped by previous study, and she has produced a little book which can hardly fail to excite interest in her subject, and which will be welcomed even by antiquaries to whom the facts of Irish archæology are already well known. A chapter on illumination is followed by one on Irish scribes on the Continent; and then come chapters on metal-work, sculpture, building and architecture, with a chronological table of examples of Irish art the date of which can be approximately fixed. The work is illustrated by upwards of a hundred good woodcuts. In her treatment of all questions relating to early Christian art in Ireland, Miss Stokes displays a thoroughly scientific spirit, and her style has the merit of being always clear, fresh, and unpretending. She rightly claims for her subject that it has a practical as well as an intellectual

interest. If the higher class of workers in Ireland took the trouble to study systematically the objects here so carefully described, an epoch might be marked in the development of Irish technical skill.

LETTERS TO THE EDITOR.

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

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

The Duke of Argyll's Charges against Men of Science.

THE Duke of Argyll's singular appetite for besmirching the characters of men of science appears to grow by what it feeds on; and, as fast as old misrepresentations are refuted, new ones are evolved out of the inexhaustible inaccuracy of his Grace's imagination.

In the last two letters which the Duke of Argyll has addressed to you, he accuses me of having charged the members of the French Institute with having entered into a "conspiracy of silence" in respect of Mr. Darwin's views. I desire to say that the assertion that I have done anything of the kind is untrue and devoid of foundation.

My words, in the passage of which the Duke has cited as much as suited his purpose, stand as follows: "In France, the influence of Elie de Beaumont and of Flourens—the former of whom is said to have 'damned himself to everlasting fame' by inventing the nickname of 'la science moussante' for evolutionism—to say nothing of the ill-will of other powerful members of the Institute, *produced, for a long time, the effect of a conspiracy of silence.*"[1] I used the words I have italicized advisedly, for the purpose of indicating that, though the members of the Institute did *not* enter into a conspiracy of silence, the notorious antagonism of some of them to evolution produced much the same result as if they had done so.

If the Duke of Argyll were properly informed upon the topics about which he ventures to speak so rashly, he would know that M. Flourens wrote a book in vehement denunciation of evolutionism. As I reviewed that book not very long after its appearance, I could not well be ignorant of its existence. And being aware of its existence, I could not possibly have charged M. Flourens with taking any part in a "conspiracy of silence."

The "effect" of the known repugnance to Mr. Darwin's views of some of the most prominent members of the Institute, to which I refer, is the effect upon the younger generation of French naturalists. Considering the influence of the Institute upon scientific appointments, the chances of a candidate known to be an evolutionist would have been small indeed; and prudence dictated silence.

Mr. Carlyle has celebrated the courage, if not the discretion, of a certain "Rex Sigismundus," who, his Latin being called in question, declared that he was, as a Royal personage, "supra grammaticam." The Duke of Argyll appears to be of King Sigismund's opinion in respect of the obligations which are felt by humbler persons, who have, wittingly or unwittingly, accused their fellows wrongfully; and I do not suppose that he will descend, on my account, from a position which may be sublime or may be ridiculous, according to one's point of view. The readers of NATURE will choose their own.

T. H. HUXLEY.

Bournemouth, February 4.

[1] "Life and Letters of Charles Darwin," vol. ii. pp. 185-86.

An Explanation.

SINCE the Duke of Argyll's references to myself have been interpreted in a manner likely to convey an erroneous impression to the readers of NATURE, it seems to me to be now necessary to give some explanation of the facts in which I am concerned. I intend, however, to go no further than to establish the position his Grace has taken up as regards myself. Such a step, savouring somewhat of presumption on my part, would not have been taken if Prof. Judd had admitted that, although no paper of mine was ever before the Council of the Geological Society, an offer to present such a paper was, doubtless for sufficient reasons, at once declined.

In the spring of 1885, by the advice of Mr. Murray, who had been for some time engaged in examining my recent geological collections from the Solomon Islands, I offered to Prof. Judd, then Secretary of the Geological Society, to present my observations on the upraised coral-reef formations in the form of a paper, in which, as I stated, Mr. Darwin's theory of coral reefs would be brought under consideration. This offer being declined, my observations were taken up by Mr. Murray and were published in the Transactions of the Royal Society of Edinburgh for 1885. As I saw too plainly that the new view of the origin of coral reefs was very far from being generally accepted, I deemed it advisable in preparing my paper to draw no inferences and to allow the facts to speak for themselves. However, six months after the reading of the paper, whilst going over the proofs, having been assured that the theory of Mr. Darwin was rapidly losing ground, I appended some remarks in which I gave the general bearing of my discoveries.

Had I harboured a desire in my mind to record any disappointment in connection with the appreciation of my work, I might have done so in the preface of my small geological volume recently published. The reflection that I had succeeded, and that Mr. Murray's views, as I was told, were being generally received, gave me ample grounds for satisfaction; and there was therefore no reason why I should refer to any difficulties of a personal character. I must confess, however, I was afterwards deeply disappointed on finding that, although the nature of my discoveries was first announced in the columns of this journal in January 1884, whilst the observations themselves had been nearly two years before the world, my name and work were *studiously ignored* in the recent controversy by those who spoke on behalf of English men of science, and particularly on behalf of the Geological Society. Naturally it was there that I looked most for approval. I soon perceived, however, that it could not be in the want of publicity that the reason lay, nor even in the insufficient lapse of time since the publication of my papers. Long abstracts were given in the columns of this journal of the principal paper (Trans. Ed. Roy. Soc., 1885), and of a paper also read before the Royal Society of Edinburgh (Proc., 1886). At the beginning of 1885 (or perhaps earlier) I sent to Prof. Judd a blue pamphlet published in New Zealand, in which I briefly described the discoveries I had made up to the end of 1883. At the beginning of 1886 I sent to him my principal Edinburgh paper of the previous year.

It then occurred to me that since Prof. Dana's last paper, of September 1885, was the chief rallying point of the opponents of Mr. Murray's views, the cue in estimating the value of my work might have been thence derived. I found, however, that Prof. Dana had only before him, when referring to my discoveries, an extract from a private letter of mine to Mr. Murray written in the midst of my work, and published in NATURE in January 1884. Rightly enough, he did not consider such a brief account as at all conclusive. My published observations had yet to come before him. It was not, therefore, from the other side of the Atlantic that in estimating the value of my observations Mr. Murray's opponents had taken their cue.

I was forced, therefore, to the conclusion that the reason lay rather in the competency than in the bearing of my observations. I could find no other explanation of the fact that in the succession of replies to the Duke of Argyll's article, entitled "A Great Lesson," no reference whatever was made to the recent important evidence I had adduced—evidence of which at least one of the writers had been previously aware during a period of two if not three years. Under these circumstances, I accepted the decision which the lapse of nearly three years had not affected; and, having naturally some degree of sensitiveness, I withdrew from the Geological Society.[1]

[1] Mr. Guppy was induced afterwards to withdraw his resignation.—ED. NATURE.

In conclusion, I may say that these circumstances do not alter my conviction of fighting on the winning side. The reasons of my faith I hope to give in the next journal of the Royal Scottish Geographical Society. H. B. GUPPY.

17 Woodlane, Falmouth.

Snow Crystals.

YESTERDAY was very favourable for observing the beautiful appearance of sunlight reflected from snow crystals. As one walked across a field, stars appeared to start forth by thousands from amongst the fresh-fallen snow. They were particularly bright and numerous when one walked in the direction of the sun. They appeared almost at all distances, and almost of all sizes, those near at hand being never very large but of great brilliancy and most exquisite colour. The phenomenon was sufficiently striking to induce me to stop and observe it more closely, and the first thing I noticed on stopping was the permanence of each little star of light, although the snow was dropping melted from the hedges and trees by the heat of the sun. A slight movement of the head was sufficient to change the colour of a red star to green or *vice versâ*. It seemed as if the most brilliant colours were seen when looking in a direction nearly but not quite towards the sun. The level surface of the snow appeared as if strewn with gems—and not only near at hand, for even twenty and thirty yards away a large star would shine forth with a subdued but fine colour. I then noticed a peculiar uniformity of shape in these reflections from snow crystals. The shape never varied from that of a blunt arrow-head. This was very striking in the large stars which appeared at a distance; but once noticed, it was obvious enough that even the minute specks at one's feet were all of this form. Nor did the position of the snow vary to any appreciable extent. The inclination seemed always a little to the right, and this occurred no matter in what direction I looked, whether towards the sun, or away from it, or in any other direction. Wishing to know the absolute size of the larger snow crystals, or combination of crystals, I looked for a fine appearance, and estimated as well as I could its magnitude by covering it with a small object held at arm's length. The distance of the spot where the crystal appeared proved to be forty-three paces from where I stood, and its magnitude could not have been much less than three inches in this particular case. Now if, as I suspect, the form of the star which appears so persistently is due to the upper or lower stem only of a complete arrangement of crystals in an hexagonal shape, these combinations must occasionally be six inches or more in diameter. I did not succeed in recognizing any larger than very minute arrangements of crystals in the snow itself, but it is obvious that the sun's rays reflected from a long distance must single out those faces of crystals which happen to be parallel to one another over a certain limited area. Observation of these reflections, therefore, calls in to our aid a power of analysis in the sun's rays to detect symmetrical arrangements of snow crystals quite unrecognizable by mere inspection. Might I ask for some explanation of the phenomena?

Hull, January 30. A. N. S.

"The Mammoth and the Flood."

MR. HOWORTH'S letter does little more than travel again over old ground, and two only of the points raised require any notice on my part; the third—the value to be attributed to the opinion of any particular geologist—being immaterial to the main question. As another President of the Geological Society has said: "Science needs no infallible Church, and admits of no Pope."

In regard to the localities in which mammoth remains have been found, I have not "resuscitated" any theory, but have taken my facts from Mr. Howorth's book. His second letter appears to me to ignore a distinction which I was careful to draw in my reply to his former one. That mammoth *bones* should be found at considerable distances from, and elevations above, the existing rivers, offers no difficulty. Indeed, they could not occur, except accidentally, in deltas which are now in course of formation. But, so far as I can ascertain, there is no reason why these "beds of clay and gravel" should not be deposits of rivers which drained the same regions under different climatal conditions, in the distant ages when the mammoth lived in Siberia. The case is precisely similar in England. We should not expect to find mammoth bones in the mud-flats about the mouths of our southern rivers, but in the old valley gravels which occur sometimes even 90 or 100 feet above the present level of the rivers. But the facts most difficult to explain are the occurrences of the *carcasses* of mammoths. It was of these, and of these only, that I was speaking in my letter, as I think would be clear to most readers. No geologist, so far as I know, would deny that the Siberian climate has considerably changed since the mammoth wandered over its tundras, and very likely not seldom got bogged; but the question is, Has it changed suddenly or gradually? The occurrence of the frozen carcass is undoubtedly most simply explained by postulating a sudden change; but when we begin to consider what this means, the remedy, though apparently so simple, seems as heroic as that of the father "who cut off his little boy's head to cure him of squinting." It is then for the best preserved of these frozen carcasses that I suggest the possibility of a drifting and a gradual entombment by the deposits of the ancient rivers. I have again consulted Mr. Howorth's book, and find, between pp. 82 and 89, notices of the discovery of at least ten mammoth carcasses, mostly occurring very far north in Siberia, and nearly all mentioned in connection with rivers: of one it is even said, "like most of the others, it is found on the bank of the river, which had been undermined by floods."

Mr. Howorth further asserts that I cannot have read his book because I charge him with invoking a series of catastrophes when he argues "in favour of one catastrophe only." But, notwithstanding his disclaimer, I would like to know how we are to bring about a deluge to drown the mammoth and a sudden permanent fall in temperature to freeze his carcass (query, one catastrophe, or two?) without "a series of catastrophes." I presume that, as this is a scientific question, we must not invoke a miracle. If continents gambolled like whales—which would be needed for Mr. Howorth's far-reaching flood—would this, unless there were a very special arrangement of continents, so materially alter the climate? and, if they did so disport themselves, what set them dancing? If a number of insular volcanoes exploded with twenty-Krakatão force, this would be a series of catastrophes, but it would probably leave the climate unchanged. If the earth's axis of rotation were suddenly altered materially in position—perhaps the simplest mode of bringing about the two results—would no catastrophic changes be needed to effect this alteration? Mr. Howorth's retort, in fact, indicates better than anything which I can write how completely he has failed to realize the conditions of the problem which he attempts to solve.

But enough. It is impossible for me to continue this correspondence. The reviewer's task is often not a very pleasant one, but a new terror would be added to the work if it involved an interminable controversy with authors on matters of opinion. Dreading this, I deliberately abstained from signing the review, because I knew from past experience that this was my only chance of escape from the flood of Mr. Howorth's controversial eloquence, which, like the proverbial river, *Labitur et labetur in omne volubilis ævum.* YOUR REVIEWER.

An Incorrect Footnote and its Consequences.

IN following up Baltzer's erroneous reference concerning the "Demonstratio eliminationis Cramerianæ," Mr. Muir, as described in his letter on p. 246, seems at first to have been singularly unlucky. For, on referring to the catalogue of Lord Crawford's mathematical library under "Mollweide," although the work itself was not immediately forthcoming, there was a cross-reference to "Prasse, M. von," under whose name the essay was duly catalogued. The Dun Echt copies, for there are two of them bound up in volumes of mathematical pamphlets, are copies of the original "Demonstratio," in 8 folios, with the pages 4 to 15 numbered, and the last blank. In a gap on the title-page of one copy has been written "auct. Mauricius de Prasse," apparently long ago, and in a German hand. But apart from this the last sentence of the first paragraph identifies the author as the writer of "Usus logarithmorum," which bears the same Latin form of the name in print.

The cross-reference is due to the presence in the library of a little book the title of which is worth giving in full, as it contains the names between which Baltzer's mistake arose, and it also gives the German form of von Prasse's name: it is "Logarithmische Tafeln für die Zahlen, Sinus und Tangenten, neu geordnet von Moritz von Prasse ehemals Prof. der Mathematik in Leipzig, revidirt und vermehrt von Karl Brandan Mollweide ordentl. Prof. der Mathematik in Leipzig. Leipzig,

1821," ix. + 110 pp. 16mo. In the preface Mollweide says that von Prasse was his predecessor in the Chair of Mathematics, as stated by Prof. Virchl. This work is entered under both the title-names in Poggendorff's "Biographisch-literarisches Handwörterbuch," a circumstance that might have given a clue to the authorship of the "Demonstratio." Strangely enough, this is not the only instance in which von Prasse omitted his name in essays written by him for academical celebrations. I can only surmise that this was done with a view to republication in his "Commentationes Mathematicæ," and that the name was written on the copies distributed as invitations to the celebrations. Whatever the reason, it has in this instance obviously added greatly to the trouble ordinarily experienced when dealing with this class of academical essay, the bibliography of which is so complicated, and at the same time often so important.

RALPH COPELAND.

Lord Crawford's Observatory, Dun Echt, January 25.

A New Historic Comet?

AT a recent meeting of the Asiatic Society of Japan, a paper was read by Mr. W. G. Aston, H.B.M. Consular Service. This paper will certainly rank high amongst historic papers relating to Japan and Korea. Briefly described, it is a comparison between the ancient records of these two countries and China, and its aim is to establish the relative credibility of these various records. Mr. Aston has so far confined his attention to the period preceding A.D. 500; and his general conclusion is that, as historic writings, the Korean and Chinese chronicles are far superior to the Japanese of the same date.

