THURSDAY, APRIL 1, 1886

A FISHERY BOARD FOR ENGLAND

IN the House of Commons, on March 6, Sir Edward Birkbeck pressed upon the consideration of the Government the advisability of taking immediate steps to give effect to the recommendations of the Trawling Commission. Few men could have handled the question with so much knowledge and force. Sir E. Birkbeck pointed out that there is urgent need for a central department for the administration of business connected with sea-fisheries, and in supporting his appeal exhibited a detailed knowledge of the clumsy state of the existing arrangements and a wide acquaintance with the statistics and conditions of fishing industries. He pointed out that Scotland and Ireland possessed each a Fishery Board with considerable powers, complete organisation, and liberally supplied with public money. He recommended that a Fishery Board for England should be established which should unite the powers and functions now distributed among the Government Offices. The duties of the Board suggested were that it should collect detailed statistics as to the amount of fish taken, its value, and the number of vessels and hands employed; that it should be responsible for the registration of fishing-vessels; and should be able to recommend legislation when necessary or advisable. The author of the motion further recommended that the Board should divide the English coast into Fishery Districts, each with its Fishery Officer, and that the supreme control of the salmon and other inland fisheries should also be vested in the new authority. Mr. Mundella replied that the Government accepted the principle of the motion, and were about to carry it out by constituting a Committee of the Board of Trade which should be responsible for matters connected with the fisheries, but reminded the House that a Bill would have to be passed to transfer the powers at present vested in the Home Office to the new sub-department.

The present Government are thus pledged to the formation of what is practically an English Fishery Board. If a Fishery Board is useful and valuable it is a surprising fact that Ireland and Scotland have long enjoyed an institution which is wanting in England. It would seem that so much fear exists lest the smaller constituents of the United Kingdom should be neglected or unjustly treated that England is in danger of suffering from complete maternal self-sacrifice. But now that the deficiency is to be remedied it is necessary to consider carefully how the new institution can best be constructed. It is easier to provide good arrangements in the course of construction than to remedy mistakes afterwards. Sir Edward Birkbeck pointed out what functions he thought the new department should undertake. Mr. Mundella refrained from entering into details, only mentioning the subject of floating grog-shops as one requiring immediate attention. Sir E. Birkbeck's recommendations are apparently founded on his knowledge of the constitution of the Irish and Scottish Boards, but he did not enter upon the question of scientific work. He thought that the Board should include a practical element. But the question of what "practical" means depends largely on the particular practice to be carried on. The ordinary interpretation of the word would mean that some member of the Board or Committee should be a man who had been personally engaged in the fishing industry. We have miners in the House of Commons, and doubtless an intelligent fisherman would be useful on a Fishery Board. But the Trawling Commission recommended that money should be granted to the Scottish Board for the purpose of conducting scientific investigations, and that a central authority for the United Kingdom should, when created, also carry on scientific work and collect fishery statistics. For scientific work the practical element means men of science to do the work. The principle is now recognised by several examples. A Professor of Zoology was appointed to the Trawling Commission, and another by the influence of the Scottish Meteorological Society, to the Scottish Fishery Board. A training in science does not always include a training in business details. But in a Fishery Board, and especially in its scientific work, the purely administrative and business work are of subordinate importance compared with the necessity that the inquiries and actions of the department should be carried on by men who have special knowledge of animals, and particularly of marine life. This principle is recognised in other countries. The Fishery Commissioner of the United States is a distinguished man of science, and his colleagues and many of his subordinates are trained scientific men. The Commission for the Investigation of the German Seas is composed of distinguished men who are students and teachers of biology or physics. In Norway and Holland the same thing occurs. It is to be hoped that we in England shall not commit the error of entrusting the affairs of a Fishery Department entirely to men whose only training has been legal or commercial. The mere collection of fishery statistics can only be efficiently carried out, or at least controlled and directed, by men of some scientific training. Fishermen themselves, as was abundantly shown during the inquiries of the Trawling Commission, are too uneducated to estimate truly the meaning of the things they see. For this reason their views and statements must be subject to the criticism of exact science. As the Trawling Commission concluded, it is impossible to discover the causes or measure the fluctuations of the fisheries in the absence of a proper system of fishery statistics and scientific observations. The new laboratory now being founded by the Marine Biological Association will form an important central station for the accurate investigation of fishery questions, and, with the co-operation of smaller and sometimes temporary laboratories at other parts of the coast, some real knowledge of the conditions of our fisheries may be obtained.

As an instance of the care and knowledge which must be devoted to inquiries concerning fishery matters, we may point out that in the Second Annual Report of the Scottish Fishery Board, a fish was described as of a species new to the northern region of the German Ocean, which really belonged to a species long known to be common in the district where it was taken. We believe that only two herring-spawning beds off the coast of Britain are at all accurately known. It is manifestly advisable that our knowledge of the herring, perhaps the most important of our food-fishes, should include an exact knowledge of all the spawning beds round the coast. The assertions of fishermen would be a guide to the acquisition of this knowledge, but it would require scientific men to ascertain the position and extent of the spawning areas, and properly mark them out on a chart. A large number of matters connected with the fisheries have not yet begun to receive attention even in Scotland. The spawn of the sprat is still entirely unknown. The smelt fisheries have never yet, we believe, been examined, and complaints are made in some places that the number of smelt has been seriously diminished by the capture of the young in tidal bag-nets. Statistics of the smaller fisheries ought to be obtained, as well as of the larger, for in many cases these smaller fisheries could be largely developed by intelligent methods. As we have already said, the collection of these statistics requires zoological knowledge, for the same species often bears several local names, which would be put down by an untrained officer as belonging to as many different kinds of fish. What is wanted is a proper division of labour. It does not require a biologist to draw up statistics concerning boats and crews, or carry on purely administrative work. But a large proportion of the work which a Fishery Board ought to carry out is really scientific work, and can only be done by men of science.

Sir Edward Birkbeck very properly included among the functions of the proposed authority that of advising legislation when necessary. The public have learnt by several examples how dangerous it is to legislate in fishery matters, apart from the mere introduction of police regulations, without the basis of results established by experiment. In many cases the laws passed have been themselves experiments, but as the conditions under which they were carried out were complicated, and not properly studied, little accurate knowledge has been gained from them. The Scottish Fishery Board is about to try an extensive experiment with regard to beam trawling, prohibiting that method of fishing in certain defined areas. The experiment is worth trying, even at the cost of temporary inconvenience to the fishery industry. But in order to render such an experiment fruitful, it would be necessary to make a detailed and exact investigation of the areas selected. It is doubtful whether the organisation of the scientific department of the Scottish Board is yet in a position to make this investigation in a sufficiently complete manner. But there can be no doubt that such experiments should be repeatedly made on a sufficiently large scale ; and on their results legislation may be based with some safety. Without them it is better not to legislate at all. No one is at present in a position to say how far artificial propagation can be applied to sea fishes with results economically successful. In America even the extensive resources of the Fish Commission have not yet settled this question. In view of the annually increasing efficiency in the means of capture of marine fish, it would be certainly wise to lose no time in at least ascertaining by suitable experiments, if it be at all possible to add by human intervention to the supplies of sea fishes provided by unaided nature. The harvest of the sea has been gathered by man for ages; the time may yet come when it will also be sown by human foresight.

Moreover, beyond and above the necessity for practical scientific work, there is another advantage which inevitably follows from the association of scientific investigation with the work of a Fishery Board. The results include additions to abstract scientific knowledge, and facilitate in many ways purely scientific researches. The extent to which biology especially has been enriched by work primarily intended to develop the fisheries is well known. It is not to the credit of the United Kingdom that this remark applies chiefly to foreign countries. The valuable aid which the Fish Commission renders to biological science in America can scarcely be too highly estimated. The attention which has been paid to the questions concerning the breeding of fishes has advanced our knowledge of teleostean embryology much more rapidly than would have been possible from purely academic work. The scientific public, then, should insist that exact science be represented in the English Fishery Department, by whatever title it may be called. At least one leading official of the department should be a biologist of recognised standing, who could properly organise the scientific inquiries which must necessarily be undertaken. It would be well if at least one other member were a meteorologist or a physicist. It is inevitable that the new department, if it is to be of any use at all, must apply to men of science for counsel and assistance, and this assistance can most efficiently be rendered by men of science who are members of the administrative body. In this way the organising and directing power of one or possibly two scientific authorities should be secured for the department, but, in addition to this, a staff of subordinates trained as scientific naturalists is absolutely necessary to carry on the actual work of inquiry and observation. These officers must be really competent men, or their services will be worse than useless. They should also be *permanently* employed, and not asked casually to undertake an inquiry. No doubt the department should have the power and the necessary funds to retain the services from time to time of the most highly-skilled men of science to carry on special investigations in connection with questions which arise. But every man of science knows that constant and permanent occupation in a special branch of inquiry, without uncertainty as to pecuniary conditions or undue anxiety to obtain a striking result in a short space of time, is the most favourable condition for the production of really trustworthy and progressive scientific work. It is on this account that we should urge the formation of a staff of permanently employed scientific investigators similar to the staff of the Geological Survey.

For in truth what that important State enterprise has effected for the economic exploration of the land of the British Islands is *mutatis mutandis* very much what has to be done for their seas. The parallel may indeed be pushed pretty far. For just as the deeper search for minerals, such as coal and iron—and even water—has now to depend on accurate geological knowledge when the resources of superficial prospecting are played out, so we may come to have to take seriously into account the conditions and place of production of the fish which we complacently content ourselves with hauling up in our nets. The Fishery Department has hitherto been in a tolerably chaotic state. But at any rate it summoned to its aid the most eminent biologist of the day. It would be an extraordinary anomaly if a carefully considered organisation discarded at starting the scientific help on which it will eventually have to rely.

ELECTRIC LIGHTING LEGISLATION

IT is not so many years ago that our only notion of practical electric lighting was the arc lamp. Experiments had indeed been made for many years (commencing as far back as in the year 1845) in the direction of incandescent lighting,—experiments where platinum and platinum-iridium wires had been made incandescent, where carbon in the form of sticks or pencils having very low resistance had been made incandescent. Indeed, King's experiments in the year 1845 had been made with the carbon pencil, and a proposition had been put forward for preserving these carbons from combustion by their use in closed vessels, in which either a vacuum was formed, or a preservative atmosphere, such as nitrogen, was introduced. But all these attempts at incandescent lighting were, as has been said, in a purely experimental condition, and the arc light was the only one in practical use.

At that time it was said that even if a satisfactory incandescent lamp could be made there was still, even for separate installations, the difficulty of dividing the electric current, and as regards anything like a distribution of electricity from a central source there was a further commercial difficulty in the great cost of the conductors suited to carry the needed current.

This state of things was followed by contradictory rumours of what Mr. Edison was doing in the United States. First that he had succeeded in producing a durable incandescent lamp; then that he had utterly failed; then that there was hope that he was about to succeed with the lamp, but he felt he must abandon any attempt to divide the current; and then similar contradictory rumours as to the possibility of supply from a central source.

At length, some six or seven years ago, it became undoubted that Edison had devised an enduring lamp, having a filament of high resistance; that the current could be readily divided to these lamps by placing them in parallel arc; and that, by the raising of the electromotive force to that needed for the working of the lamps, the mains could be reduced to within reasonable limits of cost.

After some little time had elapsed no doubt there was a very large amount of commercial speculation entered into in connection with electric lighting,—a most unfortunate thing for those who seriously desired its development, a most unfortunate thing for private persons who wished to adopt electric lighting.

The promoters of electric lighting had thought that, if they could show to Parliament they were prepared to undertake the lighting of a district, they would obtain the Parliamentary sanction needed in the case of railways, docks, water, gas, and other industrial undertakings, and under proper precautions granted by Parliament to those who were willing to subscribe capital. But at this point the Board of Trade intervened, under their then President, Mr. Joseph Chamberlain, and setting all precedent at defiance, obtained the passing of their Electric Lighting Act of 1882, an Act jocosely called "An Act to *facilitate* and regulate the supply of electricity for lighting and other purposes."

From the title of this Act any one would imagine that, while Edison had devoted years of his life to making electric lighting by incandescence possible, Mr. Chamberlain, appreciating these efforts, had stepped forward with a law which was to be generally applied; and that the labours of the statesman were to be in continuation of those of the philosopher in developing electric lighting. "Facilitate," on turning to Ogilvie's dictionary, one finds "to make easy or less difficult," "to free from difficulty or impediment."

Mr. Chamberlain's interpretation of the word "facilitate," as one gathers that interpretation from the 27th section of the Act, confirmed by four years' experience of its effects, is a very different one. "Facilitate" with him must mean "to make difficult or less easy," to "encumber with difficulty or impediment, or to add to it." The 27th section, which is set out *in extenso* in a footnote, may be briefly summarised as follows:—After the expiration of twenty-one years (or even a shorter period if the opponents can succeed in getting its insertion in a special Act), any local authority, corporation, or local board, or sanitary authority in whose district the undertaking is situated, may insist upon the undertakers selling to such authority the undertaking, and if they cannot agree as to the price, as, of course, they would not (for one does not agree in cases of confiscation), the value is to be determined by arbitration; but the value is only to be the fair market value oft he lands, buildings, works, plant, and material at the time of the purchase, but nothing is to be added in respect of "compulsory purchase," or of "good-will," or of profits, past, present, or prospective. Be it observed, however, there is no obligation on the part of the local authority to purchase if the concern does not pay at the end of twenty-one years. The local authority may forego the right to purchase. But then, still further to "facilitate" the investment of capital in electric lighting, the local authority at the end of a further seven years is again invested with the option, and so on from seven years to seven years.

At an interview between the parties something of this sort can well be imagined:—Mr. Town Clerk to the Chairman of the Company: "The end of the twenty-one years is coming, are you making a profit?" "We have begun during the last few years to pay a small dividend—3 per cent." "Oh! we can get 10 per cent. out of the extension of our gas-works. We sha'n't buy your electric light undertaking." The twenty-seventh year comes. Mr. Town Clerk and the Chairman again have an interview. By this time electricity has been appreciated; gas is going out of fashion, and the electric lighting shareholders are beginning to get some return for their years of labour, of no dividend, and of low dividend.

Chairman: "We made last year 7 per cent., and the year before 6."

Town Clerk: "Do you expect to continue 7 per cent. or do you think it will increase?"

"Well, we have now so many applications for the electric light in substitution of gas, that in frankness I must say I believe the dividend will not only be maintained but will be augmented, and within a few years will reach the maximum allowed."

"Thank you, Mr. Chairman. After the next council meeting you will receive a notice that the corporation in-tend to purchase your electric light undertaking, at the price of the materials, under the 27th clause of Mr. Chamberlain's Act!"

In fact, the local authority is by that Act put into the position of the big bully who tosses halfpence with the little boy, and makes him agree to "heads I win, tails you lose."

The Act provides that local authorities may themselves supply electricity for lighting purposes, and perhaps it may be said this was a real facility (a facility in the Ogilvie dictionary sense, and not in the Chamberlain dictionary sense). But has it been? Up to the end of last year it is believed not a single application had been made by any local authority to the Local Government Board in respect of a provisional order under this Act. The reason is clear. The local authority (and properly enough) does not wish to risk the ratepayers' money in that which may prove an unsuccessful adventure, and it says, "We'll wait until some company comes and does it—does all the pioneering, all the educating of the people to take a new source of light, runs every risk; and then if it turns out a failure, we shall have lost nothing; if it turns out a success, we'll acquire the right to make the profits for ourselves at the mere value of the then material," this being a value so small compared with the capital embarked that the revenue which would have paid only 5 per cent. on the capital invested will pay 10 per cent. upon the sum for which under Mr. Chamberlain's Bill the local authority will be entitled to acquire (we do not say "steal") the undertaking.

The Act, therefore, has proved not to "facilitate," in the ordinary sense of the word, the extension of electric lighting by local authorities; and is it surprising that (great as is the need of investment for capital with the hope of remuneration) it has been impossible to obtain money for private enterprise to develop electrical lighting by distribution from a central source with Mr. Chamberlain's 27th section staring the capitalist in the face?

When the Bill was in Committee, the maximum period allowed for enjoyment was not as long as twenty-one years, and the hardship upon investors having to give up their property at the end of the period was pointed out. The objectors were answered in this way, "Oh! you can charge such a price for your electricity that you will be able to get back your capital in the time allowed and earn a good dividend too." To this it was and is objected, that the great difficulty in spreading the business of electric lighting would be the competition with gas, and the low price to which it has been reduced by reason of private management and the sliding scale (of which more hereafter); coupled with the fact that the expense of supplying houses with gas-fittings had been incurred while a new outlay would be needed to furnish it with electrical fittings; so that it was impossible to hope for any custom at all if a high price were to be charged, which would prevent the chance of getting back capital by increasing the rate. It was also pointed out that any fixed period of purchase upon the terms of payment mentioned was prohibitory of practical working.

Suppose, for example, that £50,000 had been embarked in lighting a district, and that ten years having elapsed, the demand for electric lighting in the district was such as to need an increase of plant and mains, involving the expenditure of another £50,000. It is obvious that with only ten years' enjoyment remaining, no one would be insane enough to advance a shilling of this further capital; and this must be true, however extended the period of enjoyment might be, so long as the sum to be paid on acquisition is merely the value of the "then materials."

It may be asked, how came such an Act to be passed in the face of all these obvious objections? The answer is twofold. One, the growing and most mischievous tendency to make governing bodies into traders; the other, the fear of what might happen from having already made governing bodies, such as those of Birmingham, into traders. Local authorities had been stimulated to become the proprietors of gas undertakings, to risk the money of their ratepayers in a trade, in a highly artificial matter such as gas illumination. Under these circumstances, no matter at what sacrifice of the true principles of political economy, no matter what principles of ordinary fair dealing were abandoned, lighting by electricity must be so "facilitated" that it should never compete with local authority gas-works. No doubt it will be the same if local authorities ever make the plunge and adopt electric lighting; and if hereafter some one were to invent a practicable mode of storing up daylight and delivering it out at night (luminous paint to wit), then the Chamberlain of the day would obtain an Act to "facilitate" its use, which would be as efficacious as has been the "facilitating" Electric Lighting Act of 1882.

During the four years since that Act was passed, the public have become more and more alive to the merits of incandescent electrical lighting. Steamships, clubs, hotels, Inns of Court, and the mansions of the wealthy, are being lighted by separate installations, with a result in health, cleanliness, and convenience that must be experienced in order to be fully appreciated. This is all very well for the rich, but why are the poor, the tradesmen, or even the moderately well-off, to be debarred from the benefits of electric lighting? Why is the dressmaker's workroom or the shopkeeper's shop still to be lit by an illuminant which not only consumes the air, but gives out products of combustion intolerably heated, and charged with ingredients prejudicial to health, prejudicial to cleanliness, and destructive to books, paintings, and furniture?

In New York, where electricity has not been "facilitated," incandescent lighting has, during the last three years, been provided to all who cared to take it (and they are a very large number) who reside within a certain distance from a central distributing station. Why is that not to be allowed here? Why, in the present depressed state of trade, are not capitalists permitted to invest their capital upon the fair terms which have been allowed to every other industry, and thus give employment to thousands of operatives who are now out of work? Why are we to continue to use the gas from a ton of coal as an illuminant to obtain the light of 30,000 candles for one hour when the selfsame gas, driving an engine to produce electricity for electric lighting, would give us 50,000 candles for the same time. We are told we are to be debarred because of the fear of creating a monopoly, the truth being that this evil is permitted in order to maintain the monopoly which local authorities in certain towns have already got, and that must not be disturbed; while in the metropolis the effect of this Act is to foster the gas monopoly by preventing electrical competition.

It has been said that no other industry was ever burdened as electrical industry has been by the "facilitating" Act. The answer made to this statement before the Committee, and since, has been, "It is not so. Compulsory acquisition of a trading concern by the Government is no new thing."

There is Mr. Gladstone's Act of 1844, enabling the Government to purchase the railways; but what are the terms of purchase in this Act? At the end of a term of twenty-one years (see Section 2), notice to acquire might be given, but the payment was to be twenty-five years' purchase of the annual divisible profits on the average of the three preceding years, provided that the average rate should be less than 10 per cent; and further, mark this: "It shall be lawful for the company if they shall be of opinion that the said rate of twenty-five years' purchase of the said average profits is an inadequate rate of purchase of such railway, reference being had to the prospects thereof, to require that it shall be left to arbitration, in case of difference, to determine what (if any) additional amount of purchase money shall be paid to the said company."

In the case of certain of the Indian railways, the Government guaranteed 5 per cent. upon the money from the moment it was paid.

But the great instance relied on by Mr. Chamberlain was that of the Tramways Act of 1870. By virtue of this Tramways Act a company gets for nothing the actual surface of the road on which to lay its rails, to the great annoyance of all other traffic. The public require no education to ride in a tramcar; it appears upon the road, and the traffic begins at once. Although it may not be desirable, there is nothing revolting in the condition that at the end of twenty-one years the surface-soil should revert to the authorities on payment of the then value of the materials; but the Tramways Act has most carefully provided that the local authorities should not become traders in running tramcars. All that they can do, if they purchase, is to let the tramways on lease to other persons. The temptations, therefore, to acquire are not what they would be in the case of a successful electric light undertaking.

With respect to the bugbear of monopoly—this bugbear has been raised no doubt very largely by the mode of charging for water. On sanitary grounds it has been deemed expedient not to charge for water for domestic purposes according to the quantity supplied, but according to the ratable value of the dwelling in which it is used; and, under this provision, anomalies have arisen, and dissatisfaction has been felt, and the public, without examining the advantages, and without pausing to discriminate between the difficulties inherent to such a mode of charge, and the simplicity attendant upon a charge based on the quantity of the thing supplied, have rushed to the conclusion that every supply by a private company of that which is commonly used is an injurious monopoly involving the payment of more than a fair dividend upon the capital embarked. But recent legislation in respect of gas has entirely removed all reasonable grounds of objections such as these, and it has done so by the introduction of two clauses—the sliding scale clause already alluded to, and the auction clause.

The sliding scale gives a direct incentive to sell the commodity at the lowest possible price consistent with earning the dividend, because it provides that, as the price is diminished below the standard, the statutory dividend may be increased, while, if from any cause, such as a coal famine, the price is raised above the standard, the statutory dividend must be proportionately diminished. This great incentive to economy (benefiting alike the consumer and the shareholder) has entirely cured the supineness in the way of improvement that was fostered by the old condition of things, wherein the consumer was facetiously said to be "protected" by the fixing of a maximum dividend and a maximum price.

The other provision is one that thoroughly prevents the consumer from paying more than the fair market rate of interest needed to cover trade risks. That provision is known as the "auction clause." Under this clause all capital (after the first), instead of being allotted at par among the existing shareholders, must be offered to the public in suitable lots. By this means, if the rate of dividend allowed by the Act is deemed by the public to be more than sufficient to give a return, having regard to the trade risk, the public pay a premium for these shares. That premium goes into the capital of the undertaking, but bears no dividend. Thus the public are thoroughly protected against paying an undue rate of interest.

Having regard to all the foregoing facts, a Bill has been prepared on this very simple and intelligible basis—that electric lighting should be put on exactly the same footing as gas-supply: obligations to keep the mains always charged, to supply electricity on demand to any person wanting it on similar conditions to those which attend the obligatory supply of gas, the provision of a statutory dividend, a standard price, and a sliding scale, so as to give incentives to improvements benefiting alike the consumer and the shareholder, and the insertion of the auction clause for all future capital, by which the public are secured against paying an undue rate of interest.

This Bill—one so simple and fair in its character—has met with the thorough approval of Lord Rayleigh, who has now obtained a second reading for it in the House of Lords. No peer probably could with greater propriety take charge of a Bill relating to the practical application of electrical science. Lord Rayleigh's high position as a physicist marks him out as the proper person to bring forward such a Bill.

At the same time there are two other Bills before the House of Lords for the amendment of the Act of 1882. The first of these is that presented by Lord Ashford (better known as Lord Bury), the important section of which, the 6th, repeals the 27th section of Mr. Chamberlain's Bill of 1882, gives forty-one years as the period before the option of purchase arises, with recurrent periods of seven years, but provides that the purchase, whenever made, shall be upon the terms of paying the then value thereof as a going concern. The words prohibiting the arbitrator from taking profits into account are omitted, and the probability is that the arbitrator would be entitled to assess the value upon profits.

The second Bill is presented by Lord Houghton as representing the Board of Trade. The print of it has not yet been had, but it is understood to make no change in the objectionable features of the existing Act, but merely to add somewhat to the length of the term before the option of purchase arises. If this be so, it will still leave electric lighting as much "facilitated" as before, for there can be no increase of capital, and therefore no development, in an undertaking where, in a few years, the enjoyment of the interest upon that capital has come to an end, and where, when it does come to an end, a large portion of that capital will be confiscated.

Lord Houghton's Bill has this value, however—it shows, first, the length of time it takes the Board of Trade to admit they have made an error, and it shows, secondly, that it requires yet a still longer time to enable them to understand what that error is.

ELECTRO-DEPOSITION

Electro-deposition of Gold, Silver, Copper, Nickel, &c. By A. Watt. (London: Crosby Lockwood and Co., 1886.)

IN the preface of this book is stated:—"The author's desire was to furnish" "a comprehensive treatise, embodying all the practical processes and improvements which the progress of science has, up to the present time, placed at our command." "The author's aim has been to treat the more scientific portion of the work in such a manner that those who are not deeply versed in science may readily comprehend the chemical and electrical principles of electrolysis, the knowledge of which is essential to those who would practise the art of electro-deposition with economy and success." How far he has succeeded in his desire and aim, and to what extent the contents of his book are suitable to electro-metallurgists and agree with its title, it is our duty as reviewers carefully to examine.

The book is essentially and almost exclusively a workman's manual. In accordance with this we observe that out of about 568 pages, only about 18 are strictly devoted to the fundamental principles or foundation of the subject.