In the Tongkan, as the ancient records of the Korean kingdoms are called, there is a notice, of which the following is a translation: "Summer, fourth month, Pèkché; comet visible; day-time." The fourth month began on May 14 or 15. At the request of Mr. Aston, I tried to find out if any such comet had been observed elsewhere. The only list of historic comets obtainable in Japan was the list given in Faye's "Astronomy"; and I am not sure if this is meant to be complete. According to Mr. Aston, the Pèkché comet appeared in May or June, A.D. 302. The nearest date in Faye's list is A.D. 295. If this is the same comet, then one *at least* of the dates must be wrong. It is quite possible, however, that both are correct; in which case we shall be indebted to Mr. Aston for having added one more to our list of historic comets. In coming to a conclusion, we must know to what source we owe the knowledge of the 295 comet, and whether this source has greater claims to chronological accuracy than have the Korean records. Not having the references at hand for studying these points, I have written this note to NATURE, in the hope that someone interested in the matter may be able to come to a decision on this question of a possibly new historic comet.

CARGILL G. KNOTT.

Imperial University, Tokio, Japan, December 19, 1887.

"Is Hail so formed?"

UNDER the above heading in NATURE of January 26 (p. 295) there is a short paper by Cecil Carus-Wilson, in which the writer assumes that under certain conditions, drops of water, whilst falling from the upper branches of a tree, become converted into ice before reaching the ground, whilst other drops falling from the same tree, but at 10 feet less altitude, came to the ground in a fluid state. There is, I think, a simpler solution of this question than the one given. Suppose the following conditions—namely, a frost sufficiently severe as to lower the temperature of the leaves and branches of a tree to a few degrees below the freezing-point; after which a very gradual thaw comes on, accompanied by a fine rain or Scotch mist which freezes on the tree.

Where the leaves and smaller branches hang downwards, small beads of ice would form on their points. As the air became warmer the ice would thaw, and fall to the ground either in the liquid form, or the beads at the ends of the leaves and twigs would become detached in their solid state, and reach the ground as ice-pellets.

Sometimes these ice pellets extend in length, and assume the form of small icicles. J. RAE.

4 Addison Gardens, January 28.

MODERN VIEWS OF ELECTRICITY.[1]

PART III. (*continued*).

VII.

First Representation of the Field due to a Current.

RETURN now to the consideration of a simple circuit, or, say, a linear conductor, and start a current through it; how are we to picture the rise of the lines of force in the medium? how shall we represent the spread of magnetic induction? First think of the current as exciting the field (instead of the field as exciting the current, which may be the truer plan ultimately).

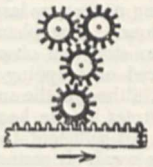

FIG. 34.

If we can think of electricity in the several molecules of the insulating medium connected like so many cog-wheels gearing into one another and also into those of the metal, it is easy to picture a sideways spread of rotation brought about by the current, just as a moving rack will rotate a set of pinions gearing into it and into each other (Fig. 34). But then half the wheels will be rotating one way and half the other way, which is not exactly right.

How is it possible for a set of parallel whirls to be all rotating in the same direction?

FIG. 35.

If there is any sort of connection between them they will stop each other, because they are moving in opposite directions at their nearest points; and yet, if there is no connection, how can the whirl spread through the field?

Well, return to the old models by which we endeavoured to explain electrostatics, and think whether they will help us if we proceed to superpose upon them a magnetic whirl in addition to the properties they already

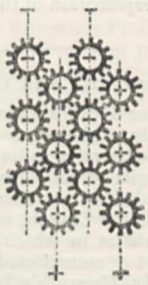

FIG. 36.—Rows of cells alternately positive and negative, geared together; free to turn about fixed axles.

possess. Looking at Figs. 5, 6, and 13, we remember we were led to picture atoms and electricity like beads threaded on a cord. And these cords had to represent, alternately, positive and negative electricity, which always got displaced in different directions.

We are forced to a similar sort of notion in respect of the wheels at present under discussion: in order that

[1] Continued from p. 323.

they may co-operate properly, they must represent positive and negative electricity alternately. If they *then* rotate alternately in opposite directions, all is well, and the electrical circulation or rotation in the field is all in one direction. Each wheel gears into and turns the next, and so the spin gets propagated right away through the medium, at a speed depending on the elasticity and density concerned in such disturbances.

It is not convenient at the present stage to ask the question whether the wheels represent atoms of matter or merely electricity. It may be that each atom is electrostatically charged and itself rotates, in which case it would carry its charge round with it, and thereby constitute the desired molecular current.

The apparent inertia of electricity would thus be explained simply enough, as really the inertia of the spinning atoms themselves; and the absence of any moment of momentum in an electro-magnet as tested mechanically would be equally explained by the simultaneous opposite rotation of adjacent atoms. A question may arise as to why the opposite molecules should have exactly equal opposite inertiæ, as they have, else a fluid magnetized medium would bodily rotate; and there may be other difficulties connected with a bodily rotation of electrostatically charged molecules: it is merely a possibility upon which stress must not be laid till it has been proved able to bear it. For our present purpose a spin of the electricity inside each atom, or even independently

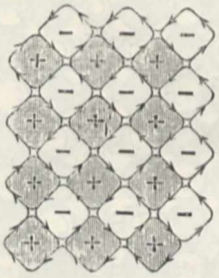

FIG. 37.—Portion of a magnetic field. Another mode of drawing Fig. 36.

of any atoms, is quite sufficient. Besides, since magnetic induction can spread through a vacuum quite easily, the wheel-work has to be largely independent of material atoms.

If any difficulty is felt concerning the void spaces in Fig. 36 it is only necessary to draw it like Fig. 37, which does every bit as well, and reduces the difficulty to any desired minimum.

Representation of an Electric Current.

Now notice that in a medium so constituted and magnetized—that is, with all the wheel-work revolving properly—there is nothing of the nature of an electric current proceeding in any direction whatever. For, at every point of contact of two wheels the positive and negative electricities are going at the same rate in the same direction; and this is no current at all. Only when positive is going one way and negative going the opposite way, or standing still, or at least going at a different rate, can there be any advance of electricity or anything of the nature of a current.

A current is nevertheless easily able to be represented: for it only needs the wheels to gear imperfectly and to work with slip. At any such slipping-place the positive is going faster than the negative, or *vice versâ*, and so there is a current there. A line of slip among the wheels corresponds therefore to a linear current; and, if one thinks of it, it is quite plain that such a line of slip must always have a closed contour. For, if only one wheel slip, then the circuit is limited to its circumference; if a row slip, then the direct and return circuit are on opposite sides of the row. But a large area of any shape with no slip inside it may be inclosed by a line of slip, and this gives us a circuit of any shape, but always closed. Understand: one is not here thinking of a current as analogous to a *locomotion* of the wheels—their axes may be quite stationary,—the slip contemplated is that of one *rim* on another.

Imagine all the wheels inside the empty contour of Fig. 38 to be rotating, the positive clockwise, the negative counter clockwise, and let all those outside the contour be either stationary or rotating at a different rate or in

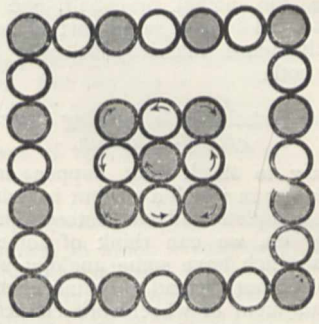

FIG. 38.—Diagram of a peripheral current partitioned off from surrounding medium by a perfect conductor, which transmits no motion, and therefore acts as a perfect magnetic screen.

an opposite direction; then the boundary of the inside region is a line of slip along which the positive rims are all travelling clockwise, and the negative rims the other way, and hence it represents a clockwise positive current.

But it may be said that the spin inside the contour, if maintained, must sooner or later rotate the wheels outside as fast as themselves, and then all slip will cease. Yes, that is so, unless there is a complete breach of connection at the contour, as in Fig. 38 there is. If the outer region has any sort of connection with the inner one the slip at its boundary can only be temporary, lasting during the era of acceleration.

Distinction between a Dielectric and a Metal, as affected by a spreading Magnetic Field.

In a dielectric the connection between the atoms is definite and perfect. If one rotates, the next must rotate too; there is no slip between the geared surfaces; it is a case of cogged wheels. A conduction-current is impossible.

But in a metallic conductor the gearing is imperfect; it is a case of friction-gearing with more or less lubrication and slip, so that turning one wheel only starts the next gradually—it may be very quickly, but not instantaneously—and there is a motion of a positive rim incompletely compensated by an equal similar motion of a negative rim while getting up speed; in other words, there is a momentary electric current, lasting till the wheels have fairly started.

In a perfect conductor the gearing is absent; the lubrication is so perfect that all the atoms are quite free of one another, and accordingly a spin ceases to be transmitted into such a medium at all. The only possible current in a perfect conductor is a skin-deep phenomenon.

A magnetized medium of whatever sort is thus to be regarded as full of spinning wheels, the positive rotating one way and the negative the other way. If the medium is not magnetized, but only magnetic—*i.e.* capable of being magnetized—it may be thought of either as having its wheels stationary, or as having them facing all ways at random; the latter being probably the truer, the former the easier, representation, at least to begin with.

Whether the medium be conducting or insulating makes no difference to the general fact of spinning wheels inside it wherever lines of force penetrate it; but the wheels of a conductor are imperfectly cogged together, and accordingly in the variable stages of a magnetic field, while its spin is either increasing or decreasing, there is a very important distinction to be drawn between insulating and conducting matter. During the accelerating era conducting matter is full of slip, and a certain time elapses before a steady state is reached. A certain time may be necessary for the propagation of spin in a dielectric, but it is excessively short, and the process is unaccompanied by slip, only by slight distortion and recovery. As for a strongly magnetic substance like iron, nickel, or cobalt, one must regard them as constituted in the same sort of way, but with wheels greatly more massive, or very much more numerous, or both.

Phenomena connected with a varying Current. Nature of Self-induction.

Proceed now to think what happens in the region round a conductor in which a current is rising. Without attempting a complete and satisfactory representation of what is going on, we can think of some mechanical arrangements which have some analogy with electrical processes, but do not pretend to imitate them exactly.

Take first a system of wheel-work connected together and moved at some point by a rack. Attend to alternate

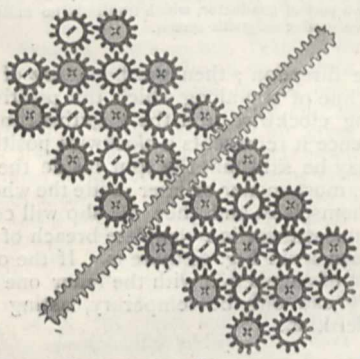

FIG. 39.—A provisional representation of a current surrounded by dielectric medium, either propelling or being propelled.

wheels more especially, as representing positive electricity. The intermediate negative wheels are necessary for the transmission of the motion, and they also serve to neutralize all systematic advance of positive electricity in any one direction, except where slip occurs, but they need not otherwise be specially attended to.

Remember that every wheel is endowed with inertia, like a fly-wheel.

Directly the rack begins to move, the wheels begin to rotate, and in a short time they will all be going full speed. Until they are so moving, the motion of the rack is opposed, not by friction or ordinary resistance, but by the inertia of the wheel-work.

This inertia represents what is called self-induction, and the result of it is what has been called the "extra current at make," or, more satisfactorily, the opposing E.M.F. of electro-magnetic inertia or self-induction.

So long as the rack moves steadily forward, the wheel-work has no further effect upon it; but directly it tries to stop, it finds itself unable to stop dead without great violence: its motion is prolonged for a short time by the inertia of the wheel-work, and we have what is known as the "extra current at break."

If the rack is for a moment taken to represent the advancing electricity in a copper wire, then the diagram may be regarded as a section of the complete field: the complete field being obtained from it by rotating it round the axis of the wire. Imagining this done, we see that the axis of each wheel becomes prolonged into a circular core, and each wheel into a circular vortex ring surrounding the rack and rolling down it as it moves forward, as when a stick is pushed through a tight-fitting umbrella-ring held stationary (see Fig. 30 B).

As one goes further and further from the rack the lengths of the vortex cores increase, but there is only a given amount of rotation to be shared among more and more stuff, hence it is not difficult to imagine the rate of spin diminishing as the distance increases, so that at a reasonable distance from the conductor the medium is scarcely disturbed.

To perceive how much rotation of the medium is associated with a given circuit, one must consider the shape of its contour—the position of the return current. Take first a long narrow loop and send a current up one side and down the other. The rotations belonging to each are superposed, and though they agree in direction for the space inclosed by the loop, they oppose each other outside, and so there is barely any disturbance of the medium outside such a looped conductor; very little dielectric is disturbed at all, and accordingly the inertia or self-induction is very small.

If the loop opens out so as to inclose an area, as the centrifugal force of the wheels will tend to make it do,

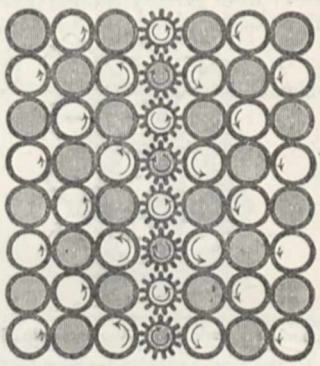

FIG. 40.—Diagram of a direct and return current close together, showing distribution of rotation and of slip in the thickness of the conductor, and in the dielectric between. The dielectric outside is very little disturbed.

then there is a greater amount of rotation, a greater moment of momentum inside it, and accordingly its self-induction is increased. The axis of every wheel is, however, continuous, and must return outside the loop: so the outside region is somewhat affected by rotation, but of a kind opposite to that inside.

Figs. 38 and 41 show the state of things for a closed circuit conveying a current. The free space in Fig. 38 represents a perfect conductor, or perfect breach of connection. Along one side of this space positive electricity is seen streaming in the direction of the arrows, and it may be streaming on the other side also, but nothing happens in its interior—which is therefore not represented.

The corresponding portion in Fig. 41 is intended for an ordinary conductor, full of wheels capable of slip. And slip in this case is a continuous necessity, for the rotation on either side of the conductor is in opposite directions, so the atoms of the conductor have to accommodate themselves as best they can to the conditions; some of them rotating one way, some the other, and some along a certain neutral line of the conductor being stationary. If a conductor is straight and infinitely long, the neutral line of no rotation is in the middle. If it be a loop, the neutral line is nearer the outside than the inside, because the rotation of the medium inside is the strongest. If the

loop be shut up to nothing, the neutral line is its outer boundary or nearly so (Fig. 40). If, again, the circuit is wound round and round a ring, as string might be lapped upon a common curtain-ring to cover it, then the axes of whirl are wholly inclosed by the wire, and there is no rotation outside at all.

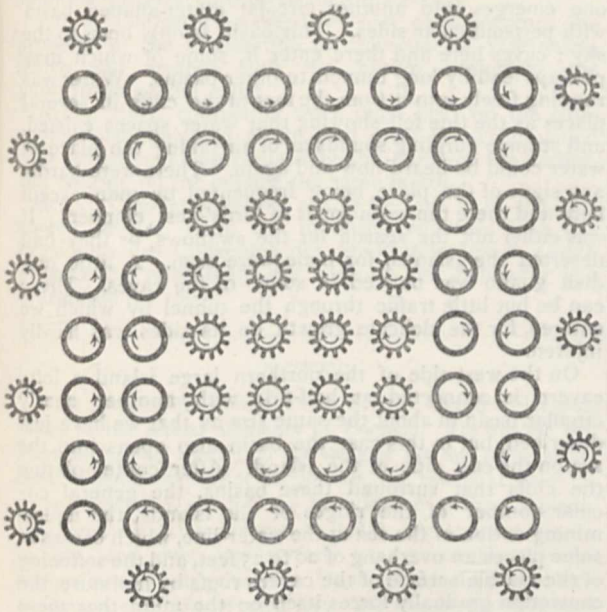

FIG. 41.—Diagram of simple conducting circuit like a galvanometer ring, with the alternate connecting-wheels omitted. The same number of dielectric wheels are drawn outside as inside, to indicate the fact that the total spin is equal inside and out, though the outside is so spread out as to be much less intense.

Fig. 42 shows a section of this last-mentioned condition, and here the wheels of the dielectric outside are not rotating at all. The inside is revolving, it may be furiously, and so between the inner and outer layers of the conductor we have a great amount of slip and dissipation of energy.

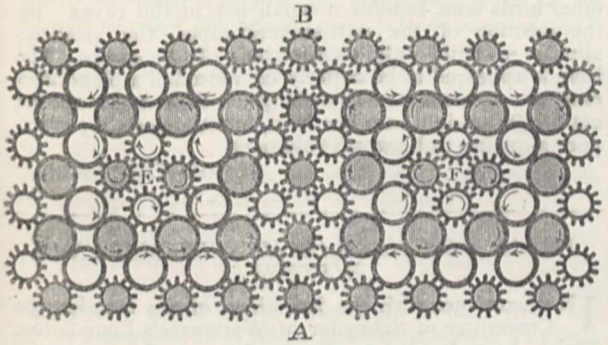

FIG. 42.—Section of a closed magnetic circuit, or electric vortex-ring, or hollow bent solenoid like Fig. 29, inclosing an anchor-ring air space; the axis of the ring being A B, the sections of the core being E and F. The arrows indicate the intensity of the spin, *i.e.* of the magnetic field, which is a maximum at the middle of each section and nothing at all outside. If the core contains iron instead of air, its wheels have to be from 100 to 300 times as massive: slipping wheels if solid iron, cogged wheels if a bundle of fine varnished iron wires.

The process of slip which we have depicted goes on in all conductors conveying a current, whether steady or variable, and in fact *is* the current. The slip is necessarily accompanied by dissipation of energy and production of heat: only in a perfect conductor can it occur without friction. In a steady current the slip is uniformly distributed throughout the section of the conductor; in the variable stages it is unequally distributed, being then more concentrated near the periphery of the wire.

When a current is started in a wire, the outer layers start first, and it gradually though very quickly penetrates to the axis. Hence the lag or self-induction of a wire upon itself is greater as the wire is thicker, and also as it is made of better conducting substance. If it is of iron, the mass or number of the wheels is so great that the lag is much increased, and the spin of its outer layers is great enough to produce the experimental effects discovered by Prof. Hughes.

One must never confuse the slip with the spin. Slip is current, spin is magnetism. There is no spin at the axis of a straight infinite wire conveying a current, and it increases in opposite directions as you recede from the axis either way; arranging itself in circular vortex cores round the axis. But the slip is uniformly distributed all through the wire as soon as the current has reached the steady state. The slip is wholly in the direction of the wire. The axes of spin are all at right angles to that direction.

Rise of Induced Current in a Secondary Circuit.

To study the way in which a magnetic field excited in any manner spreads itself into and through a conducting medium, look at Fig. 43, and suppose the region inside the contour A B C D to be an ordinary conducting region—that is, full of wheels imperfectly geared together, and capable of slip.

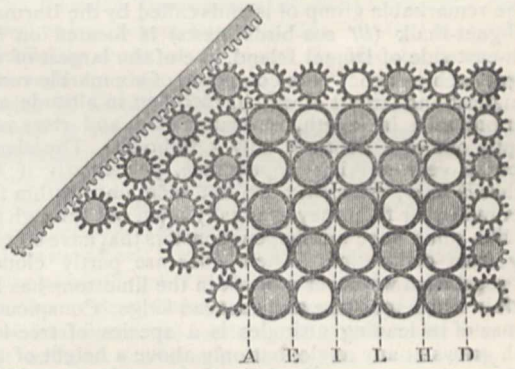

FIG. 43.—Diagram illustrating the way in which an induced current arise in a mass of metal immersed in an increasing magnetic field; also how it decays. The dotted lines A B C D, E F G H, I J K L, are successive lines of slip.

Directly the rack begins to move, all the wheels outside A B C D begin to rotate, and quickly get up full speed. The outer layer of wheels inside the contour likewise begins to rotate, but not at once; there is a slight delay in getting them into full motion. For the next inner layer the delay is rather greater, and so on. But ultimately the motion penetrates everywhere equally, and everything is in a steady state.

But while the process of starting the wheels was going on, a slip took place round the contour A B C D, and round every concentric contour inside it; the periphery of the positive wheels moving in a direction opposite to that of the wheel in contact with the rack, and so suggesting the opposite induced current excited at "make" in the substance of a conductor near a growing current, or generally in an increasing magnetic field.

The penetration of the motion deeper and deeper, and the gradual dying away of all slip, illustrate also the mode in which this induced current arises and gradually dies away, becoming *nil* as soon as the magnetic field (*i.e.* the rotation) has penetrated to the interior of all conductors and become permanently established there as elsewhere.

Suppose the motion of the rack now stopped: all the cogged wheels stop too, though it may be with a jerk and

some violence and oscillation due to their momentum; but those inside the contour A B C D will continue moving for a little longer. The outside layer of this region will slip in such direction as to illustrate the direct induced current at "break," and will begin to stop first; the slip and the stop gradually penetrating inwards, just as happened during the inverse process, until all trace of rotation ceases. This inverse slipping process is the direct induced current at "break."

Through a perfect conductor the disturbance could never pass, for the slip of the dielectric wheels on its outer skin would be perfect, and would never penetrate any deeper. A superficial current lasting for ever, or rather as long as the magnetic field (the rotation of the dielectric wheels) lasts, is all that would be excited, and it would be a perfect magnetic screen to any dielectric beyond and inclosed by it. OLIVER J. LODGE.

(*To be continued.*)

THE BIRDS'-NEST OR ELEPHANT ISLANDS OF THE MERGUI ARCHIPELAGO.

OF the geological structure of this group of islands lying off the coast of British Burmah not much is yet known. Our readers will probably be interested in the following account of a visit to one portion of the archipelago, furnished by Commander Carpenter, R.N., to the Hydrographer of the Admiralty, to whose kindness we are indebted for permission to publish it.

The remarkable group of islands called by the Burmans Ye-ei-gnet-thaik (*lit.* sea-birds' nests) is located on the south-east side of Domel Island, one of the largest of the Mergui Archipelago. It is composed of six marble rocks, the highest and largest of which, 1000 feet in altitude, and about one mile in length, is oval-shaped, and rises very abruptly out of a depth of only 5 fathoms. The islands present a very striking appearance, particularly if the weather is hazy, when they are not seen until within five or six miles, for then they gradually loom out through the mist like some huge misshapen monsters that have strayed away from civilization. Their sides are partly clothed with vegetation wherever a break in the limestone has left a cleft in which moisture and dust can lodge. Conspicuous because of its leaning attitudes is a species of tree-fern which grows at any angle, but only above a height of 200 feet from the water. The face of the rocks is reddish, partly from weathering and partly from soil, and where cliffs exist the most beautiful though uncouth stalactites have been formed, showing grotesque and snake-like patterns varying in hue and shape till one feels as if in some enchanted land. But the great feature of the group is the birds'-nest caverns, which as a rule open into the sea, the entrance being below high-water mark; fortunately I visited them at spring tides, and had plenty of leisure to examine each cavern at low water during two days.

At the south end of the largest island stands a "ninepin" of gray marble 370 feet high, almost separated from the rest. It is hollow, like a huge extinguisher, and the polished light-blue and yellow sides of the interior seem to point to its having been hollowed by the swell of the sea, which on entering the cave would probably expend its force vertically, the mouth of the cave being open to the direction of the strongest seas. This sea-stack forms the western point of a nearly circular cove, 360 yards in diameter, which runs back into the island, and the sides of the cove rise steeply though not perpendicularly from it. At the head of the cove is a perpendicular wall of rock over which can just be seen the 1000-foot summit in the distance.

At half-tide a tunnel, passable for a canoe, opens under the wall of rock at the head of the cove, but a ship's gig can only enter within an hour of low-water spring tides. This tunnel has a roof covered with large stalactitic knobs except at its narrowest part, where it is apparently scoured smooth by the action of the tidal rush. It is about 250 feet long, and 4 feet deep at low water (the rise and fall of the tide being 16 feet), and is covered with dripping marine life, corallines, small corals, Comatulæ, sponges, and sea-horses. Passing through this submarine passage one emerges into another circular crater-shaped basin with perpendicular sides. This basin is only open to the sky; caves here and there enter it, some of which may perhaps lead by long tunnels to other basins. Water was running freely into it from the foot of the cliffs in several places as the tide fell, showing that water spaces existed, and strange gurgling sounds as of air taking the place of water could be heard now and again. There were hardly any signs of the place being frequented by man except here and there the worn ropes of birds'-nest climbers. It was either not the season for the swallows, or they had deserted the islands, for none were seen. A little reddish guano was noticed in some of the caves. There can be but little traffic through the tunnel by which we entered, for the delicate growth on its sides was hardly injured.

On the west side of the northern large island a lofty cavern is connected at half-tide with another nearly circular basin of about the same size as that we have just described, but in this case the basin also opens into the sea on the east side of the island. After contemplating the cliffs that surround these basins, the general circular contour of the ridges of the islands, the undermining action of the sea at the water-line, which causes in some places an overhang of 20 to 25 feet, and the softening of the marble surface of the cavern roofs by moisture, the conviction gradually forces itself on the mind that these circular basins were themselves at one time the floors of huge caverns; that in days gone by the islands rose far higher, with cavern piled on cavern, and that the work of disintegration by solution and wave-action is slowly going on, pulling down these marble monuments of a giant age. Indeed, here and there a fall of blocks has occurred lately, and, as there is no shoal off the base of the slip, the destructive action is probably rapid.

A small oyster covers the rocks at the water-line. A handsome kingfisher was secured and sent to the British Museum. A few doves and an eagle or two were the only other birds seen, besides a small bat in the caves. By the position of the nest-seekers' ropes, the swallows appear to build only on the roofs of the caves. The islands appeared to be entirely composed of a blue-tinted marble. A vessel could lie alongside them and lower the cut blocks straight into her hold, but it is probably of too poor a quality to be worth shipment.

ALFRED CARPENTER.

PRIZE FOR RESEARCHES IN NATURAL HISTORY.

IN accordance with the intentions of the founder, the Committee of Schnyder of Wartensee's Foundation, Zürich, have decided to offer for the year 1890 a prize for the following researches in natural history:—

"New investigations are desired regarding the relation which the formation of the bones bears to the statics and mechanics of the vertebrate skeleton. The results of the investigations as a whole are to be demonstrated in detail by way of example on the skeleton of a definite species."

The conditions are as follow:—

Art. 1. Competitors for the prize must send in their work in German, French, or English, by September 30, 1890, at the latest, to the address given below in Art. 6.

Art. 2. The award will be made by a Committee consisting of the following gentlemen:—Prof. Hermann von

Meyer, Zürich; Prof. L. Rütimeyer, Basle; Prof. H. Strasser, Berne; Prof. Otto Mohr, Dresden; and Prof. Albert Heim, of Zürich, representing the Committee offering the prize.

Art. 3. The judges are authorized to award a first prize of two thousand francs; and a further sum of one thousand francs is placed at their disposal for distribution in minor prizes according to their discretion.

Art. 4. The work awarded the first prize becomes the property of the Foundation of Schnyder of Wartensee, which will arrange with the author regarding the publication of the same.

Art. 5. Each competing work must bear on the title-page a distinguishing motto, and must be accompanied by a sealed envelope containing the name of the author, and bearing on the outside the same motto.

Art. 6. Competing works are to be sent in by the date named in Art. 1, to the following address: "An das Präsidium des Conventes der Stadtbibliothek in Zürich (betreffend Preisaufgabe der Stiftung von Schnyder von Wartensee für 1890)."

NOTES.

THE death of Sir Henry Maine, F.R.S., has created a great blank in the serious literature of England. He was the first Englishman who applied to the study of law and early institutions the rigid methods of science, and the results at which he arrived marked an epoch in the investigation of these subjects. His literary style, combining as it did extraordinary vigour, lucidity, and grace, was scarcely less remarkable than his grasp of far-reaching principles. He died suddenly, of apoplexy, at Cannes, on Friday evening last. He was in his sixty-sixth year.

IN a letter received from Mr. John Whitehead, dated Labuan December 13, 1887, that gentleman writes:—"To-day or to morrow I start for Kina Balu, and I hope to make this a famous and last expedition into Borneo, for I really am in wonderful health considering everything, but at the same time I am rather tired of Borneo, with its fevers, heat, and mosquitoes. I hope to be back in England in August and September. I do not like to brag of what I hope to do, as things are so uncertain. Natives may refuse to help me, and may perhaps attack me, for the country round this fine mouutain is by no means settled." On the last occasion of his visiting Kina Balu a year ago, Mr. Whitehead was only able to remain a month upon the mountain, but he discovered nineteen new species of birds in that short time, some of them being really wonderful novelties. He now hopes to remain for at least six months, and this he will doubtless be able to do, if he can secure supplies for his hunters, and keep open his communication with Labuan.

MR. WHITEHEAD'S collections from the island of Palawan have now arrived in this country, and a brief account of them will appear in the April number of the *Ibis*. This island has already been visited by Prof. Steere, Mr. Alfred Everett, and Mr. E. Lemprière, all of whom made collections in the neighbourhood of Puerto Princesa. Mr. Whitehead's labours were also confined to the vicinity of this post, as he was prevented from visiting the interior. He has succeeded, however, in procuring specimens of every species met with by the three travellers above-mentioned, and has besides obtained about sixty additional species, several being new to science.

THE Council of the Royal Meteorological Society have arranged to hold, at 25 Great George Street, Westminster, on March 20–23 next, an Exhibition of Apparatus connected with Atmospheric Electricity, including lightning-conductors, photographs of lightning, and damaged objects. The Committee will also be glad to show any new meteorological instruments or apparatus invented or first constructed since last March; as well as photographs and drawings possessing meteorological interest.

A FRIENDLY meeting of employers and working men, to discuss the best means of obtaining technical education, will be held at the Royal Victoria Hall, Waterloo Bridge Road, on Wednesday, February 15, at eight o'clock. The chair will be taken by Sir Douglas Galton. This meeting has been arranged in consequence of the great interest shown in a similar meeting held at the same place on December 14. The speakers will be limited to ten minutes, and those who wish to speak must send in their names the day before the meeting.

THE new American Folk-Lore Society was definitely organized at a meeting held at Harvard College on January 4. The object of the Society is the study of folk-lore in general, and especially of folk-lore in North America. The first President is Prof. F. J. Child, of Harvard, and the acting Secretary is Mr. W. W. Newell, of Cambridge, Mass. It is expected that the first number of the Society's journal will be published in April.

THE Duchess of Albany has become Patroness of the Parkes Museum, of which the Duke of Albany was President until his death.