It is evidently written and compiled by a "practical" man who has spent a long period of time in electro-plate workshops. It has various excellences and defects, the most important of which we will endeavour to point out. Its chief excellence consists in the remarkable completeness of information given respecting the details of workshop manipulation, in describing the treatment of nearly every kind of article requiring a coating of electro-deposited metal. The author has with great industry and perseverance collected a large amount of such information, and his book is especially full of details respecting the electroplating of articles with nickel. The information contained in it is, with certain exceptions, well up to date, and the printer's errors are remarkably few. It has also the advantage of a copious index consisting of nearly 50 pp., and the subject-matter of the book is conveniently divided into chapters of moderate length, with the contents of each chief paragraph plainly indicated by bold headings.

Its greatest defects are those of omission; it is seriously deficient in the chemical, chemico-electric (*i.e.* voltaic), and electro-chemical (*i.e.* electrolytic) principles of the subject. Throughout the volume nothing is said respecting the fundamentally important matter, both theoretically and practically, of the chemical valency of the elementary substances; the chemical, voltaic, and electrolytic equivalents of those elements are also neither given nor explained. On p. 513 a table of atomic weights of the chemical elements appears, but as only a portion of these are equivalent to each other, and those not indicated, they would, without the valencies or a separate table of combining-proportions, in many cases only mislead an unscientific workman. The only indication of any difference existing between atomic-weight and chemical-equivalent is contained in a footnote to that table, saying, "the combining-weight of oxygen is 8."

From beginning to end of the book, the molecular and equivalent weights of all the compound substances employed in electro-deposition are omitted; none are given even for the commonest substances, such as sulphuric acid, potash, soda, lime, double cyanide of silver and potassium, blue-vitriol, potassic cyanide, double sulphate of nickel and ammonium, &c.; similar remarks may be made respecting the salts of zinc, cadmium, lead, tin, iron, nickel, copper, silver, gold, palladium, platinum, bismuth, antimony, &c.; also respecting hydrochloric, nitric, and other acids. Almost the only exception appears to be on p. 483, where it is said, respecting the salt used for making nickel-plating solution:—"The double salt consists of 1 atom of sulphate of nickel, 1 atom of sulphate of ammonium, and 8 of water."

Throughout the book also the chemical formulæ of all those compounds are omitted, notwithstanding that they would enable the workman to arrive in many cases at the chemical equivalents by comparing them with the atomic weights, and would also assist him to more perfectly realise and remember the actual chemical composition of the acids, bases, and salts used in his occupation.

In accordance with these omissions, no principle or general rule is supplied which will enable the operator to calculate how much in weight of a given metal or base would be necessary to neutralise a known amount of a particular acid, nor what quantities of acid and base would be required to form a certain weight of a salt, in making and correcting his various solutions; nor how much current would be generated by the consumption of known amounts of different positive metals or of different acids; nor what quantities of different metals would be deposited at the cathode, or of unlike ones dissolved at the anode, by the passage of a given amount of current through an electrolyte. Respecting this latter point, on p. 72 it is, however, stated:—"The decomposing effects produced by the voltaic current in different electrolytes are precisely in accordance with the *atomic-weights* or *chemical-equivalents* (which see) of the substances electrolysed." "For example, the same amount of electricity that would reduce 56 parts of iron from its solution to the metallic state, would reduce 207 parts of lead or 108 of silver." But the "chemical-equivalents" to which the reader is here referred are not to be seen in the book, nor does the table of "atomic-weights" necessarily indicate them; and either the above numbers given by the author for iron and lead are double the correct amounts, or that for silver is only half the proper quantity. This is an example of the misleading effect we have already referred to, of the table of atomic-weights, when unaccompanied by valencies or by one of combining-proportions, and used by a person unacquainted with the difference between atomic-weights and chemical-equivalents. The nearest approach to information respecting chemical-equivalents is indicated on p. 480, in instructions for testing the strength of potassic cyanide, but this is applicable only to the particular substances employed in the case. Any electro-depositor therefore who, relying upon the information contained in this book, wished to calculate the cost of depositing various metals, or to make experiments or improvements in his processes, outside the mere empirical or "rule-of-thumb" circle of knowledge, and involving chemical principles, would not be enabled to do so; in novel cases of difficulty in electro-deposition also, this deficiency of knowledge of chemical principles might prove a great disadvantage to him.

On p. 80 the writer says:—"It is necessary, in the present advanced state of electrical science, that both the student and practical operator should be acquainted with the principles and laws which govern the development of electricity;" and in the preface he speaks of "the chemical and electrical principles of electrolysis," "the knowledge of which is essential to those who would practise the art of electro-deposition with economy and success." But notwithstanding these statements, the important matters we have mentioned are omitted, and the student and practical operator are referred (pp. 80-90) "for a more intimate acquaintance with the principles of voltaic and dynamic electricity" to other books.

We observe that in Chapters V. and VI., on the theory of the subject, nothing is said about the thermal principles of electrolysis, or of the absorption and evolution of heat by chemical changes at the surfaces of the plates in voltaic and electrolytic cells. In the chapters on electro-deposition and electro-metallurgy of copper, the chemical analyses made by the Duke of Leuchtenberg (p. 395) and others, showing the composition of the insoluble matter of the anodes, are not given. The special defect of thermo-electric piles, viz. that they are only durable if kept at unvarying temperatures, is also not mentioned. And nothing is said of the presence of sulphur in electro-deposited "bright" silver. These, however, are much less important omissions.

The errors in the book are not many; we have observed the following:—"Nine parts of water consist of one part, *by weight*, of hydrogen, and eight parts, *by weight*, of oxygen; or by volume, 1 part hydrogen and 16 parts oxygen" (p. 74); the error is obvious. Roseleur says, "that solutions of cyanides, even without the aid of the electric current, rapidly dissolve in the cold, or at a moderate temperature, all the metals, except platinum" (p. 174); this statement of Roseleur's is not quite correct, iron is nearly as little dissolved as platinum, in a cold solution of pure potassic cyanide.

The author says that for containing cyanide of silver plating solution, "wooden tubs may be employed for small operations, but since that material absorbs the silver solution, such vessels should be well soaked in hot water before pouring in the solution" (p. 241). We may remark that such soaking does not prevent the wood becoming saturated with the silvering liquid.

On p. 270 it is stated that a solution of sulphide of potassium "dissolves" silver. This is not correct; it converts the surface of the silver into sulphide without dissolving either. On p. 365 the author speaks of "Chevalier Bunsen's methods" of electrolysis. We may state that the "Chevalier," and Bunsen the chemist, whose methods are referred to, are two different persons.

In various parts of Chapter XXX., on the electrolytic refining of copper, the author, speaking of where this process is in use, says:—"Besides Messrs. Elkington's works at Pembrey, South Wales," "by the Elliott Metal Refining Company at Selly Oak, near Birmingham, where Wilde's machines are employed." And under the heading of "Electrolytic Refining at Birmingham," he says:—"The Elliott Metal Refining Company, of Selly Oak, near Birmingham, employ five large Wilde machines, which refine about ten tons of copper per week;" and he then gives a variety of particulars respecting the arrangements employed, the "thickness of deposit" of copper per week at the "Selly Oak Works, Birmingham;" the "cost of electrolytic copper refining" at those and other works, based partly upon the cost of fuel "in Birmingham and Swansea," &c. (pp. 416, 420, 423, 424, 425). All this is founded upon a mistake; there is not, nor ever has been, any "electrolytic refining of copper," nor any plant for such a purpose, at "Selly Oak" or at "Birmingham," or anywhere near those places. This error appears to have been first published by M. Fontaine in his book on "Électrolyse," then copied by Berly in his English translation of that book, and again copied by Watt. The explanation and facts are: the Elliott Metal Company, of Selly Oak, near Birmingham, possess and carry on the Electrolytic Refining Works at Pembrey, near Swansea, formerly possessed by Messrs. Elkington.

The redundancies in the book are considerable; the following are examples:—Description of several voltaic batteries which are rarely used for electro-deposition, viz. Callan's, Walker's, Leclanche's, the bichromate, and Marie Davy's (pp. 11, 13, 15, 16); an account of Mr. Charles Watt's magneto-electric machine (p. 25); description and engraving of Mr. C. Watt's thermo-electric battery (pp. 42-45); the source, mode of collecting, and purifying gutta-percha (pp. 94, 95); gilding metals with gold leaf (p. 195); processes and compositions for colouring ordinary gold articles by chemical means (pp. 198-201); mercurial gilding, gilding bronzes with amalgam, ormolu (pp. 202-208).

A considerable portion of the book also is occupied by information which, although very useful to jewellers and other workers in metal, does not strictly belong to the subject of "Electro-deposition;" we allude to the following:—Driving-belts (pp. 487-493); gas-engines (p. 492); speed indicator (p. 497); characteristics of metals (pp. 498, 499); alloys (pp. 500-504); soldering metals (pp. 504-507); table of high temperatures (p. 515); tables of different wire-gauges (p. 517).

In various parts of the book, whilst there is an excess of details of manipulation, there are very few references to general principles, as if the main object of the author was to enable the workman to compensate for deficiency of knowledge of scientific laws by means of "rule-of-thumb" experience and by remembrance of a multitude of empirical instructions. In order therefore to enable the artisan reader to make the best use of the book, we would recommend him to previously learn sufficient of the principles of chemistry and of voltaic and electrolytic action, and then master the very numerous practical details of this book.

Repetitions of small matters are frequent in the book; in more than twenty instances the same statement has been made in modified forms, from two to four times. These repetitions are most frequent in the chapters on deposition of nickel.

In consequence of the considerable redundancies, the large amount of extraneous matter, the excess of details of manipulation, and the repetitions, a large quantity of matter might have been omitted, and the contents of the book would have been rendered more in accordance with the title. According to the present contents, a more appropriate title would have been "Manipulations in Electro-deposition," &c.

The writer of the book makes the following statement on p. 213; speaking of "cheap jewellery" he says: "The author has found it a very convenient plan to use a *copper* anode for gilding work of this description, and by making small additions of chloride of gold when the bath exhibited signs of weakness, he has been able to gild a very large number of articles of a very fine colour, with an infinitesimal amount of the precious metal. In his experience, although the prices were very low, the result was exceedingly profitable. Against the employment of a copper anode it has been argued that the solution must of necessity become highly impregnated with copper, to which we may reply that we did not find such to be the case in practice." The circumstance he mentions—that the solution "did not become highly impregnated with copper" is easily and correctly explained: the solution did become charged with copper, but not "highly," because the copper was deposited as fast as it was dissolved in alloy with gold upon the articles, and thus produced the "very fine colour," and conduced to the "exceedingly profitable" character of the result. A complete proof of this is afforded by the author on p. 197 of his book, in his instructions for depositing alloys of gold.

On p. 214 he very truly remarks: "The introduction of the electro-gilding art greatly favoured such unscrupulous persons as desired to prey upon the public by selling as gold, electro-gilt articles which had not a fraction of the precious metal in their composition." As an example of this he mentions "mystery-gold," and states that "the chief aim of the manufacturers" of articles made of that composition "is to defraud pawnbrokers."

In Chapters XXIX., XXX., and XXXI., on "Electro-metallurgy," the author has copied and collected together, from Fontaine and Berly's books on "Electrolysis," and various periodicals, &c., nearly all the information yet published respecting the electrolytic refining of crude copper, lead, zinc, &c., on the commercial scale, and the economic extraction of metals from minerals by the aid of electrolysis. Six pages of those chapters are devoted to a description, with drawings, of Cowle's electric furnace. But this furnace is not "electrolytic": it is one in which an intense heat is obtained by means of the electric arc on a large scale in an inclosed fire-resisting chamber, in which carbon at an enormous temperature reduces aluminium and silicon from their oxides, and those reduced elements form alloys with copper previously mixed with the carbon. Much of the information contained in these chapters is useful, but a large portion of it relates to new processes, and partly unsuccessful experiments on a large scale; and as some of those processes are imperfect and in a state of development, the statements made respecting them should be received with caution.

In consequence of the serious deficiency of information respecting the chemical, voltaic, and electrolytic principles of the subject, we do not consider that the author has succeeded in his aim "to treat the more scientific portion of the work in such a manner that those who are not deeply versed in science may readily comprehend the chemical and electrical principles of electrolysis." But notwithstanding the fundamental and minor defects which we have pointed out, as the details of workshop information and manipulation contained in the book are so copious and complete, we think he has substantially attained his "desire to furnish a comprehensive treatise embodying all the practical processes and improvements in the art of electro-deposition"; and, irrespective of its shortcomings, the book will prove of great value to many electro-depositors, jewellers, and various other workers in metal.

OUR BOOK SHELF

"*Weatherology*" *and the Use of Weather Charts.* By Campbell M. Hepworth, R.N.R. (London: Laurie, 1886.)

METEOROLOGISTS must wish success to this endeavour of Capt. Hepworth's to popularise their technical phraseology, and to explain how the public can utilise the weather-charts which appear daily in the *Times* and *Lloyd's List*, in combination with local observations of wind, sky, and weather. The author has considerable sea experience in the North and South Atlantic, and he imparts the results of it freely, but his language is still rather too scientific for an ordinary reader.