DURING the coming spring the construction of the North Sea and Baltic Canal will be begun along the whole line. There will be seven camps of workmen, and 4000 men employed.

THE Education Department of Scotland has issued a circular to the various School Boards in that country, in which are embodied the results of the careful inquiries that have recently been made into the existing system of elementary scientific teaching in Scottish schools. Technical instruction is discouraged in primary schools till the boys have reached the higher standards, and even then, the Department thinks, no attempt should be made unless skilled teachers and abundance of scientific apparatus are available. In most instances the thorough teaching of elementary science is beyond the reach of the primary schools; but by various School Boards uniting to employ a trained staff of teachers much of the difficulty will be overcome. School Boards are also recommended to seek the aid of local committees consisting of manufacturers who know what technical education is most needed in the district. The Department also recommends the extension of the system of giving evening lectures, which have been so successful in the past, and the charging of fees low enough to be within the reach of all. Nothing would tend to make technical education more popular than a small rate of charge, combined, as it should always be, with trained help and an abundant supply of scientific instruments.

A STRIKING new experiment, exhibiting the terribly explosive nature of chloride of nitrogen, is described by Prof. Victor Meyer in the current number of the *Berichte*. A few drops of the yellow chloride were prepared in the usual manner by inverting an exceptionally thin flask filled with chlorine gas in a leaden dish containing a solution of ammonium chloride. Instead, however of gently agitating the apparatus so as to cause the drops to fall into a smaller leaden capsule placed beneath the mouth of the flask, they were allowed to float freely upon the surface. The whole apparatus was then inclosed in a cover-box fitted with stout plate-glass sides, through the top of which was passed a bent pipette, turning up below just under the mouth of the flask and connected outside with a dropping funnel containing chloride of ammonium solution and a few drops of turpentine. When sufficient chloride of nitrogen had collected, the tap of the funnel was carefully turned so as to allow a little turpentine to slowly rise in the flask. After a moment or two it reached the surface and mingled with the chloride of nitrogen, causing a brilliant

flash of light and a loud explosion, which Prof. Meyer likens to a thunder-clap, so much more powerful is the detonation in a confined space. The flask of course was shattered, not into powder, but into tolerably large fragments; the plate-glass box, however, even after many repetitions of the experiment, remained intact, a small door on the side away from the observers having been left ajar so as to prevent any notable increase of pressure. Curiously, the chloride of nitrogen never entirely exploded; a part remained in the distorted leaden dish and maintained an incessant fusillade for more than a minute.

At the last meeting of the Göttingen Chemical Society, Dr. Gattermann read a preliminary note upon his recent researches as to the nature of chloride of nitrogen. From his analyses it appears pretty clear that the yellow liquid is a mixture of at least two distinct chlorides, which he has hopes of being able to separate. During the course of the experiments the reason of its capricious behaviour, the cause of so many painful accidents in the past, was happily discovered. It is decomposed by the actinic rays of light, being rapidly acted upon by sunlight with periodic spontaneous explosion, and is at once fired by exposure to the rays of burning magnesium. Hence further light upon this difficult and dangerous subject can only emanate from the dark room, a paradox the truth of which Dr. Gattermann is endeavouring to demonstrate.

On the morning of Tuesday, January 31, a distinct shock of earthquake is said to have been felt near Birmingham. In and around Coventry, too, several persons say that they experienced sensible vibrations of their houses and heard rumbling noises. At Hartshill the ceiling of a house was cracked by the shock. On Thursday, February 2, a sharp shock of earthquake was felt over a large part of Scotland. The following details regarding this shock are taken from the *Times* of Friday, February 3:—"The shock was distinctly felt at a quarter past 5 o'clock in Perth. The tremor lasted about one minute, and consisted of five or six slight, wave-like motions from west to east. In the Breadalbane and Grantully districts of Perthshire the shock lasted six seconds. It was also felt very distinctly in Aberfeldy, Acharn, Kenmare, and Strathay. It is twenty years since these districts were similarly affected. In Strathearn two shocks were felt, the first about half past 3 o'clock, and the second about 5 o'clock. Further north, in Inverness-shire and Ross-shire, a shock was felt about 5. It was sharper and seemed to travel from south-west to south-east. The tremor in Dingwall is likened to the vibration caused by a heavy waggon passing along a road, while at Crieff it was like a very heavy body thrown to the ground. In Beauly and Strathglass people were greatly alarmed. Their houses shook, dishes fell, furniture was broken, and numbers of people rushed from their beds and out of houses without dressing. On the west coast the shock was very violent. It was also felt at Mull. From Fort William it is reported that there was a slight shock at 5 a.m., which affected the old Caledonian valley, and extended down to the line of the Moray Firth."

The February Bulletin of Miscellaneous Information, issued from the Royal Gardens, Kew, contains a list of such hardy herbaceous annual and perennial plants as have matured seeds under cultivation in the Kew Gardens during the year 1887. "These seeds," it is explained, "are available for exchange with colonial, Indian, and foreign botanic gardens, as well as with regular correspondents of Kew. But the seeds are for the most part only available in moderate quantity, and are not sold to the general public. In the years 1885 and 1886 the list was printed as an independent publication. It has now been thought more convenient to issue it as a number of the Bulletin. Every effort is made to correctly determine the nomenclature of the plants in the list. As far as it goes, it will serve as a record of the herbaceous species cultivated at Kew. It must, however, be remembered that a considerable proportion of herbaceous plants do not mature seeds in the climate of England, and these are necessarily not included in the list."

Much inconvenience is caused by the fact that lists of recent additions to public libraries are not always readily accessible to persons who would like to make use of them. Readers at the Darwen Free Public Library may congratulate themselves that in their case this difficulty has been overcome. The other day the *Darwen News* printed the first instalment of a list of books which have been lately added to the collection belonging to that institution, and which are not to be found in the catalogue. Two similar instalments will follow, and afterwards lists will be given as books are purchased. If readers will take the trouble to cut out these lists and place them at the end of their copies of the catalogue, they will know exactly what works have been secured for the library. From the instalment just issued, it is obvious that the managers of the Darwen Free Public Library exercise great discretion in their choice of books, and we are glad to see that among the works selected by them science is very fairly represented.

Several correspondents have written to us about Mr. John Morison's letter, printed last week (p. 321), on what he supposed to be a case of untimely insect development. Mr. Edward Buckell, of Romsey, writes:—"Surely Mr. Morison has overlooked the fact that *Vanessa urticæ* hibernates in the imago state, selecting for that purpose houses and such other warm quarters as it can find. I have counted nine in one house. During hibernation the insect is naturally in a semi-torpid condition. As to the 'abnormal appearance' of the antennæ, I think that if Mr. Morison observes other specimens, both during the winter months and after sundown in the summer, he will find the position noted by him to be the usual one."

We referred last week (p. 328) to M. Lancaster's work on the climate of Belgium in 1887; we are also indebted to him for an elaborate discussion of the barometer observations taken at Brussels Observatory during the fifty years 1833–82. That Observatory owes its origin to the efforts of the late L. A. J. Quetelet, President of the International Maritime Conference held at Brussels in 1853, to which Conference our own Meteorological Office owes its origin. The Annals of the Observatory contain one of the most complete series of climatological and phenological observations extant. The barometrical results, which M. Lancaster has carefully resumed, are drawn from the eye observations taken up to June 1841, and since that time from self-recording instruments, one of which is a photographic barograph of the Kew pattern. In addition to the usual monthly and annual means, the tables contain summaries of the days on which the barometer was above or below certain values, the epochs of all remarkable falls and rises, five-day and seasonal means. The mean for the whole period was 29·766 inches (not reduced to sea-level); the greatest height was 30·753 inches on January 17, 1882; and the lowest, 28·367 inches, on December 10, 1872. The mean diurnal range for the year was 0·023 inch. The diurnal and monthly variations are greatest in winter and least in summer; the highest and lowest absolute readings occur generally in the month of January.

Mr. R. H. Scott delivered a lecture on British and Atlantic weather, at the London Institution, on the 2nd instant. After some interesting remarks on the effect of difference of height upon vapour, the dependence of our weather on the upward or downward movement of the atmosphere in cyclonic and anti-cyclonic systems, and on the cause of fogs, he discussed the utility of the present American reports in forestalling storms, based on a consideration of their movements as shown by the Atlantic Weather Charts lately published by the Meteorological

Council. These charts showed that only a small proportion of storms travelled across the Atlantic. The track of the depressions is determined by the distribution of pressure over the ocean, and of this distribution we are ignorant at the time of despatch of telegrams from America. The lecturer stated that in their present incomplete form the telegrams were of no assistance to the Meteorological Office in issuing storm warnings.

DR. BILLWILLER reports the establishment of a permanent observatory on the summit of the Santis, in October last. This observatory ranks as the third in height in Europe, being at an elevation of 8200 feet, and 108 feet higher than the temporary station at the Gasthaus, on the Santis, where the observations have been taken for the last five years. The results of these observations are published in a *Neujahrsblatt*, by the scientific Society of Zürich. The lowest temperature during the five years was −9° F. on March 13, 1883, and the highest, 69°, on July 21, 1886. The prevalent winds were westerly and south-westerly, which usually occur on high mountains in these atitudes.

ACCORDING to the last annual report on the Dutch East, Indies, rainfall was measured at 183 stations in these possessions. The military portion of the report, the topographical survey of Java, on a scale of 1 : 200,000, is completed, and the members of the Survey have been sent to the west coast of Borneo, where a preliminary survey to join certain points already astronomically determined has been undertaken. The survey on the west coast of Sumatra will also be continued. A considerable part has already been triangulated, and 344 positions have been determined. The definitive calculation of the triangulation work of Java, on which Prof. Oudemans, of Utrecht, has been at work for five years, is not yet completed.

RECENT Java journals give particulars of a remedy for coffee-leaf disease, discovered by Dr. Burck, manager of the Government Botanic Gardens at Buitenzorg, near Batavia. The specific is said not only to cure the disease, but also to prevent its recurrence. For preventive purposes, he makes use of a highly attenuated solution of chloride of iron applied to the under portion of the leaves by means of a pulverisator. The sticky nature of the solution enables it to adhere two months to the coffee-leaves. It is a powerful antidote to the *Hemileia vastatrix*. To stay the progress of the latter when it has once taken hold, a different method is employed. The coffee-leaves in which the *Hemileia* first manifests itself in the form of orange-coloured spots are at once taken in hand. Holes are pricked in the spots with a needle dipped in a strong solution of sulphuric acid, which kills all the germs of the disease in the leaf. Dr. Burck estimates the cost of the preventive specific at 2½ guilders per 133 lbs., and the healing remedy at 4 guilders. He anticipates that the price of coffee will be enhanced in consequence. The second specific in particular is said to have yielded good results and to be easy to administer. The economic value for Java of the discovery of the remedies, should they prove successful, can scarcely be over-estimated. In Ceylon the disease in the coffee-plant produced a revolution in planting; year after year the coffee crops were failures, many planters were ruined, and ultimately tea-growing took the place of coffee with results which are just now astonishing the world. But the period of transition from one staple to the other was one of economic disaster, from which perhaps Dr. Burck has saved Java.

WE have received the recent issues of the *Journal of the Asiatic Society of Bengal*. Vol. lv. Part 2, No. 5, is wholly occupied by the second instalment (Rhopalocera) of the Lepidopterous insects collected in Tavoy and Siam during 1884-85, under the superintendence of Mr. Pitman, the Chief Superintendent of Telegraphs. Of this list nearly 100 species are quite new. The list is drawn up by Messrs. Elwes and L. de Nicéville. Vol. lvi. Part 2, has numerous and varied contributions. The first paper is by Mr. Blanford, on the influence of Indian forests on the rainfall. The other papers are: the changes in the density of sea-water, by S. R. Elson; notes on Indian Rhynchota, Heteroptera, Part 1, by E. T. Atkinson; new species of Ficus from New Guinea and Sumatra, by G. King, where eleven new species are spoken about; the mammals and birds collected by Captain Yate with the Afghan Boundary Commission, each species briefly described and commented on by J. Scully; the species of Loranthus indigenous to Perak, by G. King; Étude sur les Arachnides de l'Asie meridionale, by M. Eug. Simon; the differential equation of a trajectory, by H. Mukhopadhyay.

THE current number of the *Folk-Lore Journal* (vol. vi. part i.) contains a most interesting collection of Aino tales and legends, made by Prof. Chamberlain, the well-known Japanese scholar. We are glad to see that he was encouraged to publish the collection by certain observations contained in a review, in these columns, of his recent monograph on the Ainos. The collection consists of fifty-four tales (a few being omitted as unfit for general publication), classified under the headings—tales accounting for the origin of phenomena, moral tales, tales of the Panaumbe and Penaumbe cycle, miscellaneous tales, and, finally, scraps of folk-lore. These were all taken down from the mouths of Ainos. The other papers in the number include a continuation of one on Irish folk-lore collected from a "Statistical Account or Parochial Survey" of that country published more than seventy years ago; and a collection of the traditions of a race as curious in its way as the Ainos, the Mentra, or aborigines of Malacca and the adjoining States.

THE January number of the *Auk* announces that the affairs of the American Ornithologists' Union have considerably brightened, and that by the public spirit of some of its members the Association begins the new year free from debt. The new part also strikes us as full of vigour, and of more than ordinary interest, and it is evident that the recent exertions of the Americans in getting collections from little-known parts of the Western world, such as Texas and Northern Mexico, are being amply rewarded. The reviews are as good as ever, and some of the original papers are excellent. Mr. Sennett describes a new finch from Arizona, and gives an account of the North American species of *Peucæa*, but not one word is said respecting the "Biologia Centrali-Americana" of Messrs. Salvin and Godman, where all Mr. Sennett's facts were duly set forth a year ago. The new Arizona finch, *Peucæa ruficeps scotti*, of Mr. Sennett, was also described some months ago by Mr. Bowdler Sharpe as *Peucæa homochlamys* in the twelfth volume of the "Catalogue of Birds," but as this work has only just appeared, Mr. Sennett's name secures priority of publication. Mr. Brewster's new species from Mexico seem to rest on somewhat trivial characters, at least in the case of the small owls (*Scops*) and the *Aimophilæ*.

AMONGST the subjects of special interest referred to in the report of the Smithsonian Institution for the past year is the exploration for a collection of skeletons and skins of the now almost extinct American bison or buffalo. The exploraton was very successful, a small herd being found in a wild part of Montana, from which the officers of the Institution secured a series of skins, as well as sixteen complete skeletons, and fifty-one dry skulls. The herd appears to have been completely exterminated by the settlers soon afterwards. An expedition was also despatched to the Swan Islands in the Caribbean Sea, which are said to abound in land birds in great variety, and also in large iguanas and other reptiles. The National Museum

collections are extending so rapidly that the provision of additional and adequate space for their exhibition is becoming a matter of pressing importance. In 1884 the number of specimens was estimated at 1,471,000; the number is now increased by more than a million. At the beginning of the present decade there was only one curator with a few assistants; now there are thirty-one regularly organized departments and sections, under the care of twenty-six curators and numerous assistants. The work of the Ethnological Bureau in all its branches—mound explorations, general field studies, and office work—appears to proceed as vigorously as in previous years. The most important forthcoming work of the Bureau appears to be a report by Mr. E. W. Nelson, on the Eskimo of Northern Alaska. During 1886 the vocabularies of twelve Eskimo dialects were arranged in the form of a dictionary, which will form one part of his report; the other will contain chapters on Eskimo life and customs in Alaska, illustrated by photographs taken on the spot.