Without being hypercritical, we must take exception to two statements. The definition of a "gradient" is defective, for no mention is made of the unit of barometrical difference (0·01 inch), which is employed, while the modern unit of distance is 15 miles, not 60.

Again we must protest against fathering on Admiral FitzRoy (p. 5) the form of siphon barometer which is sold for a guinea, and sometimes is called after him, sometimes dubbed the "Polytechnic barometer." There is no authority to connect the Admiral with it, as either inventing or even approving of it. ROBERT H. SCOTT

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.*]

Residual Magnetism in Diamagnetic Substances

IN the account which Prof. Lodge gives of his very interesting experiments (NATURE, March 25, p. 484) he describes an observation which at first sight seemed to show the existence of residual diamagnetic polarity in a diamagnetic substance after exposure to a strong field, and remarks that this seemed an incomprehensible result. It appears to me that this result, should it be confirmed, is not incomprehensible on Weber's theory of diamagnetism, if we supplement that by a modification of the Ampère-Weber theory of ordinary magnetisation.

Suppose that the induced currents in the molecules of a diamagnetic substance are confined to definite channels, that there is little or no primitive current, and that the molecules are capable of being deflected. Then as the field is increased, each molecule is turned so that the plane of its channel becomes more and more nearly parallel to the lines of force. We may assume that this turning of the molecules is resisted, like the turning of the molecules of iron, and that when the field is withdrawn they return more or less completely towards their initial positions.

Experiments with iron and steel show that in the turning of the molecules the resistance while the field is being applied is on the whole greater than the restoring force, while the field is being removed: in fact something very like static friction acts on each molecule. There is what I have elsewhere called "hysteresis," or lagging behind, in the relation of the molecule's movement to the magnetising force. If this molecular quasi-friction also exists in diamagnetic substances, and if the molecular channels are turned at all, they will, during the removal of the field, be in less favourable positions for the induction of currents than they were in during the application of the field. There will consequently be a residue of current in each when the field is wholly withdrawn; and these residues will make the substance a permanent "diamagnet."

But the fact that this result would be comprehensible is no evidence of its truth, and apparently Dr. Lodge inclines to interpret the experiment referred to in an entirely different—indeed opposite—sense. Moreover, his other results show not residual *diamagnetism*, but residual *paramagnetism* in diamagnetic substances which have been immersed in a very strong field.

Now I think this result may also be interpreted in terms of the magnetic theory of magnetisation; and the purpose of this communication is to suggest an explanation which seems to me so probable that it may perhaps serve, until Dr. Lodge confirms these results, as a set-off against the suspicion he has cast on them by suggesting the presence of iron in his diamagnetic bodies.

When we begin to magnetise iron by a field which increases from zero, we find at first scarcely a trace of magnetisation. A curve showing the relation of intensity of magnetism to magnetising force starts off (as nearly as can be judged) tangent to the line along which the magnetising force is plotted, but soon, of course, takes a rapid bend as the permeability increases. This is very consistent with the idea that the molecular electromagnets are held back from turning by a sort of static friction which requires the field to reach a finite value (different perhaps for different molecules) before the process of turning begins. But what has happened before this process begins? Diamagnetic induction has been going on in each molecule that has not begun to turn; and hence, if the molecular configuration is rigid for a magnetising force of any finite magnitude, the substance is diamagnetic in that and all weaker fields.

If this be the case in iron (and the experimental evidence certainly points to the existence of a finite frictional resistance to the turning of the molecules) that metal is really diamagnetic in excessively weak fields, because the molecules are fixed by friction; then very paramagnetic in stronger fields, because the molecules are turning; and, finally, diamagnetic in a field strong enough to turn the molecules as far as they will go, and to induce currents in them which swamp the primitive Ampèrian currents.

Next, imagine a substance whose molecules are held by friction in a very tight grip, so that no moderate magnetising force is able to alter their configuration. The substance is then diamagnetic, and when the field is withdrawn there is no residual polarity. But let a field be applied strong enough to begin turning the molecules. This will cause a decrease of diamagnetic susceptibility. And when the field is withdrawn the molecules remain deflected, and the substance is a permanent *paramagnet*.

Now this is exactly what Dr. Lodge has observed in his copper, coke, wood, and so forth. They behaved as diamagnetics while in the field, but showed paramagnetic polarity when withdrawn from it.

My suggestion, then, is that in diamagnetics, as in paramagnetics, there are strong primitive Ampèrian currents circulating in the molecular channels. That in a strongly paramagnetic substance such as iron there is comparatively little molecular rigidity, so that the molecules begin to turn even in very weak fields; the induction of currents in their channels then plays a very insignificant part in the magnetisation. That in a diamagnetic substance, on the other hand, the molecules stick so fast that in any moderate field they have scarcely begun to turn; the induction of currents goes on independently of the existence of the primitive currents, and is then practically the whole affair. But if the field be made strong enough the molecules begin to turn, not in the way spoken of in the earlier part of this communication (where it was assumed that the induced currents swamped the primitive currents), but in the way in which the molecules of iron turn. Then common magnetisation becomes superposed on diamagnetic induction. And when the field is withdrawn the molecules are left with a paramagnetic alignment, and with their primitive Ampèrian currents strengthened, if anything, since they have been facing more favourably during the withdrawal of the field.

There is nothing to show that the primitive Ampèrian currents are not as strong and as numerous in copper or bismuth as in iron. If they are, and if we could only apply a field strong enough to force them into alignment, we might expect to find, in substances so hard to magnetise, a permanence in the residual magnetism which would put steel to the blush.

University College, Dundee, March 27 J. A. EWING

Ferocity of Rats

I HAVE recently had occasion to chloroform a number of wild rats for the purpose of procuring their blood. The rats are sent to me by a ratcatcher, who places from six to twelve in the same trap or cage. It usually happens that, within a few hours after their imprisonment, some of their number are killed and eaten by the others; while they all exhibit scars as the result of their struggle for existence in confined quarters.

A few days ago I placed two wild rats in a cage, and for a long time endeavoured unsuccessfully to catch the larger one under a bell-jar let in through a doorway in the top of the cage. The rat perfectly well understood my object, and for about ten minutes succeeded by his agility in thwarting it. This animal, therefore, must have been in as great a state of alarm as it is possible that a rat could be. Nevertheless, after the ten minutes' chase inside the cage—during which he had been many times very nearly caught—he appeared to be suddenly seized with a violent outburst of ferocity against his fellow-prisoner; for he fell upon the smaller rat, drove it into a corner of the cage, and killed it by biting its throat. By means of a glass rod I drove him away, drew the dead body of his victim beneath the doorway in the roof of the cage, and held the bottom of the bell-jar just above the dead rat. I had not long to wait before the living one again fell upon his victim and began to devour the carcass. It was then an easy matter to lower the bell-jar over both the living and the dead, when, by pouring chloroform in at the open top of the bell-jar, I quickly reduced the murderer to a state of insensibility. But up to the very last moment of consciousness this animal continued to bury his fangs in the body of the little rat, and even after his head had dropped away in stupor the jaws still continued to move as if he were enjoying the feast in his dreams.

Now, I do not believe that any instance of ferocity at all approaching this could be found in any other animal. But it has been suggested to me that the fact may have been due to a kind of emotional insanity produced by extreme terror. I therefore write to ask whether any of your readers can supply me with additional facts bearing upon the subject. In particular, is it the habit of wild rats when not confined, or when in a state of nature, to devour one another? Or do they only do so when shut up together in a cage? GEORGE J. ROMANES

The Recent Weather

THE enclosed extract from the log of one of the "excellent" observers for the Meteorological Office may be interesting to some of your readers, as bearing upon the large amount of easterly winds and severe weather which were experienced at the time.

HENRY TOYNBEE,
Marine Superintendent

Meteorological Office, London, March 27

Extracts from Meteorological Log of the Ship " Timaru," Capt. D. Fullarton

1886 March 15; Noon Position, Lat. 48° 31′ N., Long. 8° 16′ W.

" A great many small land birds about us; put about 60 into a coop, evidently tired out."

1886 March 17; Noon Position, Lat. 48° 30′ N., Long. 7° 34′ W.

" Over 50 of the birds cooped on the 15th died, though fed. Sparrows, finches, water wagtails, two different small kinds of birds, names unknown to me, one kind like a linnet, and a large bird like a starling. In all there have been on board over 70 birds, besides some that hovered about us for some time and fell into the sea exhausted."

Variable Stars

I HAVE to express my indebtedness to Mr. Castell-Evans (NATURE, March 25, p. 486) for drawing my attention to Prof. Meldola's valuable memoir of 1878. Occasionally I cannot help passing over a paper of great interest; and, much to my regret, I did not read Prof. Meldola's until to-day. According to his theory there is ". . . actual combustion taking place in the atmosphere of a slowly-cooling star previously at a temperature of dissociation." The previous existence of elements is assumed throughout the memoir; and it is these which undergo "actual combustion," and of course give rise to compounds capable of the dissociation referred to. Prof. Meldola proceeds to show that dissociation of compounds and actual combustion of elements may very well lead to a "periodically unstable chemical equilibrium."

For my part I was not writing about combustion, but about polymerisation; not about compounds, but about elements; and nothing was said about dissociation. Chemical effect, moreover, was expressed by an equation totally different in form from dissociation equations.

There is thus a perfect distinction between my work and that of Prof. Meldola. He is, so far as I am aware, the originator of the theory that the variability of a star may depend on actual combustion of elements, followed by dissociation of compounds. I regard this theory as having considerable value, and great probability. But it has obviously nothing whatever to do with my own.

EDMUND J. MILLS

Glasgow, March 27

Colours in Clouds

I AM afraid I cannot give any further details to aid Mr. Backhouse. My object was to point out that the presence of coloured fringes is not very rare, though they require suitable means to see them.

I do not think the dark blue tone is very material. Mr. Backhouse will, however, see that it implies a general absence of glare and illumination of the atmosphere in the neighbourhood of the cloud, and that is exactly the condition which I artificially made by a suitable dark glass, which stopped the glare. It is the dilution of the tints with white light which makes them faint or invisible. Of course it may be said that the dark glass will weaken the tints as well as the general light, but as a fact the tints do show better through a proper one, and reduction of glare does make colour more marked.

Nor do I think that the square or rhomboidal form is important, for I think that is only the result of the air-currents which cause the light cloud.

These colours will be oftener seen in projections from banks near the horizon, if my view be correct of the height at which they are formed, because it is only when the bank or mass of thick cloud hiding the sun is low that we see well above it. Mr. Backhouse gives enormous heights at which water could only visibly exist as minute ice-crystals, such as cause halos.

J. F. TENNANT

37, Hamilton Road, Ealing, W., March 27

The Distribution of Appendicularia

IN regard to Prof. Herdman's query concerning the distribution of *Appendicularia* it may be mentioned that this form was frequently met with near the surface of the sea during the observations for H.M. Trawling Commissioners along the east coast of Scotland. From previous observations it would seem to be prevalent, especially in summer and autumn, all round our shores, as well as to stretch far into the neighbouring seas.

W. C. MCINTOSH

St. Andrew's Marine Laboratory, March 23

THE TECHNICAL INSTITUTE

IN considering the sixth Annual Report of the Council of the City and Guilds of London Institute to the Governors, we cannot but be impressed with the substantial advance made in each of the several branches of the Institute's work.

The past year has seen the completion of the great Central Institution in Exhibition Road, the University of the system of technical education, and London may be congratulated on at last possessing an institution which is, as pointed out in the Report, comparable with, and in some respects superior to, a German Polytechnic School. Considering the thorough manner in which the workshops and laboratories in the several departments have been equipped, we think the Institute is justified in claiming that parents will be enabled to secure in England for their sons technical instruction of the same high class as has been for so long provided in the great technical colleges abroad, and moreover better adapted to the special circumstances of home industry. The Report further expresses a patriotic hope that students trained in the Central Institution will gradually occupy the places in manufacturing works, and especially in chemical works, both in Great Britain and the colonies, which have of late been almost monopolised by the Germans and Swiss.

Besides the regular courses of instruction, special series of lectures are given by the Professors of the Institution at 5 o'clock, and we have reason to know that such courses as Prof. Henrici's on the Differential and Integral Calculus for engineering students, and those by Prof. Armstrong on Carbon Compounds, and by Prof. Ayrton on Industrial Applications of Electricity, now being given, fulfil a distinctly-felt want. The same may also be said of the special courses, including that on Iron-Girder Bridge Construction, by Prof. Unwin, to be given in July.

At the Finsbury Technical College the year has been marked by the appointment of Dr. Silvanus Thompson to the office of Principal, a post the duties of which have hitherto been discharged by Mr. Philip Magnus, the Director and Secretary of the Institute, but which the enormous increase in all the branches of the Institute's work has compelled him to relinquish. It is satisfactory to note that the great success already achieved by this College, both with respect to its Day and Evening Departments, has continued, and the Institute has determined to considerably increase the accommodation at a cost of 17,500*l*. In the Evening Department greater prominence has been given to courses of instruction for persons engaged in the various branches of the building trade, laboratories for instruction in plumbing, in gas-fitting, and in metal-plate work having been arranged, as also a class for builders' quantities. There are now between 600 and 700 persons attending the courses in the Evening Department.