AN elaborate review of the mineral industries of the United States during the year 1886 has just been issued by the United States Geological Survey. It is the fourth of a series of volumes entitled "Mineral Resources of the United States." The first three volumes contain the statistics from 1882 to December 31, 1885.

THE U.S. Bureau of Education has issued the first of what promises to be a most interesting series of "Circulars of Information." The present Circular is by Dr. H. B. Adams, who has chosen as his subject the College of William and Mary. This College was founded in 1693 by Royal grant, and was long supported by popular legislation in Virginia. The greater part of its property was destroyed during the Civil War, and since that time the institution has been allowed to decline almost to ruin. Dr. Adams' aim, as explained in a prefatory letter, has been to discover the historical beginnings of the higher education in the South; to trace the causes of the early prosperity of William and Mary College; to show its influence upon Virginia statesmen and the Southern States, its relation to the University ideas of Jefferson and Washington, and its significance to the whole country; to point out the causes of the decline of William and Mary College; to explain the rise of the University of Virginia, and the necessity of popular support for the higher education.

POPULAR editions of the late Dr. Parkin's volumes—"Are Epidemics Contagious?" and "The Volcanic Origin of Epidemics" (Sampson Low)—have been published. Dr. Parkin died nearly two years ago at the age of eighty-five, and it is explained in an editorial note that "his long and strenuous life had been devoted to the study of cholera and similar epidemics." His attention was first specially directed to the subject of cholera more than fifty years ago, when he was visiting India and China. A prolonged series of observations and experiments satisfied him that "the cause of the disease was atmospheric, and that carbonic acid gas was its antidote." The editor of these volumes admits that Dr. Parkin's theories have met with comparatively limited acceptance in England. This fact he attributes in part to the comparative mildness of cholera outbreaks in England, in part to "an erroneous notion that the results of Dr. Parkin's teaching were hostile to sanitation."

MESSRS. LONGMANS have just issued the ninth edition of Mr. William Jago's "Inorganic Chemistry, Theoretical and Practical." In this edition the paragraphs are numbered, and have side-headings. The more important statements and definitions are printed in bolder type. A number of students and teachers have pointed out to Mr. Jago that they have been using his book in preparing for the Matriculation Examination of the London University, and have been inconvenienced by its not covering the whole syllabus of that examination. Chapters have now been added to supply this want.

AT the last meeting of the Society of Science of Christiania Prof. Schöyen exhibited and described four species of Lepidoptera new to the Norwegian fauna; viz. *Agrotis præcox*, L., found as larva in the Hval Islands, in the Christiania Fjord; *Asopia glaucinalis*, L., produced from larva at Christiania; *Tortrix inopiana*, Haw., from southern Aurdal; and *Cerestoma nemorella* from Christiansand. At the same meeting Prof. Blytt read a paper on the alterations of the so-called "Strandlinjer," or shore-lines, in Norway, maintaining that the changes in the division of land and sea might have been caused by an alteration in the length of day and night.

A RESIDENT in the isolated little island of Bornholm, in the Baltic, writes to a Danish journal that a curious Christmas custom is observed in that island. When the so-called "Christmas table" has been spread on Christmas Eve, a large long loaf of rye bread is laid at the upper end of it. In this loaf, before it is baked, two transverse grooves are made about 3 inches from each end. On the top of the loaf a large cheese and various articles of food are laid. This is the so-called "*Julegalt*." It remains untouched throughout Christmas, and when the table is not in use, the cloth is gathered from the other end and laid over the "*galt*." This curious custom is believed to have been handed down from Pagan times, the *galt* (pig) having reference to Freÿ's *galt* or pig "Gyldenbörste" ("Gold bristle"). Freÿ was the god of rain, sunshine, harvest, and general felicity.

THE acclimatization of the so-called "American" trout in Norwegian waters has been very successful. Attempts are now about to be made to acclimatize black bass obtained from America.

THE Danish Government has decided upon forming an oyster bank in the Limfjord, in Jutland, and has despatched the inspector of the Danish fisheries to Norway to obtain all possible information respecting the artificial banks formed in that country during the last few years.

THE manner in which the spruce and pine forests of Norway are being exterminated, is becoming so serious that the Government is called upon to put a stop, by legislation, to the deforestation of the country. At present there is no law to prevent the purchaser of a forest from felling everything, even down to the tiniest saplings. It is urged by forest officials that trees under a certain diameter should not be permitted to be cut, and that the branches of the trees should not be left in the forest (as is now nearly always done), because they stifle the growth of the young trees. Apart from the wanton exhaustion of this commercial wealth, it is maintained that wholesale felling has the effect of changing the climate in the forest localities.

THE strict preservation of the eider fowl on the south-east coast of Sweden during recent years has had the effect of greatly augmenting the number of these valuable birds. The penalty for killing one is very heavy, and informers receive a considerable reward.

DURING the present winter term there are 26,945 German students at the German Universities. Of this number 5791 study theology, 5769 law, 6650 medicine, and 8735 belong to the Philosophical Faculty. 1644 students are foreign. The Vienna University has 238 theologians, 2569 law students, 1565 medical students, and 634 of the Philosophical Faculty. In Graz there are 1305 students, and in Innsbruck 863. Prague has 3805. Cracow 1234, Lemberg 1112, and Czernowitz 259. At Berne University there are 637 students, 51 theologians, 158 law students, 287 medical students, and 141 physical science students. At Zürich there are 70 female students, 40 being medical.

THE *Bulletin Pharmaceutique* states that a new remedy for Phylloxera has been discovered by M. Laffon, of Capendu, and it has proved successful. It consists of a weak solution of nitrate of mercury.

THE additions to the Zoological Society's Gardens during the past week include a Red-winged Parrakeet (*Aprosmictus erythropterus*); eight Peaceful Doves (*Geopelia tranquilla*) from Australia, presented by the Hon. Stormont Finch-Hatton; a Fulmar Petrel (*Fulmarus glacialis*) from Norfolk, presented by Mr. H. M. Upcher, F.Z.S.; a Jardine's Parrot (*Peocephalus gulielmi*) from West Africa, received in exchange.

OUR ASTRONOMICAL COLUMN.

THE ROYAL ASTRONOMICAL SOCIETY'S MEMOIRS.—The first part of vol. xlix. of the Memoirs of the Royal Astronomical Society has just been published, and contains a new General Catalogue of nebulæ, by Dr. J. L. E. Dreyer. Sir John Herschel's General Catalogue, published in the Philosophical Transactions for 1864, was almost entirely founded upon his own and his father's observations, and hence, since several observers have devoted themselves to the work of searching for nebulæ since that catalogue was prepared, the number known to us has been very largely increased. D'Arrest's great work on nebulæ, which appeared three years later than the General Catalogue, gave the means of correcting many of its positions, and hence Dr. Dreyer had been induced as early as 1876 to compile a supplement to the General Catalogue, which he published in the Transactions of the Royal Irish Academy in 1878 (vol. xxvi.), containing a list of corrections to it, and a catalogue of recently-discovered nebulæ. In 1886, Dr. Dreyer presented a second similar supplement—in which the later discoveries of Messrs. Stephan, Swift, Ormond Stone, and other observers had been incorporated—to the Council of the Royal Astronomical Society; but the Council, considering that the General Catalogue was practically out of print, and that the use of three catalogues and two lists of corrections would be very inconvenient, proposed to Dr. Dreyer that he should prepare from the whole of his materials a single new General Catalogue. This work he has now carried out, and the present catalogue contains 7840 objects, the positions of which have been as thoroughly corrected and revised as the materials available permitted. The epoch of the first General Catalogue, and of D'Arrest's final positions—1860—has been retained, as it is close to the epochs of the great star-charts of Argelander, Schönfeld, Chacornac, and Peters, and nearly all the modern micrometric observations of nebulæ are referred to an epoch but little later. The precessions have been given for 1880, as done by Sir John Herschel, and the descriptions have been carefully revised. The work also contains an index to published figures of nebulæ and clusters, and an appendix giving the places of several new nebulæ discovered by Prof. Safford and Mr. Swift, but published too late to be incorporated in the catalogue itself. These are added that the volume may contain a complete record of all nebulæ of which the places have been published up to December 1887.

PUBLICATIONS OF DUNSINK OBSERVATORY.—The sixth part of the observations of the Observatory of Trinity College, Dublin, at Dunsink, has just been published, and contains the separate results reduced to 1885·0, and the mean places for 1012 southern stars observed with the transit circle by Dr. Dreyer, the late, and Mr. Rambaut, the present, Assistant Astronomers. These stars are nearly all in the Southern Durchmusterung Belt, between S. Decl. 2° and 23°, and were suggested for observation by Prof. Schönfeld on account either of their proper motion or of discordances between their places as given in different catalogues. A few other stars were observed either at the request of Prof. Peters or Dr. Auwers. The work had been commenced by Dr. Dreyer in September 1881, who continued it until his appointment to the Armagh Observatory in May 1882, and Mr. Rambaut took it up, on succeeding to Dr. Dreyer's position, in November of the same year. Mr. Rambaut gives the probable error of a single observation—most of the stars were observed only once—as ± 0·065s. in R.A., ± 0″·864 in Decl.; the faintness of the objects and their low altitude at meridian passage making observation somewhat difficult. A plate at the end of the volume shows a portion of one of the chronograph sheets, and illustrates a convenient method of making notes whilst at the telescope by sending special signals to the chronograph.

ROUSDON OBSERVATORY.—Astronomical observations have been steadily carried on during the past year at Mr. Peek's private observatory, Rousdon, Lyme Regis. The principal work undertaken, besides transit observations for time, has been the observation of twenty long-period variable stars. It is proposed, so soon as any star has been observed over several complete periods, to publish a memoir with plates showing the variations in the light curve. The record of the Observatory shows that there were 165 good observing nights in 1887, as against 146 in 1886.

β DELPHINI.—Mr. J. E. Gore published two years ago elements for this difficult and interesting binary (NATURE, vol. xxxiii. p. 518), in which he gave the period as 30·91 years, a value fairly corresponding to that found by Dubiago a couple of years earlier, viz. 26·07. Sig. Celoria having been placed in possession of Prof. Schiaparelli's observations made in 1875 and 1886–87, and those of Engelmann made in 1885 and 1886, has re-investigated the orbit, and deduced elements differing widely from these two earlier sets, particularly in the period, which he finds to be a little short of seventeen years (*Astr. Nachr.* No. 2824). If this last orbit be correct, the star has already been watched through nearly a complete revolution. There is, however, a considerable divergency between the recent observations of Schiaparelli and Engelmann, and those of the latter would accord better with a longer period. It is, therefore, much to be desired that astronomers who possess sufficient optical power should give early and careful attention to this star. The following are Sig. Celoria's complete elements:—

T = 1868·850	...	ϵ = 0·09622
Ω = 10°·938	...	a = 0″·46000
λ = 220·952	...	P = 16·955 years
γ = 61·582		

OLBERS' COMET.—The following ephemeris for Berlin midnight is in continuation of that given in NATURE, vol. xxxvii. p. 234:—

1888.	R.A. h. m. s.	Decl. ° ′	Log r.	Log Δ.	Brightness.
Feb. 11...	17 46 35 ...	6 5·7 S.	... 0·3320	... 0·3974	.. 0·29
13...	48 57 ...	6 17·2			
15...	51 15 ...	6 28·4	... 0·3394	... 0·3970	... 0·28
17...	53 28 ...	6 39·3			
19...	55 36 ...	6 50·0	... 0·3477	... 0·3962	... 0·27
21...	57 39 ...	7 0·4			
23...	59 36 ...	7 10·7	... 0·3558	... 0·3951	... 0·26
25... 18	1 28 ...	7 20·8			
27...	3 15 ...	7 30·7 S.	... 0·3638	... 0·3936	... 0·25

The brightness on 1887 August 27 is taken as unity.

NEW MINOR PLANET.—A new minor planet, No. 272, mag. 13, was discovered by M. Charlois, of the Nice Observatory, on February 4.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 *FEBRUARY* 12–18.

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

At Greenwich on February 12

Sun rises, 7h. 22m.; souths, 12h. 14m. 28·6s.; sets, 17h. 7m.: right asc. on meridian, 21h. 42·4m.; decl. 13° 46′ S. Sidereal Time at Sunset, 2h. 36m.

Moon (New, February 12, 0h.) rises, 7h. 47m.; souths, 12h. 41m.; sets, 17h. 43m.: right asc. on meridian, 22h. 9·2m.; decl. 13° 19′ S.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. and declination on meridian. h. m. ° ′
Mercury..	7 54 ...	13 19 ..	18 44 ...	22 47·5 ... 7 39 S.
Venus ...	5 37 ...	9 41 ..	13 45 ...	19 8·2 ... 21 38 S.
Mars ...	22 59*...	4 20 ...	9 41 ...	13 46·6 ... 8 18 S.
Jupiter ...	2 27 ...	6 42 ...	10 57 ..	16 9·1 ... 20 4 S.
Saturn ...	14 51 ...	22 46 ...	6 41*...	8 15·4 ... 20 22 N.
Uranus ...	22 4*...	3 37 ...	9 10 ...	13 3·9 ... 6 4 S.
Neptune..	10 33 ...	18 13 ...	1 53*...	3 41·6 ... 17 55 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Feb.	h.	
13	9	Mercury in conjunction with and 3° 8′ north of the Moon.
16	12	Mercury at greatest elongation from the Sun 18° east.
17	0	Mercury at least distance from the Sun.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·4	81 16 N.	Feb. 14,	19 58	*m*
Algol	3 0·9	40 31 N.	,, 12,	22 19	*m*
R Aurigæ	5 8·3	53 28 N.	,, 18,		*M*
R Canis Majoris	7 14·5	16 12 S.	,, 13,	21 35	*m*
			,, 15,	0 51	*m*
S Cancri	8 37·5	19 26 N.	,, 16,	21 43	*m*
S Ursæ Majoris	12 39·1	61 42 N.	,, 15,		*m*
R Boötis	14 32·3	27 13 N.	,, 17,		*m*
δ Libræ	14 55·0	8 4 S.	,, 15,	2 24	*m*
U Coronæ	15 13·6	32 3 N.	,, 15,	0 9	*m*
W Herculis	16 31·3	37 34 N.	,, 18,		*M*
U Ophiuchi	17 10·9	1 20 N.	,, 14,	2 16	*m*
		and at intervals of		20 8	
W Sagittarii	17 57·9	29 35 S.	Feb. 16,	0 0	*m*
U Sagittarii	18 25·3	19 12 S.	,, 16,	4 0	*m*
R Scuti	18 41·5	5 50 S.	,, 18,		*M*
R Lyræ	18 51·9	43 48 N.	,, 16,		*m*
R Aquilæ	19 1·0	8 4 N.	,, 16,		*M*
S Vulpeculæ	19 43·8	27 1 N.	,, 12,		*M*
Y Cygni	20 47·6	34 14 N.	,, 12,	19 56	*m*
			,, 15,	19 50	*m*
δ Cephei	22 25·0	57 51 N.	,, 13,	2 0	*m*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A. °	Decl. °	
Near 49 Camelopardalis	110	62 N.	Slow.
From Monoceros	120	5 S.	Slow.
Near υ Herculis	238	46 N.	February 17.
,, σ Ophiuchi	260	3 N.	Swift; streaks.

GEOGRAPHICAL NOTES.

THE French traveller, M. Thouar, who was believed to have perished on his way to the Gran Chaco, has returned to Port Pacheco with his companions. This news was lately sent from Buenos Ayres to Chuquisaca (Sucré).

IN the new number of *Appalachia* Mr. F. H. Chapin describes his ascent of a glacier on Mummy Mountain, Northern Colorado, lying directly north of Long's Peak, and in line with the centre of Estes Park. A single glance at the series of crevasses convinced Mr. Chapin that it was really a glacier, and not a mere accumulation of snow. To the same number Mr. S. H. Scudder contributes a paper on the White Mountains as a home for butterflies.

IN the paper contributed to the Berlin Geographical Society by Dr. H. Meyer on his ascent of Mount Kilimanjaro, he modifies his first statements as to the height which he attained; according to a statement of his companion, Dr. Meyer did not get within 2000 feet of the top.

IN the new Bulletin of the American Geographical Society will be found a useful paper by Mr. A. S. Packard, in which he brings together a *précis* of what was known of Labrador. Accompanying the paper is a good map, in which Mr. Packard has embodied information hitherto unpublished. Dr. Fr. Boas gives the results of his year's sojourn among the Eskimo.

IN the last number of the Proceedings of the Victoria Branch of the Australasian Geographical Society will be found a detailed account of Mr. Cuthbertson's expedition to explore the highlands of British New Guinea. The accompanying map gives a good idea of the nature of the country. Mount Obree was found to be only 8000 feet high, 2000 feet lower than previous estimates.

WE learn from the *Izvestia* of the East Siberian Branch of the Russian Geographical Society (vol. xvii. fasc. 1) that the vertical section of the Angara at its issue from Lake Baikal is 17,920 feet, and that the volume of water discharged from the great Siberian lake reaches 121,353 cubic feet per second. If this outflow were checked, the level of the lake would rise 7 feet in thirteen months.

DR. ROBERT SIEGER contributes to the Geographical Society of Vienna University a paper in which he discusses what information exists as to the changes of level in the African lakes. This shows clearly that for the last ten years at least these have been lowering in level, and, in the case of Tanganyika, to the extent of many feet. The changes which take place are almost entirely dependent on rainfall, and the probability is that there are periods of depression and periods of elevation. It is important that observations should be carried on both in African lakes and African rivers for a period sufficiently long to afford data numerous enough to warrant any conclusion to be drawn.

PROF. EUARD SÜSS, the able author of "Das Antlitz der Erde," recently read a paper to the Vienna Geological Society, on the history of the ocean, which is to some extent supplementary to that work. In this he points out that from the mouths of the Ganges all round the Pacific coasts of Asia and America to Cape Horn, the coasts are outlined by mountain-ranges which close in upon each other in great curves. From Cape Horn, again, all round the Atlantic and the Indian Oceans to the mouths of the Ganges, the coasts are unconnected with mountain-ranges, but are encircled by table-lands or broken mountain patches. We have thus, then, so far as the structure of the ocean basins is concerned, to distinguish between a Pacific and an Atlantic type. As regards the age of the oceans, Prof. Süss concludes from the geological formations that the Pacific is the oldest, next to that the Indian, and last of all the Atlantic. The oceans, he points out, are areas of depression. Each new depression would form a fresh receptacle for water, and so the shore-line of the land would be lowered. Prof. Süss seems to maintain that it is to this, and not to the actual rising of the land, that the elevation of the coast-line in certain regions is due.

MR. J. F. NEEDHAM has been engaged to conduct an expedition from Sadiya to the Hukeng Valley, and thence to Bhamo on the Upper Irrawady. His previous achievements in the Abor Hills, and the country lying between the Brahmaputra and the Zayal Chu, and his success in conciliating the unfriendly tribes on that frontier region, marked him out for selection as the proper officer to conduct the present mission.

THE new part (Nos. 133-34) of the *Zeitschrift* of the Berlin Geographical Society is mainly occupied with Dr. W. Sievers's account of the results of his exploration of the Sierra Nevada of Santa Marta in the north-east of the United States of Columbia, an excellent large-scale map accompanying the number. A considerable section of the paper deals with the geology of the region, after which Dr. Sievers treats of the surface formation, altitudes, climate, vegetation, and agriculture, the land-snails population.

NEWS from Victoria, in the Cameroons, states that the African traveller, Dr. Zintgraff, started for Rio del Rey in the steamer *Nachtigal*, accompanied by thirty porters. He is on his way to the Elephant Lake in order to establish a scientific station. The other half of the Expedition, under the command of Lieut. Zeuner, is to proceed up the Mungo River to Mundame, to reach the Elephant Lake from that part.

OUR ELECTRICAL COLUMN.

IF a platinum plate be immersed in a porcelain or glass vessel containing dilute sulphuric acid, and another similar plate be immersed in another vessel containing caustic potash solution, then if the two vessels be connected by a siphon tube or a cotton wick, a current will be set up, but which rapidly diminishes owing to the polarization of the metal plates by the deposition of oxygen and hydrogen upon them. Becquerel removed the hydrogen by using nitric instead of sulphuric acid, and increased the current considerably. Dr. Alder Wright and Mr. C. Thomson (Royal Society, February 2, 1888) have been examining this form of battery, and have found many other acids which act in the same way, such as potassium permanganate, potassium bichromate, potassium ferricyanide, and bromine dissolved in sulphuric acid, ferric chloride, hydrochloric acid and chlorine. Moreover, they have removed the oxygen by using a concentrated solution of sodium hyposulphite made strongly alkaline with caustic soda, strong caustic soda with pyrogallol, cuprous chloride, ferrous sulphate, and ammonium chloride dissolved in ammonia. They also found the quantity of oxygen

and hydrogen evolved exactly proportional to the current passing. If a silver voltameter were included in the circuit, for every milligramme-equivalent (108 milligrammes) of silver deposited, 1 milligramme-equivalent of hydrogen occupying 11·2 cubic centimetres and 8 milligrammes of oxygen occupying 5·6 cubic centimetres at 0° C. and 760 millimetres, were liberated.

ALTHOUGH Sir William Thomson did not publish any electrical theoretical work in 1887, he perfected during that year his practical electrical measuring instruments. They are in use at the Grosvenor Gallery central station in London. There are no more beautiful or accurate instruments in the world, and they reach over an enormous range both of potential and of current measurement. They were admirably illustrated and described in *Industries* of January 27 by Prof. Fleming.

HERTZ (*Wiedemann Ann.* 1887), has shown that the ultra-violet rays have an influence on the passage of sparks. E. Wiedeman and H. Ebert have been repeating and verifying his experiments. The effect of light falling on the spark region was to lower the potential required to produce it. If a succession of sparks be sent, and a telephone be used, the effect of light falling on the sparks was to change not only the note but the whole character of the sound heard in the telephone. If a Geissler's tube were used, an intermittent and irregular discharge became steady and continuous. The effect was evident only on the negative pole.

IT is known that the magnetic qualities of iron diminish considerably when raised to 525° C. (red heat), but iron remains magnetic up to 650° C. Nickel loses its magnetic properties suddenly at 300° C. Lodeboer recently (January 9) read a paper before the Académie des Sciences, in which he showed that with magnetizing forces of 35, 100, and 200 C.G.S. units the iron retains its magnetic properties up to 680° C. ; that beyond this temperature it rapidly loses them ; that at 750° C. they scarcely exist, and at 770° C. they entirely disappear, to reappear only on cooling. It is known that the specific heat of iron undergoes a change of condition between 660° and 720° C., and the coincidence of these two changes is very interesting.

THE treatment of sewage by electricity is, it seems, likely to receive a practical test at the Metropolitan Board of Works' outfall at Crossness. Mr. Fewson, of Buckingham, made some experiments in this direction at Wimbledon last summer, and now Mr. W. Webster is about to do the same thing at one of the large tanks on the Thames. The electric current is said to have a wonderful disinfecting and purifying influence. The evolution of gas stirs up the liquid, the nascent oxygen is brought into rapid contact with the impurities and reduces them, precipitation is expedited, and the whole cleansed. It is to be hoped that the cost will not swamp this new and useful field for electricity.

THE extraordinary rise in the price of copper has attracted much attention to the use of iron for lightning conductors. Prof. Silvanus Thompson advocates iron in preference to copper under all circumstances. Iron is much used by the War Department to protect magazines. Dr. L. Weber recommends it even in a solid form rather than as a stranded rope, but the latter form is much more portable and workable ; moreover, Prof. Hughes showed it to be less subject to self-induction than a solid rod—an obstruction not to be neglected. Iron conductors are stronger, much cheaper, less easily fused, and less liable to theft than copper. There can be no objection to the use of iron.

THE electro-deposition of aluminium has attracted much attention since the introduction of the Cowles process. Herman Reinbold has proposed the following solution, with which he has obtained good but small results : alum 50 parts, water 300 parts, aluminium chloride 10 parts. This solution is heated to 200° F., and after cooling 39 parts of potassic chloride are added.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THIS Society held its forty-first annual general meeting in the theatre of the Institution of Civil Engineers on Thursday and Friday of last week. After the Annual Report had been presented and accepted, Mr. John Richards' paper "On Irrigating Machinery on the Pacific Coast" was read and discussed. The need of irrigation in this district arises from three causes : the lack of rain, which ceases altogether along the coast in summer-time ; the want of surface-water ; and the free percolation into the sandy soil beneath. The whole of the land in the country, excepting the low-lying sedimentary plains near the mouths of the rivers, and around the Bay of San Francisco, where water reaches the surface by capillary saturation, requires irrigation. Nearly all the land upon which water can be led, either by training small mountain streams, or by leading long canals from the rivers, has been occupied, so that the only remaining resource for getting water will be by lifting it from the rivers or the gravel strata by machinery. The paper is descriptive of the various pumps and hydraulic rams employed, and was illustrated by means of thirty-five figures.

Mr. William Geipel's paper "On the Position and Prospects of Electricity as applied to Engineering" refers to those branches of electric engineering which involve the employment of considerable power, and are in some way or other connected with the use of dynamos. They comprise electric transmission and distribution of power, and electric lighting, locomotion, and metallurgy.

In the author's opinion the transmission and distribution of power by electricity will occupy in the near future most of the attention of the electric engineer. Owing to its simplicity, the ease with which an electric motor can be applied to any purpose requiring power, and its high efficiency, it is certainly an approach to an ideally perfect system of transmission. In the United States great strides have been made in the applications of electric motors, which already rival those for lighting purposes. One of the great advantages of these applications is due to the low efficiency of belts and shafting where high speed is required and the demand for power is variable. By getting rid of shafting the necessity for additional stability in buildings is obviated, and constant lubrication is done away with. The distribution of power by electricity from a central station to small users can be effected from the same mains and generators as are used for electric light purposes ; as to whether gas through the medium of gas engines or electricity by means of electric motors should be used, will become entirely a question of economy and convenience. On the one hand the electric motor can be started and stopped with the greatest ease, it requires little attention, occupies little space, and can be placed anywhere, while against the use of the gas engine, the author brings forward its irregularity of speed owing to the intermittent impulse and the wear and tear in the valves and working parts. Shunt motors, which are now almost exclusively used, possess a practically perfect power of self-control, not only over their rate of speed with varying load, but over the energy absorbed, for they help themselves, as it were, to only such an amount of energy as will enable them to deal with the work imposed upon them. Another advantage in shunt motors, first pointed out by the late Sir William Siemens in 1880, is that they act as generators when themselves driven by any extraneous power, without any complication of the switch gear required with series motors. The author refers to various installations which have already taken place in Europe and America, which are paying their way, whilst at the Falls of Niagara plant is being put down to distribute power obtained from the Falls to neighbouring towns, including Buffalo, which is twenty miles distant ; the amount of power is stated at 15,000 h.p., of which 10,000 h.p. is contracted for at £3 per h.p.

Electricity has been applied with efficiency in collieries for underground hauling, pumping, ventilating, and drilling ; in ship-yards and similar works it has been proved to be a suitable and economical means of transmitting power for riveting, drilling, &c.

In its application to the transmission of power to great distances, electricity is found to be more economical than either hydraulic, pneumatic, or wire-rope transmission, and comparative tables are given showing the first cost of plant per horse-power transmitted, and also the working cost per horse-power transmitted per hour. For a distance of 22,000 yards the cost of installation for the transmission of 100 h.p. is £87, £310, £192, and £162 per h.p. for electric, hydraulic, pneumatic, and wire-rope transmission respectively ; whilst the cost per h.p. transmitted per hour is 4·08, 6·84, 4·50, and 9·73 pence.

Amongst many interesting applications, that made by the Marquis of Salisbury at Hatfield may be specially referred to. The River Lea is utilized to generate electricity by means of turbines, the electricity being transmitted to the house and over the estate for a variety of purposes. The motors at the house

drive pumping and ice-making machinery and an air-propeller fixed in the roof for ventilating; on the farm the motors are used for elevating hay and corn sheaves to the top of the stacks, for thrashing, for cutting rough grass with a chaff-cutting machine for ensilage, in fields extending to a distance of two miles, for grinding corn, &c., to make fodder, and for other purposes. The motors have also been used for pile-driving, for making cofferdams where necessary in the river, and also for dredging the river and clearing it of weeds, and for pumping the town sewage into a tank at the height of thirty feet for irrigation. The conductors are carried overhead on poles about the farm and underground in wooden troughs to the house. The practical methods employed for electric locomotion—being those of a third insulated rail, an overhead conductor, an underground insulated conductor, and storage batteries—are described, and examples of the application of all are given. To the first belong the Portrush Railway, and Besbrook and Newry Tramway; to the next the electric railway at Moedling, near Vienna, and the Frankfort-Offenbach railway. This plan has been most largely adopted in America, where there are probably not far short of one hundred electric railways at work and projected. Of the underground conductor, the most important example is the electric tramway at Blackpool, while storage batteries are being employed on the North Metropolitan Tramway in London. The ordinary rails have been used as conductors in the short electric railway at Brighton, where the expenses amount to twopence per car-mile.

The plan of transporting material in skips on overhead wire-ropes by means of electricity, introduced under the name of telpherage by Prof. Fleeming Jenkin, has been employed with success for two years past at Glynde, near Lewes, for transporting clay to the railway over a distance of 1600 yards, and is applicable for use in places where material has to be conveyed across hilly districts. In the author's opinion a modification of this plan might be advantageously applied to alleviate the heavy street traffic in our larger cities.

The author considers the question of electric lighting under the three aspects of comfort, convenience, and economy. As regards the first two, electric lighting has the advantage over other systems; whilst as regards cost, although electric lighting, and especially incandescent electric lighting, is still heavy, yet for lighting main streets and railway stations, or other places where concentrated light is required, the arc light is cheaper than gas. As its use extends, the cost of working becomes reduced. Thus in the Waverley Station, Edinburgh, on the North British Railway, thirty-three arc lamps, with 41,884 lamp hours, cost 2·77 pence per lamp hour from July to December 1884; whilst in 1886, thirty-nine arc lamps, having 55,068 lamp hours, cost 1·79 penny per lamp hour.

The cost of incandescent lighting is especially variable, and affected by the local conditions of the installation. The chief of these are the average number of hours of lighting each lamp, and the average distance of the lamps from the generating station. Where conditions are favourable, incandescent lighting can already compete with gas. Messrs. George Jager and Sons' yearly cost of lighting their sugar refinery at Leith is given as an example, it having been £347 with gas and £204 with incandescent lamps. The author draws special attention to the circumstance of the much larger application of electricity to lighting in the United States as compared with this country. In the United States there is hardly a city or town of 20,000 inhabitants which has not a central station for arc or incandescent lamps; and many towns of 3000 to 4000 inhabitants are also supporting them.