The branch of its work by which the Institute is most widely known, the system of technological examinations, develops rapidly. According to Mr. Magnus's present Report, 3968 candidates presented themselves for examination in May last, of whom 2168, or nearly 55 per cent., were successful in passing. Examinations were held in forty-two subjects. In four subjects included in the programme, viz. salt manufacture, oils and fats, silk manufacture, and mechanical preparation of ores, the number of candidates was below the minimum for which an examination is held. In regard to silk manufacture, Mr. Magnus, in deploring the want of attention given in this country to technical instruction in connection with this important industry, points out the great improvement which has taken place in the silk trade of Crefeld as a result of the establishment of the Weaving and Dyeing School at that place.

Examinations were held for the first time, in 1885, in boot and shoe manufacture and in framework knitting, at which a number of students from the new Technical School at Leicester presented themselves.

It is satisfactory to observe that great attention continues to be paid to making the examinations of such a character as to prevent students possessed only of mere book-knowledge from passing. Practical examinations were held in weaving and pattern designing, in metal-plate work, in mine surveying, and, for the first time, in carpentry and joinery. In all these subjects (except mine surveying), candidates have to send in specimens of work duly certified as having been executed by themselves.

The examinations were held in 167 towns in Great Britain and Ireland, Manchester heading the list of provincial towns so far as regards the number of its successful candidates. The Polytechnic Institution, London, was equally successful, and next in order came Bradford, Leeds, Bolton, and Huddersfield.

With regard to the prospects of the examinations in May of this year, it appears from returns furnished in November last that 6396 persons were receiving instruction in the registered classes of the Institute, as against 5874 in the previous year; and it may therefore be expected that a considerably increased number will present themselves this year.

It must be gratifying to the Institute to have received an application, recently noticed in these columns, from the Board of Technical Education in New South Wales, to extend the examinations to that colony, and we are glad to observe that the Council of the Institute, believing that whatever tends to unite more closely the colonies with the mother country is calculated to improve their mutual trade and commerce, recommend that the application should be acceded to.

The annual meeting of the Governors was held yesterday, under the presidency of Lord Selborne, who delivered an address on the work of the Institute during the past year.

EXHIBITION OF BAROMETERS

THE Royal Meteorological Society held its seventh annual Exhibition of Instruments on March 16 and 17, in the Library of the Institution of Civil Engineers, 25, Great George Street, Westminster. The Exhibition was devoted entirely to barometers, with the exception of a few new instruments which have been brought out during the past year. A very valuable collection of different forms of barometer was brought together, and in those cases where it was not possible to obtain a specimen of the instrument a photograph or illustration of it was shown. The Exhibition therefore practically included almost every known form of barometer.

The instruments were classified under the following headings:—Mercurial Barometers: Adjustable Cistern, Closed Cistern, Siphons; Barographs; Aneroids; Metallic and other forms of Barometer. There were altogether 78 barometers, 9 new instruments, and 33 drawings, photographs, &c., making 120 exhibits.

Some very fine specimens of standard barometer on the Fortin principle were exhibited—Mr. P. Adie showing one with a glass plunger to raise the mercury in the cistern, Mr. Casella showing another with the scale figured to tenths of an inch, and Messrs. Negretti and Zambra showing a third with cistern and tubular casing square in section. By the side of these were placed a portable barometer, with ivory float, about 100 years old, and a standard barometer, by Barrow, the pattern used by the members of the British Meteorological Society about 1850-60. Messrs. Negretti and Zambra exhibited a self-compensating barometer with a double rack moved by one pinion, so that, when adjusting the vernier in one position, the second rack moves in the opposite direction, carrying along with it a plunger, which is the exact size of the internal diameter of the tube. This firm also showed a standard barometer with electrical adjustment, and a new standard barometer with overflow cistern adjustment. Some interesting specimens of mountain barometers were exhibited, including one originally used by the North American Boundary Commission in 1857, which since its return has been employed by the Kew Committee on the inter-comparison of the various standard barometers of this country.

Among the closed cistern barometers was the large cistern one made for the Meteorological Society of London in 1837 by Mr. R. C. Woods. The proportion of the calibre of the tube to that of the cistern is as 1 : 50, a proportion which was considered sufficient to obviate the necessity for applying capacity corrections. The tube and cistern originally held 70 lbs. of mercury! The next instrument to this was the Kew barometer, first designed in 1853, in which the cistern is closed and the scale contracted so as to obviate the necessity of correction for capacity. Specimens were exhibited of the marine barometer, as supplied to Her Majesty's ships previous to 1854; the Kew marine barometer, as adopted by the Admiralty; the gun barometer, with the glass tube packed with india-rubber to check the vibration caused by firing; and the coast barometer. The Meteorological Office showed patterns of barometers as used in France, Holland, and Russia. Two specimens of long-range barometer were exhibited, viz. Morland's diagonal, by Messrs. Negretti and Zambra, in which the top part of the tube is inclined more or less from the perpendicular to give an enlarged scale-reading; and Hicks's spiral tube, which gives a range of 8 inches for 1 inch variation of atmospheric pressure.

Among the siphon barometers were two very old forms, viz. Hooke's double barometer and a Dutch barometer, by Reballio, combining siphon and long-range barometer, thermometer, and hygrometer. An interesting relic was the mounting of the travelling-barometer formerly belonging to, and used by, De Luc. The siphons included Gay Lussac's, Bunten's, Jones's, Adie's, Dollond's, Bogen's, and Wild's forms of barometer; also a siphon designed by Capt. J. B. Basevi, R.E., and used by him in the high table-lands of Tibet, in connection with the operations of the Great Indian Trigonometrical Survey; Stanley's barometer, with "rising and falling" index; and Guthrie's sensitive barometer, which has a flat horizontal spiral in which is a bubble of air for indicating the variations of atmospheric pressure, the motion of the bubble being four and a half times that of the true barometric variation.

A specimen of Milne's barograph was shown by the Meteorological Office, while Messrs Negretti and Zambra exhibited their improved form of the same instrument in which the paper is carried on a cylinder. MM. Redier, of Paris, sent two forms (large and small) of their barograph, which works so satisfactorily; and MM. Richard Frères, of Paris, in addition to sending a self-recording mercurial barometer, exhibited several specimens of their self-recording aneroid, which is becoming so popular in this country. This instrument consists of a series of eight vacuum-boxes, by which the effects of the atmospheric pressure are increased and transmitted by a system of levers to an arm carrying a pen. The pen, of a special form, contains an ink mixed with glycerine, and marks the curve of atmospheric pressure on the paper round the cylinder, which revolves once in seven days. This firm also showed a Bourdon's metallic recording barometer, in which the drum turning in eight days is supplied with a continuous band of paper, serving for six months or a year.

Various specimens of aneroids were exhibited, including skeleton aneroid, showing the various working parts; aneroid with altitude scales; pocket watch aneroid, indicating heights to 20,000 feet; Stanley's surveying aneroid; Field's engineering aneroid; aneroids as supplied to Her Majesty's ships previous to 1854, and the pattern now adopted; and self-registering aneroid with maximum and minimum indexes. Messrs. Lund and Blockley exhibited a barometer dial 6 feet in diameter, the hand of which is kept in its true position by a single aneroid vacuum-box.

Mr. Stanley showed his chrono-barometer, which is a clock that counts the oscillations of a pendulum formed by a suspended barometer. The upper chamber of the pendulum is a cylinder of an inch or more in diameter. By change of atmospheric pressure the mercury in the pendulum is displaced from the bottom to the top, and *vice versâ*. The rate of the clock is accelerated or retarded in proportion to the displacement of the mercury.

Among the other forms of barometer were Jordan's glycerine barometer, the cistern and upper part of the tube only being shown, as the instrument, when complete, would be about 30 feet in height; Cetti's long-range mercurial and glycerine barometer; Hicks's flexible barometer; Lowne's handy weather-glass; Ronketti's thermo-barometer; Wilson's differential barometer; and several patterns of sympiesometer.

The most interesting of the new instruments was Immisch's pocket metallic thermometer. This is a watch-shaped instrument, and about the size of a small locket. The index-hand is actuated by the expansion and contraction of a very small Bourdon tube filled with a highly expansive liquid, and hermetically sealed, the motion of the tube being multiplied by an ordinary rack and pinion.

SONNET

To the Savilian Professor of Astronomy in the University of Oxford, Author of a Memoir on the Proper Motion of Forty Stars in

THE PLEIADES,

On his receiving the Gold Medal of the Royal Astronomical Society for his Investigations of the Relative Brightness of the Fixed Stars

PRITCHARD! thy praise is lifted to the skies,
Who in the starry fields find'st pure delight,
Noting each ray that gilds the brow of night
From pale gems set in depths beyond surmise.
Press on, where Fame's sublimest summits rise-
Time's stroke falls lightly on his sacred might
Who ploughs from morn to eve his furrow right
Then sinks to rest 'midst sunset's gorgeous dyes.
Hail! faultless herald of the bright-eyed throng
Heir to the wand, once Tycho's, to assign
What place and precedence to each belong:
Whilst yet with watery ray yon Pleiads shine
Or strew with sands of gold their hair divine,
Thy name shall flourish in immortal song.

NOTES

HER MAJESTY THE QUEEN has been pleased to intimate her intention of opening the Colonial and Indian Exhibition on Tuesday, May 4.

M. VULPIAN has been elected by a majority of one over M. Alphonse Milne-Edwards, Permanent Secretary of the Paris Academy of Sciences, in the place of the late M. Jamin.

THE death is announced of Mr. Charles George Talmage, F.R.A.S., on Saturday. He was director of the private observatory of Mr. J. G. Barclay, at Leyton.

THERE has recently died in Calcutta one who, though not in any sense a man of science, has done much for science as an artistic delineator. A Belgian by birth, Jules Schaumberg more than twenty years ago found his way to India, in search of the picturesque, and was at first associated with M. Rousselet, author of "Les Indes des Rajahs," during which time he made many admirable sketches and water-colour pictures illustrative of the architecture and life in the cities of Central India. His capital having been exhausted, he accepted an appointment as artist in connection with the Geological Survey of India. The number of plates drawn by him for the Survey and also for the *Journal* of the Society amount to hundreds, and those who knew Schaumberg well remember the interest and spirit he threw into the drawing of plates representing animated life. He lately officiated as Principal of the Bengal School of Art, and died suddenly at the age of forty-six.

THE Biological Section of the Canadian Institute of Toronto proposes to petition the Dominion Government to reserve one of the islands in Lake Superior for the preservation of native Canadian animals.

MR. EDGAR HALL, of Queenborough, sends us a cutting from the *Sydney Echo* of February 4, giving an interesting account of a vessel which is reported to have been set fire to by a meteor. The vessel, a schooner, the *J. C. Ford*, was on her voyage from the Pacific Coast to Kahului, Maui, and the communication originally appeared in the *Pacific Advertiser*, published at Honolulu. The letter is dated "Kahului, Dec. 22, 1885," and addressed to the Hon. S. G. Wilder. It is signed "T. H. Griffiths, captain; B. J. Weight, passenger." On Saturday, Dec. 12, according to the letter, being in latitude 23° 53′ N., longitude 143° 26′ W., at 1.30 p.m., the weather being fine and wind moderate, the first mate, Mr. Mercer, discovered the mizen-staysail, which was clewed up, to be in flames at the mainmast-head. With all possible speed the fire was put out by means of water, beating, and cutting away. "It is needless to say that all hands wondered at a fire occurring at the mast-head, but the finding of fragments of some metallic-like substance showed us that something of a meteoric nature was the cause. Those on the deck were picking up burning fragments and throwing them overboard. The pieces of the strange substance were found at the base of the mainmast. A piece as large as a man's hand was thrown overboard quite hot by Mr. Weight, and a piece as large, or larger, which was burning the mainsail, was thrown overboard by one of the hands. The above are the facts, as we remember them, and as they are recorded on the ship's log. In the night previous the weather was clear, but meteors were very numerous, and the mate and man at the wheel noticed their frequency and numbers, and also that they would burst in a manner resembling a rocket. No shock was noticed, the first intimation of the occurrence being the staysail in flames. Our theory is that the substance found is the crust of a meteor or fragment projected laterally. As there was a large quantity of kerosene and other combustible matter on deck, there were doubtless more than the two pieces thrown overboard in our anxiety to avoid disaster."