The efficiency of dynamo machines being as high as 95 per cent., and there not being much likelihood of material improvement in steam engines, the author draws attention to the importance of improving the lamps by making them with a higher resistance and greater efficiency, the voltage having a great effect on the cost of working distant lamps. Transformers, by means of which high tension currents of electricity, sent from a distant generating station along a small conductor with comparatively small percentage of loss, can then be converted into low tension currents for the supply of ordinary incandescent lamps, are receiving a large amount of attention, the loss by conversion being as low sometimes as 5 per cent. Efforts are also being made to introduce the system of secondary batteries, charged in series by a high tension current, and discharged in parallel circuit, and if it can once be demonstrated to be economical, there would be a large field of application. At Leamington an extensive central station is now at work, the cost of the undertaking being £30,000; while the Bradford Corporation have recently voted a sum of £15,000 for erecting a central station in their town. Both these are instances of direct supply without transformers or secondary batteries. Electric metallurgy is a branch of electric engineering to which attention was first drawn by the late Sir William Siemens, whose death occurred before he had perfected his invention. The electro-chemical separation of ores on a commercial scale by the electric furnace has been recently put to the test, chiefly in obtaining aluminium from conundrum. The furnace designed by Prof. Mabery is built of fire-brick and lined with powdered charcoal; electricity is conducted to the ore by carbon rods, meeting near the centre. The ore mixed with charcoal and granulated copper surrounds and covers the carbons; the furnace is closed with a layer of charcoal and a lid lined with fire-brick. A current of 50 volts electromotive force is supplied and melts the metal around the electrodes, which are moved apart gradually until the whole is melted. The conundrum becomes gradually deoxidized, the aluminium combining with the copper, while the oxygen with the carbon escapes as carbonic oxide, about five hours sufficing to complete the reduction. Aluminium, being only one-third the weight of iron, and possessing great strength, its production at a cheap rate would probably cause a revolution in engineering construction.

The meeting was presided over by Mr. E. H. Carbutt, the President, who was re-elected to the chair, whilst Sir Douglas Galton, K.C.B., was the new member elected on the Council. The meeting was as usual of a very successful character.

THE NATIONAL SMOKE ABATEMENT INSTITUTION.[1]

IN presenting the Report to the members for the year 1887, the Council consider it desirable to reprint from the Memorandum of Association the objects for which the Institution was established. These are the following:—

To promote the abatement of coal smoke and other noxious products of combustion in cities and other places, in order to render the atmosphere as pure and as pervious to sunlight as practicable. To check the present serious waste of coal, and the direct and indirect loss and damage accompanying the over-production of smoke and noxious products of combustion. To continue, organize, and extend the public movement inaugurated and hitherto carried on by the Smoke Abatement Committees (otherwise known as the Joint Committees for Abatement of Smoke, appointed by the National Health Society and Kyrle Society of London, and the Smoke Abatement Committee of Manchester), and to take up and proceed with any work undertaken or commenced by such Committees. To advance the aforesaid objects by promoting and encouraging the better and more economical use of coal and coal products, and the selection of suitable fuel, as well as general improvement in the various modes of obtaining, applying, and using heat and light for domestic and industrial purposes. And in connection with such objects to obtain and provide such buildings, appliances, and assistance as may be deemed expedient. And without prejudice to the advancement of the objects aforesaid by other means to advance the same by the following means more particularly:—

(*a*) By calling public attention to the serious pecuniary loss and injury, to the health and comfort, which arise from coal smoke, and from defective heating, ventilating, and lighting arrangements.

(*b*) By stimulating, assisting, and encouraging inventors, manufacturers, traders, and others to bring forward, develop, and perfect new or improved fuels, substances, methods, and appliances for the generation or application of heat or light, and for consuming or lessening the production of smoke and noxious products of combustion.

(*c*) By conducting practical trials of fuels, apparatus, and systems connected with the generation or application of heat or light, and causing reports to be made thereon for the guidance, assistance, or information of inventors, traders, intending users, and the public generally.

(*d*) By granting awards, certificates, medals, or prizes in connection with approved fuels, methods, or apparatus.

(*e*) By establishing, or assisting in establishing, public exhibitions, either periodical or otherwise, of appliances pertaining to heating, ventilating, or lighting.

[1] Report of the Council for the year 1887.

(*f*) By collecting and recording statistics and information, and making, assisting, or encouraging experiments or researches as to the effects upon the atmosphere, and upon life, health, and property of the use of coal and other fuels and means employed or to be employed in connection with heating or lighting; and by printing, publishing, and circulating any such statistics or information, including the intended report of the Committees aforesaid, or any similar composition or literary work.

(*g*) By imparting information, instruction, and assistance to local authorities, manufacturers, workmen, householders, servants, and the public generally whether by means of lectures, demonstrations, pamphlets, written articles, or otherwise in relation to the subject of smoke prevention or abatement.

(*h*) By joining or concurring with any other institution, society, or persons, in doing or causing, or procuring to be done, any of the things aforesaid.

To promote the abatement of noxious vapours arising from manufactures or manufacturing processes, and to resort to and use for that purpose powers and means analogous to those hereinbefore contemplated with reference to Smoke Abatement and any other reasonable means. For all or any of the purposes aforesaid, either alone or in conjunction with others, to promote legislation and parochial and other regulations, and to assist in the enforcement thereof, and of any existing or future legislative, parochial, or other regulations.

In reporting upon the business transacted by the Institution during the past year, it is essential that the members should be reminded of the urgency for further legislation on the subject of smoke prevention.

The Institution has been in communication with the medical officers of health and chief constables throughout the country, and the most valuable information obtained with reference to the working of existing by-laws is given as supplements Nos. 1, 2, 3, 4, 5, and 6, to a paper on Smoke Abatement, read at the Bolton Congress of the Sanitary Institute. These supplements are published in the Transactions of the Sanitary Institute of Great Britain, and by reference to them it will be seen that the municipal authorities of Liverpool are much more alive to the necessity of prosecuting offenders against the Smoke Abatement Acts than the authorities in any of the other places from which reports have been obtained.

By comparison with the Report issued by the Commissioner of Police for the Metropolis of 1886, it will be seen that the number of cases in which fines were imposed in Liverpool was 545, whereas the number of convictions in the metropolis amounted only to 82. It might further be noted, however, in respect to the penalties imposed, that the average of all the fines in Liverpool was 19*s*. 11¼*d*. The average in London was £1 17*s*. 5*d*. The inadequacy of the fines imposed is a serious obstacle in dealing with police prosecutions, and the fines have little effect, if any, in the prevention of smoke, in consequence of the amount of the penalty being so disproportionate to the financial positions of the persons on whom they are imposed.

During the year attention was prominently called by Lord Stratheden and Campbell to the provisions in the Bill introduced by him to the House of Lords "To amend the Acts for abating the nuisance arising from the smoke of furnaces and fire-places within the Metropolis," and resulted in a Select Committee being appointed to consider the terms of the Bill, and to report to the House of Lords. The minutes of evidence were laid before the House of Lords on the 15th of July, 1887, and the published Report contains much valuable information with respect to the working of the Smoke Abatement Acts:—The nuisance created by steamers on the Thames; the necessity for extension of the metropolitan area to be within the Acts; the necessity for controlling the emission of smoke from club-houses, hotels, private residences, and other buildings not within the scope of the existing Acts; the usual course followed by the police in instituting prosecutions; a return showing the number of police employed in carrying out the Smoke Nuisance Abatement Acts; the effect of the increase of smoke on the health of the people, and the advantages from a sanitary point of view to be derived by the prevention of smoke; also particulars regarding the commercial advantages to be derived by the consumption of smoke; particulars of the methods which might be adopted for the complete combustion of fuel in domestic grates; and generally, a great mass of information dealing with the subject laid before the House of Lords by the following gentlemen: Mr. W. R. E. Coles, the engineer appointed by the Home Secretary to examine furnaces in the metropolis; Mr. James Edward Davis, of the Home Office, legal adviser to the Commissioners; Mr. Charles Cutbush, Superintendent of Police; and Mr. Ernest Hart, Chairman of Council of the National Smoke Abatement Institution.

By reference to the Police Orders and Regulations reprinted at the end of this Report, it will be observed in paragraph 36 that hotel-keepers in the metropolis not using steam-engines can only be proceeded against under Section 19, Sub-Section 3, of 29 and 30 Vict., cap. 90, and be guilty of an offence under that Section. In consequence of this Act of Parliament, Section 19, Sub-Section 3, stipulates that any chimney (not being the chimney of a private dwelling-house) sending forth black smoke in such quantity as to be a nuisance is exempt from the working of the Act and it is left to the justices to dismiss the complaint if they are satisfied such fire-place or furnace is constructed in a manner to consume, *as far as practicable*, all smoke arising therefrom, but it does not state any standard smoke shade or any degree to be fixed upon as the limit, and therefore the justices may or may not convict at their option.

The purpose of Lord Stratheden and Campbell's Bill is to prohibit or regulate the emission of smoke from any building, no immunity being granted to hotels, club-houses, or domestic fire-places now exempted from the existing Acts. The effect of the general evidence brought before the Select Committee of the House of Lords was a resolution to await the results of the further operation of the existing Acts, the purpose and intention of which should, it was held, be more fully carried into effect.

The Council invite the careful consideration of members to the necessity for legislation, and on an early date will arrange for a series of meetings to be held, at which it is expected the sanitary inspectors from the leading provincial towns will assemble, in order to compare and suggest revisions for the existing municipal by-laws, as well as for the purpose of drafting propositions to submit to the authorities on the subject of improved legislation in the metropolis.

The Council having considered the desirability of taking the first opportunity for conducting simultaneous tests of the furnaces of a large number of steam-boilers under equal conditions, thought that such an opportunity might be offered at the forthcoming Exhibition to be held in Glasgow. They accordingly directed the Secretary to write to the Lord Provost of Glasgow, laying the outlines of their scheme before him, and suggesting its adoption by the Exhibition authorities. Briefly stated, the proposal was: That the whole range of boilers to be used for working the machinery of the Exhibition should be erected in such a manner that each boiler should have its setting and chimney independent of the other boilers, so that the several systems of stoking and arrangement of furnaces could be fully tested under identical conditions of fuel, atmosphere, and time; while the results as regards smoke would be evident to the public.

It is to be regretted that the authorities in charge of the Glasgow Exhibition have not been able to see their way to co-operating with the Smoke Abatement Institution as proposed. Simultaneous tests on such a large scale have never previously been made. Many tests of great value have been made on furnaces, but these have been at separate times, and under different atmospheric conditions, and the results, however favourable in themselves, have been incapable of classification for comparison. The proposal of the Council, if adopted, would have supplied what is wanting by making these tests of several boilers at the same time, and under the supervision of an impartial body.

With reference to this subject, a correspondence has taken place with Mr. Fletcher, Chief Inspector under the Alkali Acts, as he has in preparation a report upon the injurious effect of the impurities of the air and water on the Clyde. Mr. Fletcher was asked to furnish a copy of the report, but replied that it was in the hands of the Secretary for Scotland. Application has been made to the Secretary for Scotland, and attention drawn to the importance of the series of tests which the Council proposed. The Secretary for Scotland in his reply stated that Mr. Fletcher's report has not yet been brought before Parliament, and with respect to the testing of the boilers, said that he would inform the Committee of the Glasgow Exhibition that he considers the suggestion of the Institution to be deserving of consideration and adoption.

At a meeting of the Institute of Engineers and Shipbuilders in Scotland, on the 8th of December, a very comprehensive paper

was read by Mr. George C. Thomson on "Smoke," and in the discussions which followed, Mr. W. R. W. Smith, Chairman of the Health Committee of the Glasgow Corporation, urged upon the members present the desirability of doing all in their power to secure that at the forthcoming International Exhibition in Glasgow each of the boilers be supplied with a separate chimney, so that a series of exhaustive trials may be made with mechanical stokers, &c., and other means for the purpose of showing what might be done in the way of smoke prevention.

With reference to the subject of testing, the Committee are of opinion that arrangements should be made as soon as possible for obtaining the use of three testing-rooms for testing stoves, grates, and ranges, the rooms being conveniently accessible for such articles, and having gas connections under command. The tests made in these rooms, under the same conditions of chimney and cubic capacity, would then become of greater comparative value than tests made in independent rooms.

Arrangements will be made as soon as practicable for procuring such accommodation for testing, and also for providing the necessary instruments used for testing; and as the system develops, attention will be given to the establishment of a chemical laboratory, the analysis of gases, and testing-rooms for testing-apparatus incidental to the work of the Institution.

SCIENTIFIC SERIALS.

American Journal of Science, December 1887.—On the destruction of the passivity of iron in nitric acid by magnetization, by Edward L. Nichols and W. S. Franklin. From the experiments described in this paper, which was originally read before the Kansas Academy of Science, November 1885, it appears that the action of the magnet tends to lower the temperature of transition to the active state, and that the intensity of the magnetic field necessary to convert passive into active iron at a given temperature increases rapidly with the concentration of the acid. An account is promised of further researches offering a satisfactory explanation of the manner in which the chemical behaviour of iron is modified, and its passivity destroyed in the magnetic field.—On a method of making the wave-length of sodium light the actual and practical standard of length, by Albert A. Michelson and Edward W. Morley. The preliminary experiments recently carried out according to the method here proposed seem to confirm the anticipation that it would furnish results more accurate than any of those hitherto suggested. The apparatus for observing the interference phenomena is the same as that used in the experiments on the relative motion of the earth and the luminiferous ether.—The work of the International Congress of Geologists, by G. K. Gilbert. This is a reprint of an address delivered before the Section of Geology and Geography of the American Association for the Advancement of Science at the New York meeting, August 10, 1887. It deals largely with a revised system of geological terminology, the substance of which has already been published. The question of geological coloured maps is also considered, and practical suggestions made for their greater efficiency and economy.—On the existence of certain elements together with the discovery of platinum in the sun: contributions from the physical laboratory of Harvard University, by C. C. Hutchins and E. L. Holden. These investigations, carried on with Prof. Rowland's magnificent diffraction grating, deal with cadmium, lead, tin, silver, potassium, and several other elements, including platinum, the presence of which in the solar atmosphere is here for the first time determined. Between 4250 and 4950 were found sixty-four lines of platinum, sixteen of which agree with the solar lines.—The flora of the coast islands of California in relation to recent changes of physical geography, by Joseph Le Conte. A careful study of these insular groups, at present from 20 to 30 miles distant from the coast, shows that they at one time formed part of the mainland, from which they were undoubtedly separated during the Quaternary period. That they still formed part of the continent during later Pliocene times is shown by the remains of the mammoth found on Santa Rosa, one of the largest and furthest off of the whole group.—A new instrument for the measurement of radiation, by C. C. Hutchins. The instrument here described and illustrated presents great advantages over the thermopile as an accurate measurer of radiations. It is much more sensitive and requires no longer time to return to zero than for the galvanometer needle to come to rest. A lighted match at 6 feet drives the needle round to its stop.—Mineralogical notes, by George F. Kunz. Descriptions with analyses are given of a rhodochrosite from Colorado, of crystals of hollow quartz from Arizona, of hydrophane from Colorado, and of a remarkable silver nugget weighing 606 ounces from the Greenwood mines of Michoacan, Mexico.