A PRIZE of 25,000 francs, or 1000*l.*, is offered every year by Leopold II., King of the Belgians, for the best essay on some predetermined subject tending to advance the well-being of mankind. The competition is alternately restricted to Belgians and thrown open to the whole world, being settled by an international jury. The subject of this year's competition, open to the whole world, was "The Best Means of improving Sandy Coasts"; and the prize has been awarded by an international jury, including some of the most eminent English and French engineers, to M. de Mey, Engineer of Ponts et Chaussées, Bruges, against fifty-nine competitors. The subject for the essay at the next international competition is "The Progress of Electricity applied to Motive Power and Illumination, its Applications and Economical Advantages." The essays for competition, which must be written in French, or translated into that language, are to be sent before January 1, 1889, to the Minister of Agriculture, Industry, and Public Works, from whom the conditions of the competition may be obtained.

BOTANISTS will be pleased to learn that the "Flora of the West Riding of Yorkshire," which Dr. F. Arnold Lees has been engaged on for some years, will shortly be ready for the press. It will be a complete and comprehensive enumeration of species in all the groups, phanerogamic and cryptogamic, which occur in the wide and diversified area of which it treats, together with chapters on lithology, climatology, bibliography, &c. The account of each plant will include its range, horizontal and vertical, and its history as a West Riding species. The work is to be issued by subscription under the auspices of the Yorkshire Naturalists' Union, and will constitute an important volume of their series of memoirs dealing with the flora and fauna of Yorkshire.

THE Sheffield Free Library Committee can report a greatly increased use of the specifications of patents in the Reference Library as well as of the books of the Science and Art Class. The issue also of works of fiction in the circulating departments has also fallen off, while that of history and travels and arts and sciences has increased in both central and branch libraries. Of this, however, the Committee may probably take much of the credit, as they have not only spent a larger amount of money in the more valuable books, but have also purchased a larger number of volumes. The value of branch libraries is shown by the result that three in Sheffield have scarcely reduced the average issues of the central one; and if, in a place of so great a rental, further progress is crippled for lack of funds, how highly necessary must something beyond a penny rate be in many towns only a small fraction of its size. Although during the past year the Observatory was open only thirty-seven nights, yet the Committee report that its "utility is confirmed by experience."

A LIONESS's brain was recently dissected and studied by Herr Familiant at the Anatomical Institute of the Berne Veterinary School. Among other results he finds (*Mittheilungen* of Berne Naturalists' Society, 1885) that in form it is in many respects intermediate between the dog's and the cat's brain; from both it is distinguished by relatively small projection of the cerebellum and narrowness of the *lobus pyriformis*. Further, the chief fissures of the brain of carnivores are to be found in that of primates, the principal differences between homologous fissures being partly in imperfect formation or perhaps retrograde formation of certain parts, and partly in confluence of some sections of originally separate fissures. In some varieties of the fissuring of man's brain, the original relations of the carnivore's brain recur. The parieto-occipital fissure is a special formation not met with in the brain of carnivores. The secondary fissures, especially in the frontal lobes, are due to a special mode of fissuring that has appeared late, and is therefore subject to wide variations.

ARCHÆOLOGISTS are placed under fresh obligations to Dr. A. B. Meyer, the indefatigable curator of the Dresden Natural History Museum for his recent publications on the prehistoric settlements and graveyards of Gurina in Karinthia and of Hallstadt in Upper Austria. Since about the middle of the century, Gurina, which lies on the Upper Gail, an Alpine stream flowing to the Drave above Klagenfurth, had been vaguely spoken of in connection with a few stray antique objects from time to time falling into the hands of collectors. But the very locality of the place was scarcely known until, one of these objects coming in the way of the author, he was induced to visit the neighbourhood during the summer of 1884 on behalf of the Viennese Anthropological Society. Although able to do little more than "scratch the surface," he was soon convinced that Gurina must have been an important centre of European culture, either Etruscan or more probably Illyrian, some centuries before the new era, consequently that a systematic exploration of the locality is urgently demanded in the interest of archæological science. The results of his own preliminary investigations are embodied in an elaborate monograph, entitled "Gurina im Obergailthal" (Dresden, 1885), which also contains a full account of all the interesting finds hitherto made and here figured on fourteen admirably executed photographic plates. Although mostly picked up accidentally without any systematic research, these finds are of the most varied character, including Greek (Alexandrian), Roman (Imperial), Keltic (?), and other barbaric coins in silver, bronze, copper, and brass; bronze and iron fibulæ, iron chains, bronze chains and plaques, bronze and tin statuettes, iron swords and knives, glass ware, potsherds plain and ornamented, and other artistic remains, some apparently of local manufacture, some introduced from Greece, Italy, Gaul, and other countries during a period ranging from perhaps 200 or 300 years before to as many after the new era. Amongst the most interesting objects are the bronze plaques, pins or bodkins inscribed with Etruscan or Illyrian characters, a few words of which have been deciphered and referred by Paoli to the Illyrian branch of the Aryan linguistic family. The Illyrian (Thraco-Illyrian) peoples would seem to have reached their extreme western limits in this part of Noricum, where they came in contact with the Etruscans and Kelts, and were ultimately absorbed in the Roman Empire.

ON his return from Gurina, Dr. Meyer made an excursus to the prehistoric necropolis of Hallstatt in Upper Austria, an account of the past and present state of which he communicates in a short memoir, "Das Gräberfeld von Hallstatt" (Dresden, 1885), illustrated with a photographic view of the place and photographic plates of two of the finest objects found there. Although Hallstatt has been "exploited" by treasure-seekers ever since 1835, during which nearly 2000 graves have been opened, Dr. Meyer's hasty survey satisfied him that the place is still far from exhausted. Most of the graves have been rifled; but the site occupied by the neighbouring prehistoric settlement appears to have been scarcely touched, and there remain several thousand square yards of ground still to explore. Until this is done it will be difficult to come to any definite conclusion as to the origin, period, and duration of the settlement. The fact that no Keltic coins have ever been discovered at Hallstatt seems to support Morlot's view that the foundation dates from about the fourth century before the new era. Basing his calculations on the number of graves in the place, Dr. Meyer thinks that it cannot have flourished for more than two hundred years, if so long. The two objects here figured and now preserved in the Museum of Linz, are a large fibula or brooch with twelve long chain pendants spreading out like a fan, and a knife with peculiar bronze handle and iron blade.

SOME little time since an account was given in NATURE (vol. xxx. p. 271) of the edible birds'-nest caves at Gomanton, in British North Borneo. A recent number of *Die Natur* contains a translation from the Danish *Geographical Journal* of an account of a visit to certain caves in islands off the coast of the Malay Peninsula, where these nests are also produced. The islands are very small, and almost inaccessible; they lie between 8° and 10° N. latitude, and lie between twenty and forty miles off the coast. They belong to the Siamese Government, and are farmed out to contractors, who collect the nests, and despatch them to China. The harvest is during the months of March and April. As soon as the nests are built, and before the swallows begin to lay their eggs, they are collected; the birds then build second nests, and these are likewise taken away; the third nests are left undisturbed for the birds to lay and hatch. The island visited by the Danish writer was about 500 feet high, and 3000 feet in diameter. The caves are only accessible by means of rattan ladders, and the nests are collected from the roofs by means of rattan galleries and stagings. To show the impossibility of ingress and egress without artificial assistance, it is stated that about forty years ago, before the collection and sale of the nests was made a Government monopoly, about fifty Malays arrived at the caves before the Siamese, and commenced taking the nests; while they were engaged in this the Siamese arrived, and in revenge ran away with the rattan ladders, leaving the whole of the Malays to die of hunger and thirst in the caves, from which their only means of escape had been taken. Their skeletons are still in the caves. These Siamese caves appear smaller, not so well ordered, and infinitely wilder and more dangerous than those at Gomanton, but otherwise there appears little difference in the nests themselves, or in the mode of collecting them.

THE latest numbers of the Ceylon *Orientalist* (Nos. 3 and 4, vol. ii.) are largely occupied with folk-lore. The editor writes on comparative folk-lore, showing how certain Singalese stories occur elsewhere in Sanskrit and Siamese collections. Mr. Lewis's "Notes on some Oriental Folk-lore Stories" is on much the same lines, the field examined being somewhat more extensive. Thus a story from a Singalese collection of stories, the "Jataka," is found in English in Chaucer's "Pardoner's Tale." There are two other papers of a like character. The Rev. H. Horsley writes on Tamil proverbs, while Mr. Lewis concludes some interesting papers on a subject which appears to have escaped investigation hitherto—viz. the terms of relationship in Singalese and Tamil.

PROF. LODGE wishes to state that in his letter under the heading of "Permanent Magnetic Polarity," in our last issue, in the last paragraph the word "*explained*" should be "*unexplained*."

THE additions to the Zoological Society's Gardens during the past week include a Ring-tailed Lemur (*Lemur catta*) from Madagascar, presented by Mr. Alfred Best; a Bonnet Monkey (*Macacus sinicus*) from India, presented by Dr. E. Woakes; a Mountain Ka-Ka (*Nestor notabilis*) from New Zealand, presented by Mr. James Ellis; four Leopard Tortoises (*Testudo pardalis*), eleven Angulated Tortoises (*Chersina angulata*), an Areolated Tortoise (*Homopus areolata*), three Geometric Tortoises (*Testudo geometrica*), a Robben Island Snake (*Coronella phocarum*), two Infernal Snakes (*Boodon infernalis*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; two Common Boas (*Boa constrictor*) from South America, a West African Python (*Python sebæ*) from West Africa, presented by Mr. Daniel Nicols; two Golden Plovers (*Charadrius pluvialis*), European, a Sharp-nosed Crocodile (*Crocodilus acutus*) from Central America, deposited; three Wheatears (*Saxicola œnanthe*), British, purchased; a White-fronted Lemur (*Lemur albifrons*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE BINARY STAR β DELPHINI.—In 1873 Burnham discovered that the primary star of the well-known wide double-star β Delphini was itself a very close double, and a few years' observations sufficed to show that it was a binary star in rapid motion. As the companion star has now described over 180° of its apparent path, a fairly accurate approximation to the elements of its orbit is possible. An attempt has accordingly been made, first by Dubiago and more recently by Gore, to determine the orbit, with tolerably accordant results. The former makes the period to be 26·07 years, with perihelion passage at 1882·19 and semi-axis major 0″·55. Gore finds the period to be 30·91 years, and fixes the periastron passage at 1882·25, with semi-axis major = 0″·517. The observations are fairly well represented by these elements, considering what a close and difficult object the star is to measure. According to Gore's elements the components were at their minimum distance, 0″·192, at the epoch 1879·91; and during 1879 Burnham failed to elongate the star with the 18½-inch Dearborn refractor. We hope that those double-star observers who possess sufficiently powerful telescopes will not lose sight of this interesting object.

THE VELOCITY OF LIGHT AND THE SOLAR PARALLAX.—From two determinations of the velocity of light made by Prof. Michelson (in 1879 and in 1882), and from one made by himself in 1882, Prof. Newcomb concludes that the most probable value of this physical constant, expressed in kilometres per second, is 299860 ± 30. Adopting Nyrén's value of the constant of aberration from Pulkowa observations, viz. 20″·492, the corresponding value of the solar parallax is 8″·794, taking the earth's equatorial radius to be 6378·2 kilometres, as determined by Clark. We may also draw attention to the circumstance that Prof. Newcomb considers that his observations negative the hypothesis put forward by Messrs. Forbes and Young as to the existence of a difference between the velocities of rays of different colours. Had there been such a difference to anything like the extent asserted by these physicists, it would have shown a well-marked effect in Prof. Newcomb's apparatus. No trace, however, of any such effect could be seen. Prof. Michelson has arrived at similar conclusions as to the erroneous nature of the views expressed by the Scotch experimenters.

FABRY'S COMET.—The following ephemeris by Dr. H. Oppenheim (*Astr. Nach.* No. 2712) is in continuation of that given in NATURE for 1886 March 18:—

For Berlin Midnight

1886	R.A. h. m. s.	Decl. ° ′	Log r	Log Δ	Brightness
April 16	23 58 48	38 46·9 N.	9·8317	9·6825	118
18	0 13 47	37 53·4	9·8417	9·6282	145
20	0 33 27	36 24·0	9·8527	9·5686	181
22	0 58 58	33 58·3	9·8645	9·5043	230
24	1 31 39	30 2·6	9·8770	9·4370	297
26	2 12 8	23 52·1	9·8899	9·3726	376
28	2 59 25	14 52·2	9·9031	9·3229	445
30	3 50 0	3 37·0 N.	9·9165	9·3042	456

The brightness on December 2 is taken as unity.

BARNARD'S COMET.—The following ephemeris by Dr. H. Oppenheim (*Astr. Nach.* No. 2714) is from elements by Dr. A. Krueger:—

For Berlin Midnight

1886	R.A. h m. s.	Decl. ° ′	Log r	Log Δ	Brightness
March 31	1 50 22	30 45·4 N.	9·9509	0·2006	11
April 4	1 49 33	32 15·9		0·1868	
8	1 48 25	33 49·1	9·8776	0·1699	18
12	1 46 58	35 23·8		0·1494	
16	1 45 6	36 57·3	9·7962	0·1245	32
20	1 42 50	38 25·0		0·0941	
24	1 40 23	39 38·9	9·7188	0·0568	62
28	1 38 22	40 26·0		0·0111	
May 2	1 38 8	40 28·4 N.	9·6796	9·9556	118

The brightness on December 5 is taken as unity.

THE NEBULA ROUND MAIA.—MM. Perrotin and Thollon (*Comptes rendus*, cii., No. 10) have succeeded in seeing the Maia nebula "without too much difficulty"; but M. Perrotin adds, "We have seen the nebula because we knew it existed. We should certainly not have observed it else." The nebula seemed comprised in an angle of about 120°, with the opening turned towards the north-west, and the summit to Maia; one of the sides lies along the line joining Maia to Bessel's star An. 4. The general appearance is that of a faintly luminous cloud, of which the different parts are very unequally bright. A nebulous filament stretching from Maia nearly to the little star just named, and a region towards the north-east and nearly 2′ from Maia, are the brightest parts of the nebula. On one occasion exceedingly faint luminous points were suspected in the centre of this latter district.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 *APRIL* 4–10

(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 April 4

Sun rises, 5h. 30m.; souths, 12h. 3m. 0·0s.; sets, 18h. 36m.; decl. on meridian, 5° 46′ N.: Sidereal Time at Sunset, 7h. 28m.

Moon (New) rises, 5h. 43m.; souths, 12h. 2m.; sets, 18h. 32m.; decl. on meridian, 3° 6′ N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	5 23	12 27	19 31	11 37 N.
Venus	3 59	9 20	14 41	8 20 S.
Mars	14 40	21 46	4 52*	11 56 N.
Jupiter	16 54	23 7	5 20*	1 44 N.
Saturn	9 7	17 19	1 31*	22 50 N.

* Indicates that the setting is that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich)

April	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
8	Aldebaran	1	17 8	17 54	175 257
9	130 Tauri	6	23 49	0 21†	175 251
10	26 Geminorum	5½	22 25	23 18	143 285

† Occurs on the following morning.

Saturn, April 4.—Outer major axis of outer ring = 40″·9 outer minor axis of outer ring = 18″·3; southern surface visible.

April	h.	
9	4	Mercury in inferior conjunction with the Sun.

Variable-Stars

Star	R.A. h. m.	Decl. ° ′		h. m.	
Algol	3 0·8	40 31 N.	Apr. 10,	2 49	*m*
T Canis Minoris	7 27·7	11 59 N.	,, 9,		*M*
S Cancri	8 37·4	19 27 N.	,, 5,	0 25	*m*
T Virginis	12 8·8	5 24 S.	,, 4,		*M*
R Virginis	12 32·7	7 37 N.	,, 10,		*M*
W Virginis	13 20·2	2 47 S.	,, 9,	19 10	*m*
δ Libræ	14 54·9	8 4 S.	,, 4,	4 44	*m*
			,, 8,	20 26	*m*
U Coronæ	15 13·6	32 4 N.	,, 5,	21 54	*m*
S Coronæ	15 16·8	31 47 N.	,, 10,		*M*
U Ophiuchi	17 10·8	1 20 N.	,, 4,	2 19	*m*
		and at intervals of		20 8	
X Sagittarii	17 40·4	27 47 S.	Apr. 7,	2 30	*m*
			,, 10,	0 0	*M*
U Sagittarii	18 25·2	19 12 S.	,, 5,	21 40	*m*
			,, 8,	21 30	*M*
β Lyræ	18 45·9	33 14 N.	,, 4,	2 20	*M*
S Vulpeculæ	19 43·7	27 0 N.	,, 8,		*M*
η Aquilæ	19 46·7	0 7 N.	,, 5,	21 30	*m*
δ Cephei	22 24·9	57 50 N.	,, 4,	4 50	*M*
			,, 7,	21 40	*m*

M signifies maximum; *m* minimum.

Stars with Remarkable Spectra

Name of Star	R.A. 1886·0 h. m. s.	Decl. 1886·0 ° ′	Type of spectrum
D.M. – 0° No. 2668	13 6 55	1 9·2 S.	III.
D.M. + 47° No. 2053	13 18 13	47 35·8 N.	III.
R Hydræ	13 23 29	22 41·4 S.	III.
83 Ursæ Majoris	13 36 25	55 15·5 N.	III.
i Draconis	13 48 6	65 17·2 N.	III.
D.M. + 38° No. 2501	13 55 31	38 25·5 N.	III.
D.M. + 44° No. 2325	14 3 22	44 23·8 N.	III.
169 Schjellerup	14 19 4	26 13·4 N.	III.
V Bootis	14 25 10	39 22·1 N.	III.
R Bootis	14 32 10	27 13·9 N.	III.
LL. 26918	14 40 23	15 36·6 N.	III.
342 Birmingham	14 55 46	66 23·2 N.	III.

BIOLOGICAL NOTES

Crayfish.—The Museum of Comparative Anatomy at Harvard having an uncommonly rich collection of the genera and species of the family Astacidæ, Mr. Faxon presents us with a revision of the group, which falls little short of being a well-illustrated monograph. In the first part, which has just reached us, we find the crayfishes of the northern hemisphere treated of, and in a second part the author promises to write of those of the southern hemisphere. As will be known to all readers of Huxley's work, "The Crayfish," the family Astacidæ (which in a strict sense is equivalent to the genus Astacus, as limited by Milne-Edwards) falls naturally into two subordinate groups. These groups of Huxley's Faxon makes into sub-families: (1) the Potamobiinæ, comprising the crayfishes of Europe, Asia, and North America; and (2) the Parastacinæ, comprising those of the southern hemisphere, viz. those of South America, Fiji Islands, New Zealand, Tasmania, Australia, and Madagascar. The Potamobiinæ are treated of in this memoir, and include the genera Astacus and Cambarus. The Parastacinæ will be treated of in a second memoir. Of the genus Cambarus, established by Erichson in 1846, fifty-two species are accepted by Faxon, and all of these except one are American forms, ranging from Lake Winnipeg to Cuba and Guatemala, from New Brunswick to Wyoming Territory (in Mexico to the Pacific Ocean). The genus Cambarus would not seem to have been developed under the influences affecting cavern life, though several cave and blind species are known, and in Europe it would appear that one solitary species still lingers in the underground waters of some of the Carniola caves. It seems strange that on so interesting a question any doubt should remain, and yet it is true that, except a short notice in the Berlin *Entomologische Zeitschrift*, by Dr. G. Joseph, of a specimen of a crayfish referred to Cambarus, and labelled, as found, "Aus der Grotte von St. Kanzian bei Metaun," we know nothing of this interesting form, which must, if the determination is correct, be taken as an indication that at one time species of Cambarus inhabited the European rivers. Of the genus Astacus fourteen species are given. These occupy three widely-separated geographical areas: (1) Western North America, from the Rocky Mountains to the Pacific Ocean; (2) the western portion of the Europeo-Asiatic continent from the Ural Mountains and the basin of the Sea of Aral to the Spanish peninsula and (?) Ireland; (3) Eastern Asia, in the Amoor River system, and in Japan. No Astaci are known from any part of Siberia between Lake Baikal and the Urals, or from any of the Siberian rivers flowing into the Arctic Ocean. To this memoir an interesting note on the fossil forms referred to Astacidæ and a table showing the geographical distribution, as far as has been ascertained, of the species of Cambarus and Astacus are appended.—["A Revision of the Astacidæ," by Walter Faxon. Part I. "The Genera Cambarus and Astacus" (with ten plates). Cambridge, for the Harvard Museum, August, 1885 (being vol. x. No. 4, of the *Memoirs* of the Museum of Comparative Anatomy).]

Habits of the Cuckoo.—However well known may be this summer visitant of ours, there are still few points in its strange life-history that have been well worked out. Even an ornithologist will hesitate to say whether it is the male or female bird which utters the familiar cry, or will be able to say when the young bird moults. In Mr. Henry Seebohm's important and just-published "History of British Birds" we find that the strongest doubts are thrown on the statements that the young cuckoo, soon after it is hatched, ejects the young or eggs of its foster-parents from the nests. "One feels inclined," we read, "to class these narratives with the *equally well authenticated* stories of ghosts and apparitions," and this, too, though these narratives are from the pens of such accurate observers as Montagu, Jenner, and others. It is therefore not without interest that we find, from a series of observations made with every precaution as to their accuracy by Mr. John Hancock (*Nat. Hist. Trans.*, Northumberland, Durham, and Newcastle-on-Tyne, vol. viii., 1886), that the observations of the older writers were exact. The nest of a hedge-accentor, built in a convenient spot for observation, was found, on January 17, 1884, to contain four eggs of the accentor and one cuckoo's egg. On the 27th the cuckoo's egg and two eggs of the accentor were hatched. On the 28th the "murder" began with an attempt on the part of the cuckoo to put out of the nest one of the unhatched eggs. At 10.30 a.m. on the same day the egg was successfully thrown out. Getting more perfect with practice, about half an hour later one of the young accentors was ejected: strange to say, its mother was present, and looked on quite calmly, but the desperate efforts of the young murderer seemed for the time to exhaust it, so that it was not until 1 p.m. that it returned to the work and pushed out the second egg, and then tried to put out the remaining accentor. This at 3.30 was done, and the cuckoo remained sole occupant. No wonder Mr. Hancock writes:—"The cuckoo's proceeding, as I saw it, is, in my opinion, the most wonderful and unaccountable piece of business that I ever witnessed in bird life." Some of our readers may like to learn that one of the unfortunate young accentors was placed in a whitethroat's nest, where there were four young ones about its own age, and that it was properly attended to by its foster-parents, whereas the young cuckoo was, after a week's short existence, found dead, apparently of sunstroke, at the bottom of its nest.

THE TORTURE OF THE FISH-HAWK.—While the facts above recorded about the cuckoo are wonderful, and, from a human standpoint, perhaps cruel, they would seem to be surpassed in both respects by those recently recorded about the fish-hawk of Southern Florida by a well-known observer, J. Lancaster (*American Naturalist*, March 1886). The distribution of land and water on the Gulf coast of Florida is very favourable to the existence of fish, and the flats and creeks swarm with life. Birds subsisting on fish diet also abound. Long lines of pelicans can be seen on every hand; armies of cranes stalk about; fish-hawks abound. These latter are arboreal in their habits, nesting in the tops of the pine-trees, and rarely resting on the ground. For the most part they fish in the secluded creeks and inlets, hovering over the water and capturing their prey by suddenly diving upon it; but sometimes they fish in the open waters. While large, active-winged birds, they never soar. On first acquaintance their actions seemed inexplicable: while in the hidden creeks they uttered no cry and seemed to be masters of the gentle art; but in the open, allured thereto by a school of mullet, at the moment when they would seem eager for action and all alive with expectation, just as they might be swooping on a fish, they would emit a discordant, frightened scream, and make for the shore with a haste so ill-advised as to seriously impede their progress. The shelter of the trees gained, the terror would subside. Desire for food would tempt the bird once more out, and again and again the same frantic performance was to be witnessed. The reason was soon made evident. A fine specimen of the fish-hawk swooped on a fish, which soon left its element and swung aloft in the bird's talons. The hawk began its homeward journey. But now a new-comer appeared on the scene. A black creature, which seemed all wings, dropped from above and confronted the hawk, which at once let go its prey and uttered a scream so brimful of mortal terror as to excite one's pity. The hawk was not struck, and it made off with wild haste for shore. The intruder was a frigate-bird, which seized the dropped fish in its beak long ere the prey reached the water, and then with a sweep of exquisite grace, on tense wings, fronting a mild breeze, the corsair was lifted half a mile into the air. A bite was taken from the fish by a wringing motion of the bird's head, which sent the carcass whirling. The morsel being swallowed, the bird, folding its wings tightly on its body, dropped swiftly after the fish, seized it, again swept upwards, and then the performance was repeated till the meal was over. In a personal contest for superiority on the ground of physical strength the frigate-bird, with its small legs and feet and its head and beak not stronger than the fish-hawk's, was no match for the latter; but sometimes the fish-hawk does not play its part as capturer of the prey desired by the frigate-bird, and several of these latter combine to cut off its retreat landwards, swoop about it until the unfortunate victim loses its power of screaming, then of flight; down it falls at last exhausted into the waters of the Gulf; the demon birds still pursue it; with their miserable, puny feet they alight on it, and push it beneath the surface, continuing in one case to do this for over an hour, until the bird was dead. When the hawks captured fish they were not so treated—they were robbed, not killed. It would seem as if the existence of the fish-hawk as a species depended on their understanding this, and that now and then those that did not understand lost their lives in the struggle.

THE SENSIBILITY AND MOVEMENTS OF PLANTS.—To the last number of the *Bulletin de l'Académie Royale de Belgique*, the late Prof. Morren contributes a valuable memoir on the sensibility and movements of plants, in which he further developes Darwin's well-known theory, and attempts to establish a complete synthesis of the animal and vegetable kingdoms. It is argued that the law of sensation producing motion dominates all the biological sciences, that plants are sensible to the influences of the environment, and not only move, but are able to co-ordinate their movements. All the phenomena of motion are referred in ultimate analysis to protoplasm, a living substance common alike to plants and animals, and whose general and essential characteristics are precisely the power of sensation and movement. It has the faculty of receiving external agencies, and of moving *proprio motu*. It stirs, therefore it lives! And this is equally true of all organisms from man to the microbe and the plant. Life might be defined as the activity of protoplasm, although this is a substance whose true nature is still unknown, of whose texture we are ignorant, and whose activity is a property, the mechanism of which has not yet been discovered.