January.—The speed of propagation of the Charleston earthquake, by Prof. Simon Newcomb and Captain C. E. Dutton. A careful comparative study of the reports from all parts of the disturbed area shows a general average speed of $3{\cdot}214 \pm 0{\cdot}072$ miles, or 5171 ± 116 metres per second.—History of the changes in the Mount Loa craters, Hawaii; Part I, Kilauea, by James D. Dana. The first paper embraces the whole period from 1823 to 1886, during which there appear to have been at least eight discharges from Kilauea. The general dynamical conclusions are that the cycle of movement is simply (1) a rising in level of the liquid lavas, and of the bottom of the crater; (2) a discharge of the accumulated lavas down to some level in the conduit determined by the outbreak; (3) a down-plunge of more or less of the floor of the region undermined by the discharge. It is further shown that Kilauea is a true basalt volcano in its normal state, the rock material being dolerite or basalt, and the heat sufficing for the perfect mobility of the lavas.—The analysis and composition of tourmaline, by R. B. Riggs. The methods of analysis are described, with results for various specimens from different parts of North America and Brazil. The general inference is that there are three types, lithia, iron, and magnesia tourmaline, with an indefinite number of intermediate varieties, iron appearing to be the connecting link between the whole series. The special formulas of the three distinct types are:—

(1) Lithia: $12SiO_2, 3B_2O_3, 4H_2O, 8Al_2O_3, 2(NaLi)_2O$.
(2) Iron: $12SiO_2, 3B_2O_3, 4H_2O, 7Al_2O_3, 4FeO, Na_2O$.
(3) Magnesia: $12SiO_2, 3B_2O_3, 4H_2O, 5Al_2O_3, \frac{25}{3}MgO, \frac{2}{3}Na_2O$.

—On the different types of the Devonian system in North America, by Henry S. Williams. It is shown that in North America the Devonian system offers at least four distinct types in four corresponding areas, blending somewhat at their borders, but in their central parts presenting marked peculiarities. The four areas are: (1) Eastern Border, mainly in Northern New England; (2) Eastern Continental, including New York, thence southwards to West Virginia and north-westwards to Canada West and Michigan; (3) Interior Continental, chiefly Iowa and Missouri, extending northwards probably to the Mackenzie basin; (4) Western Continental, in Nevada and conterminous States.—On the law of double refraction in Iceland spar, by Charles S. Hastings. The general inference from these researches is that Huyghens' law of double refraction in uniaxial crystals is probably true to less than 1 part in 500,000, and consequently that there is no known method by which any error in it can be detected by observation alone.—In the Appendix, Mr. O. C. Marsh describes a new genus of Sauropoda and other new Dinosaurs from the Potomac formation; also a new fossil Sirenian from California.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 19.—"Notes on the Spectrum of the Aurora." By J. Norman Lockyer, F.R.S.

I exhibited to the Society on November 17, 1887, a tabular statement showing the bright lines seen in the spectra of various celestial bodies, and I also gave those recorded in the spectrum of the aurora, showing many remarkable coincidences.

I now find that the connection is closest between the auroral spectrum and that of stars III.*a*, and, in anticipation of a subsequent communication of details, I send on the accompanying table, showing the origin of Dunér's bands, so far as I have at present made them out, and their connection with the spectrum in question.

The individual observations which I have used in the table are those collected by Mr. Capron and Mr. Backhouse (NATURE, vol. vii. pp. 182 and 463).

TABLE OF WAVE-LENGTHS OF AURORAL LINES.

Barker	431	470	482	502	517				562	623
Smyth									558	635
Zöllner										628
A. Clerke			485				532			
Herschel							531			
Backhouse	430			501	516·5		532			606
Lord Crawford			more ref. than F			523				
H. R. Proctor			,,							
Vogel		469								
Ellery										635
O. Struve									554	
Ångström		472				521			556	
Lemström	426	469				525				
German North Polar Expedition									557	
Respighi									557	
Peirce	431	464	486			520	531	545	557	
Probable origin	CH	C (hot)	C (cold)	Mg	C (hot)	Mg	*	Zn† (1)‡	Mn (1)	Fe (1)
Wave-lengths of probable origin	431	474	483	500	516·5	520·1		546	558	615
Dunér's bands			477–485 (9)					550–545 (5)		616–627 (2)
		460–474 (10)		495–503 (8)	516–521 (7)				564–559 (4)	

* Coronal line. † Another probable origin for this in the aurora is 540 Mn. ‡ This means brightest fluting.

Addendum.—The following table shows the above figures in another form and includes the bright lines recorded in γ Cassiopeiæ :—

Aurora.	Dunér's bands.	Bright lines in γ Cassiopeiæ.	Probable origin.	Wave-length of probable origin.
431	...	...	CH	431
474	460–474 (10)	...	C (hot)	474
...	...	462·3	Sr	460·7
483	477–485 (9)	...	C (cool)	483
500	495–503 (8)	499	Mg	500
516·5	516–521 (7)	516·7	C (hot)	516·5
520·1	...	...	Mg	520·1
531	...	531	Coronal line	
...	...	542·2	Mn	540
545	545–550 (5)	...	Zn (1)	546
558	559–564 (4)	555·7	Mn (1)	558
...	585–595 (3)	586	Mn (2)	586
615	616–627 (2)	616	Fe (1)	615
635	...	635·6	*	...

Geological Society, January 25.—Prof. J. W. Judd, F.R.S., President, in the chair.—The following communications were read :—On *Ailurus anglicus*, a new Carnivore from the Red Crag, by Prof. W. Boyd Dawkins, F.R.S. The specimen described is a small fragment of the right lower jaw with the last three molar teeth in position, and belongs to the Crag collection of the Yorkshire Philosophical Society. It differs in a marked degree from all fossil European Carnivores, and presents no important points of difference when compared with a series of jaws of recent *Ailurus*. The author gave a description of the fossil, and comparison of it with *Ailurus fulgens*, and also a table giving the comparative measurements of the teeth and jaws of the fossil and of recent *Ailuri*. The species from the Crag was a more powerful animal than any recent *Ailuri* in the British Museum. The paper concluded with a notice of the range of *Ailurus* in space and time. After the reading of this paper the President remarked that seldom had a fact of greater interest in its bearing upon geographical distribution in past times been brought before the Society. Some comments on the paper were also made by Mr. Lydekker, Prof. Seeley, Mr. Newton, and Mr. Blanford.—A contribution to the geology and physical geography of the Cape Colony, by Prof. A. H. Green, F.R.S.—On two new Lepidotoid Ganoids from the early Mesozoic deposits of Orange Free State, South Africa, by Mr. A. Smith Woodward. The results presented in Prof. Green's and Mr. Woodward's papers were discussed by the President, Prof. Rupert Jones, Mr. Blanford, Dr. Geikie, Mr. Clement Reid Prof. Hughes, and Mr. Irving.

* This line is seen as a pretty bright line in the spectrum of the Limerick meteorite, but its origin has not yet been determined, although comparisons have been made with most of the common elements. So far, it has not been observed in any other meteorite.

Royal Microscopical Society, January 11.—Rev. Dr. Dallinger, F.R.S., President, in the chair.—The President referred to the death of Dr. Arthur Farre, a former President of the Society, and one of its earliest Fellows.—Prof. C. Stewart exhibited specimens of *Thecalia concamerata*. In this genus the female shell exhibited a peculiarity which was quite unique. As age advanced the mantle became folded back upon itself in a very curious manner, and simultaneously with this there occurred a similar in-folding of the contiguous portions of the shell by which two depressions were produced, forming a fusiform chamber when the two valves came together. In this cavity the embryonic shells were found.—Edmond's automatic mica stage rotating by clockwork was exhibited and described.—Mr. A. W. Bennett gave a *resumé* of his paper on freshwater Algæ of the English Lake District, with a description of a new genus of *Capsulococcus* and five new species, in continuation of his previous communication on the same subject.—Dr. G. Gulliver read a paper on *Pelamyxa palustris*. The large size of this amœboid organism had enabled it to be cut into sections, and the granulated structure of its exoplasm thus revealed was described. As regarded its classification, it was thought that ultimately it would be found to have a nearer relationship to the true Heliozoa than to the more lowly Amœbæ.—Mr. E. M. Nelson handed round for inspection two photographic positives ; one of *Amphipleura pellucida*, and the other of a fungus growth which attacked calcareous sand, as described by Mr. J. G. Waller in the Journal of the Quekett Microscopical Club, i. p. 345. This object presented some photographic difficulty because of its non-actinic colour. With regard to the other he remarked that in resolving diatoms with oblique light it was essential to decide whether they intended to focus upon the real surface or upon the optical image produced in a higher plane, in consequence of the double nature of the structure of the valve. In the latter case they would obtain a result such as he exhibited, which was a photograph of the optical image and not of the real diatom.—Mr. Nelson also called attention to a curious optical effect for which at present he was unable to account. In a flat box he had placed a glass positive of *A. pellucida* which was viewed as a transparency through a piece of tube fitted at right angles to the surface. If this was looked at when held towards a surface of light such as an optical lamp-shade or a sunlight gas-burner, the black lines appeared to be slightly smaller than the white lines ; but if it was turned towards a small light at a distance, then the black lines appeared very

large and the white ones were reduced to mere threads. The scale of the photograph showed that the effect was not due to the operation of the first diffraction spectrum, and it was still more curious to note that in the case of another positive taken from the same negative and upon the same scale this optical illusion was not observed.

Anthropological Institute, January 24.—Anniversary Meeting.—Prof. Flower, C.B., F.R.S., Vice-President, in the chair.—The following were elected Officers and Council for the ensuing year:—President: Francis Galton, F.R.S. Vice-Presidents: J. G. Garson, Prof. A. H. Keane, F. G. H. Price. Secretary: F. W. Rudler. Treasurer: A. L. Lewis. Council: G. M. Atkinson, E. W. Brabrook, C. H. E. Carmichael, Hyde Clarke, A. W. Franks, F.R.S., Lt.-Col. H. H. Godwin-Austen, F.R.S., T. V. Holmes, H. H. Howorth, M.P., Prof. A. Macalister, F.R.S., R. Biddulph Martin, M.P., Prof. Meldola, F.R.S., Rt. Hon. the Earl of Northesk, C. Peek, Charles H. Read, Lord Arthur Russell, M.P., Prof. A. H. Sayce, H. Seebohm, Oldfield Thomas, M. J. Walhouse, Lieut.-Gen. Sir C. P. Beauchamp Walker, K.C.B.

PARIS.

Academy of Sciences, January 30.—M. Janssen in the chair.—Note on the first volume of the *Annales de l'Institut Pasteur*, presented to the Academy, by M. L. Pasteur. This volume contains the first twelve numbers of a monthly serial established and directed by Prof. Duclaux, of the Sorbonne, and entirely devoted to the progress of the new branch of pathological physiology to which M. Pasteur gives the name of "Microby" or "Microbiology." His remarks were mainly confined to the important memoir by MM. Roux and Chamberland, entitled "Immunité contre la septicémie, conférée par des substances solubles." In this memoir is contained the rigorous demonstration of the far-reaching fact that the septic vibrion, a living ferment analogous to the butyric vibrion, develops soluble chemical products, which gradually act as an antiseptic on the organism itself. These products, introduced in sufficient quantities into the body of the guinea-pig, confer absolute immunity from the deadly attacks of the virus, to which that animal is specially susceptible.—Note on the total lunar eclipse of January 28, by M. J. Janssen. The observations taken at the Observatory of Meudon were mainly directed towards determining a point of telluric spectroscopy connected with the absorption bands of oxygen. They were necessarily of a somewhat preliminary character, and will be continued during future total eclipses of the moon.—Researches on ruthenium, by MM. H. Debray and A. Joly. The paper deals more especially with hyperruthenic acid, its purification, physical properties, behaviour in the presence of water, and under varying temperatures.—An apparatus adapted for experiments at high temperatures in the presence of gases under high pressure, by M. L. Cailletet. For this apparatus, which the inventor has had in use for some years, it is claimed that it enables experimenters to raise substances to temperatures near the fusion of platinum while keeping them in a gaseous atmosphere, the nature and pressure of which may be varied at pleasure.—On double dielectric refraction; simultaneity of electric and optical phenomena, by M. R. Blondlot. These experiments have been undertaken in order to determine whether the double dielectric refraction of a condenser is produced and ceases simultaneously with the charge, or whether there exists an appreciable interval of time either between the production of the electric phenomenon and that of the luminous phenomenon, or between periods of cessation of both phenomena. The conclusion seems to be that, if there is any difference in point of time between these several manifestations, it cannot exceed 1/40000 of a second.—On the laws of chemical equilibrium, by M. H. La Chatelier. It is shown that the numerical laws of chemical equilibrium, such as they are deduced from the two principles of thermodynamics, may be expressed in a very simple way by means of M. Massieu's characteristic function H′, which may be regarded as the true measure of chemical force.—On cinchonigine, by MM. E. Jungfleisch and E. Léger. The authors describe the process of preparation, the chemical properties, and the salts of this substance, whose composition is expressed by the formula $C_{28}H_{22}N_2O_2$.—Persistence of the virus of rabies in dead bodies, by M. V. Galtier. These researches show that the virus retains all its virulence in the bodies of dogs that have been dead seventeen and buried fifteen days. Inoculation from the bulb produces rabies in ten and kills in fifteen days after trepanation.—On the antiseptic properties of naphthol-α, by M. J. Maximovitch. The experiments here described show that, owing to its feebler toxic and stronger antiseptic properties, this substance is in every way superior as an antiseptic to M. Bouchard's naphthol-β.—On the presence of primordial fauna (Paradoxidian) in the neighbourhood of Ferrals-les-Montagnes (southern slope of the Montagne Noire), Hérault: (1) stratigraphic study by M. Jules Bergeron; (2) palæontological study, by MM. Munier-Chalmas and J. Bergeron. Considerable interest attaches to the recent discovery of these organisms by M. Bergeron, for the first time in any part of France. They belong to the earliest forms of the Silurian group, forms which were not known to exist when that group was first established by Murchison in 1835. These first French Trilobites of the primordial fauna, as it was named by Barrande, include some exceptionally fine specimens of the genera Conocephalites and Paradoxides, the latter closely allied to the *P. rugulosus* of Bohemia, and the *P. Pradoanus* common in the Cambrian of Spain.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Astronomical Observations and Researches made at Dunsink, sixth part (Hodges, Dublin).—A Student's Manual of Psychology, adapted from Kirchner by E. D. Drought (Sonnenschein).—The Cardinal Numbers: M. Hopkins (Low).—Civilization and Progress; new edition: J. B. Crozier (Longmans).—Lessons on Prescriptions and the Art of Prescribing; new edition: W. H. Griffiths (Macmillan).—Lehrbuch der Entwicklungsgeschichte des Menschen und der Wirbelthiere, Zweite Abthg.: Dr. O. Hertwig (Jena).—Practical Forestry: C. E. Curtis.—South African Butterflies; two vols: R. Trimen, assisted by J. H. Bowker (Trübner).—Journal of the Society of Telegraph-Engineers and Electricians, No. 69, vol. xvi. (Spon).—Journal of the Royal Statistical Society, December (Stanford).—Annalen der Physik und Chemie, 1888, No. 2 (Leipzig).—Beiblätter der Physik und Chemie, 1888, No. 1 (Leipzig).—Brain, parts 39 and 40 (Macmillan).

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