HEREDITY.—The same *Bulletin* contains an equally interesting paper by M. Ch. Van Bambeke, on heredity, in which the theories of Darwin, Haeckel, Nägeli, Pflüger, and others are subjected to a searching criticism. Both pangenesis and plastidulperigenesis are rejected, as inadequate to explain all the phenomena of heredity, which, it is argued, can be accounted for only by supposing that the germ, Weismann's *Keimplasma*, is in fact continuous. It is not to be regarded as the final outcome of the ontogenesis of each individual, but passes from parent to offspring directly, being from the first present in an unmodified form in a large number, possibly in all the somatic cells. The germinative plasma persists through certain cellular series, concentrating itself anew in the embryonic cells of the new organism. In a word, in the phylogenetic development of the organisms the germ, whose true seat has now been determined, is perpetuated throughout the whole series of successive ontogenies. The generations succeed and efface each other; the *Keimplasma* alone is immortal.

GEOGRAPHICAL NOTES

THE progress of drying up of the steppes around the Caspian Sea is steadily going on. Thus we learn from a recent communication by M. Krasnoff to the Geographical Society that the series of the Sarpinsk lakes in the eastern part of the Kalmuck steppes, close to the Ergheni hills, are rapidly disappearing; the lakes Chilguir and Keke-tzun have quite disappeared in the course of the last year.

GENERAL TILLO publishes in the last issue of the *Izvestia* of the Russian Geographical Society the results of new exact levellings made in order to ascertain the heights above the sea of Lakes Ladoga, Onega, and Ilmen. Their respective heights above the average level of the Gulf of Finland appear to be only 16, 115, and 59 feet, with a probable error not exceeding 1·5 feet. The formerly accepted heights were 59, 237, and 157 feet.

A VERY interesting paper on the irrigation of the oases of Merv and Akhal-Tekke was recently read by M. Pokrovski-Kozel at St. Petersburg, before the Society for the Assistance of Russian Trade and Commerce, Count Ignatieff being in the chair. The lecturer considers the Merv oasis as one of the most fertile spots on the earth. Wheat, rice, and other cereals cultivated by natives for home consumption yield beautiful crops. The oasis includes about 900,000 acres of cultivable land. But, in order to cultivate them, it would be necessary to colonise the oasis with civilised pioneers, and to spend about 120,000*l.* on the restoration and extension of the splendid system of canals built up by the Arabs a thousand years ago, and preserved until now in some parts, as, for instance, at the mouth of the River Murhab, about 50 miles from Merv. These canals are 14 feet deep and 70 feet wide, and partly used even now by the Merv Turcomans for the irrigation of their fields, though in a primitive manner. The Akhal-Tekke oasis is not so rich as that of Merv, but still it has about 900,000 acres of land suitable for culture. It covers the space of 7 miles along the railway line from Mikhailovsk Bay to Khizil Arvat, and could be irrigated by the water from the River Tejen.

THE Imperial Russian Geographical Society has decided in its Natural Science Section, to organise during the current year another expedition to Central Asia, in order to investigate the mountain district of Khan-Tengri, which has never yet been explored by any of the European travellers in Central Asia.

PROF. GUIDO CORA has lately printed the address he delivered in November 1883 at the opening of the annual course of geographical studies in the University of Turin. This address, dealing with the surface of the earth as the proper subject of geography, has a special interest for the English public, who are just now occupied with the question of geographical reform. The author accordingly appeals more particularly to those English men of science "who seem still to entertain grave doubts whether geography really possesses a scientific and individual character, and whether it is entitled to be taught even in Universities." Amongst the subjects discussed are, the relations of geography to the other sciences, geography an individual science, separation of geology from geography, division of geography in reference to its subject-matter and methods of investigation, mathematical and physical geography, necessity of teaching geography according to the most exact scientific and didactic methods.

AT the last meeting of the Geographicnl Society of Paris, a letter was read from Major Serpa Pinto, dated Zanzibar, December 10, describing his recent explorations in Eastern Equatorial Africa. He started from Mozambique, and followed the coast, carefully examining the country as he proceeded, until he reached Ibo. Here he organised a large expedition with 200 guards and 700 bearers, carrying provisions and wares, and started for Lake Nyassa, which he reached without difficulty. On the journey he undertook a triangulation survey with levelling. Major Pinto was forced to return to the coast by himself from Nyassa, on account of ill-health; but M. Cardozo, his second in command, continued the journey, and at the time of writing should have been between Nyassa and Bangweolo. Capt. Monteil, of the French Marines, read a paper on the French establishments in Senegal.

A LENGTHY report from M. Thouar to the President of the Argentine Republic, on the Pilcomayo River, has been published. The object of his last exploration was to seek the branch of the river which was most navigable. Leaving Fort Fotheringham on October 25, he reached, on November 12, the rapids, the point which, from the other side, he reached with the Bolivian Expedition in 1883. His conclusion is that it is possible to go at any season of the year from the mouth at Lamboré to the mission of San Francisco de Solano in Bolivia, at the very foot of the Andes, at a short distance from the principal commercial centres of Southern Bolivia. The difficulties caused by accumulations of trees, and the consequent formation of shallows can, in his judgment, be overcome. The report then goes on to describe the incidents of the journey, and the hostility of the Toba Indians, which more than once threatened the existence of the Expedition. M. Thouar left in the beginning of February for Bolivia, crossing the Chaco between the 18th and 19th parallels, still intent on his exploration of the Pilcomayo from the Bolivian side.

THE current *Zeitschrift* (Bd. xxi. Heft 1) of the Berlin Geographical Society has for its first contribution a paper of great interest on the discovery and conquest of Chili, the portion published in the present number dealing with the period between the discovery of the Straits of Magellan and the death of Pedro de Valdivia (1520–54). The writer, Herr Polakowsky, tells the story of the stirring events of which Chili was the theatre at this time with much fire and vigour. The second paper is also devoted to South America. It is an account (accompanied by a map) by Capt. Rohde, of the expedition of Gen. Victorica to the Grand Chaco. The writer first gives some general information about the Chaco, its size, natural divisions, productions, flora and fauna, so far as they are known; then he refers to earlier expeditions, and this brings him to the plan of the campaign under review, and to the events attending the march of the column specially under the command of General Victorica, and of the other columns acting in conjunction with it. As part of this comes the work on the Pilcomayo and Bernejo of Lieut. Feilberg, of which much has already been heard in Europe. In conclusion a list is given of the trees of the Chaco, their native and botanical names, with a few words of description in each case. A shorter paper (the last in the number) is a report on the same expedition by the head of the Topographical Department of the Argentine army. From a geographical and geological point of view this is the most valuable part of the accounts of the campaign. It describes the geology, climate, zoology, mineralogy, &c., of the Chaco.

THE *Verhandlungen* (Band xiii., No. 2) of the same Society contains a paper, by Dr. Zintgraff, entitled "Impressions of the Lower Congo." The writer was a volunteer with Dr. Chavanne, who was despatched to map the lower part of the river, and does not appear to be able to add much that is new to our knowledge of this region. Dr. Ehrenreich writes on the land and people in the Rio Doce in Brazil. This is a paper of much interest, as it sketches the life and habits of a comparatively little-known people, from long and careful observation. Herr Paul Reichard has a long report on his journeys in Eastern Africa and the regions around the source of the Congo. These journeys, of which much has been heard from time to time, extended over about five years, and the present is a popular account of some of their leading features.

THE *Mittheilungen* of the Vienna Geographical Society (Band xxix., No. 2) contains an account by Dr. Breitenhohner, the Director of the Meteorological Station at Sonnblick, near Salzburg, which is the loftiest in the world, being more than twice as high as the Ben Nevis Station. Herr Steinhauser continues and concludes his review of the mathematical geography of the last five years, which takes the form of a series of notes on various books. Dr. Diener continues his contribution to the geography of Central Syria, while further letters from the Congo, from Dr. Lenz, are published.

UNIVERSAL OR WORLD TIME[1]

CONSIDERING the natural conservatism of mankind in the matter of time-reckoning it may seem rather a bold thing to propose such a radical change as is involved in the title of my discourse. But in the course of the hour allotted to me this evening, I hope to bring forward some arguments which may serve to show that the proposal is not by any means so revolutionary as might be imagined at the first blush.

A great change in the habits of the civilised world has taken place since the old days when the most rapid means of conveyance from place to place was the stage-coach, and minutes were of little importance. Each town or village then naturally kept its own time, which was regulated by the position of the sun in the sky. Sufficient accuracy for the ordinary purposes of village life could be obtained by means of the rather rude sun-dials which are still to be seen on country churches, and which served to keep the village clock in tolerable agreement with the sun. So long as the members of a community can be considered as stationary, the sun would naturally regulate, though in a rather imperfect way, the hours of labour and of sleep and the times for meals, which constitute the most important epochs in village life. But the sun does not really hold a very despotic sway over ordinary life, and his own movements are characterised by sundry irregularities to which a well-ordered clock refuses to conform.

Without entering into detailed explanation of the so-called "Equation of Time," it will be sufficient here to state that, through the varying velocity of the earth in her orbit, and the inclination of that orbit to the ecliptic, the time of apparent noon as indicated by the sun is at certain times of the year fast and at other times slow, as compared with 12 o'clock or noon by the clock. [The clock is supposed to be an ideally perfect clock going uniformly throughout the year, the uniformity of its rate being tested by reference to the fixed stars.] In other words, the solar day, or the interval from one noon to the next by the sun, is at certain seasons of the year shorter than the average, and at others longer, and thus it comes about that by the accumulation of this error of going, the sun is at the beginning of November more than 16 minutes fast, and by the middle of February 14½ minutes slow, having lost 31 minutes, or more than half-an-hour, in the interval. In passing it may be mentioned as a result of this that the afternoons in November are about half-an-hour shorter than the mornings, whilst in February the mornings are half-an-hour shorter than the afternoons. In view of the importance attached by some astronomers to the use of exact local time in civil life, it would be interesting to know how many villagers have remarked this circumstance.

It is essential to bear these facts in mind when we have to consider the extent to which local time regulates the affairs of life, and the degree of sensitiveness of a community to a deviation of half-an-hour or more in the standard reckoning of time. My own

[1] Lecture by W. H. M. Christie, F.R.S., Astronomer-Royal, at the Royal Institution, March 19, 1886.

experience is that in districts which are not within the influence of railways the clocks of neighbouring villages commonly differ by half-an-hour or more. The degree of exactitude in the measurement of local time in such cases may be inferred from the circumstance that a minute hand is usually considered unnecessary. I have also found that in rural districts on the Continent arbitrary alterations of half-an-hour fast or slow are accepted not only without protest but with absolute indifference.

Even in this country where more importance is attached to accurate time, I have found it a common practice in outlying parts of Wales (where Greenwich time is about 20 minutes *fast* by local time) to keep the clock half-an-hour fast by railway (*i.e.* Greenwich) time, or about 50 minutes fast by local time. And the farmers appeared to find no difficulty in adapting their hours of labour and times of meals to a clock which at certain times of the year differed more than an hour from the sun.

There is a further irregularity about the sun's movements which makes him a very unsafe guide in any but tropical countries. He is given to indulging in a much larger amount of sleep in winter than is desirable for human beings who have to work for their living and cannot hibernate as some of the lower animals do. To make up for this he rises at an inconveniently early hour in summer and does not retire to rest till very late at night. Thus it would seem that a clock of steady habits would be better suited to the genius of mankind.

Persons whose employment requires daylight must necessarily modify their hours of labour according to the season of the year, whilst those who can work by artificial light are practically independent of the vagaries of the sun. Those who work in collieries, factories, or mines, would doubtless be unconscious of a difference of half-an-hour or more between the clock and the sun, whilst agriculturists would practically be unaffected by it, as they cannot have fixed hours of labour in any case.

Having thus considered the regulating influence of the sun on ordinary life within the limits of a small community, we must now take account of the effect of business intercourse between different communities separated by distances which may range from a few miles to half the circumference of our globe. So long as the means of communication were slow, the motion of the traveller was insignificant compared with that due to the rotation of the earth, which gives us our measure of time. But it is otherwise now, as I will proceed to explain.

Owing to the rotation of the earth about its axis, the room in which we now are is moving eastward at the rate of about 600 miles an hour. If we were in an express train going eastward at a speed of sixty miles an hour (relatively to places on the earth's surface), the velocity of the traveller due to the combined motions would be 660 miles an hour, whilst if the train were going westward it would be only 540 miles. In other words, if local time be kept at the stations, the apparent time occupied in travelling sixty miles eastward would be 54 minutes, whilst in going sixty miles westward it would be 66 minutes. Thus the journey from Paris to Berlin would apparently take an hour and a half longer than the return journey, supposing the speed of the train to be the same in both cases.

In Germany, under the influence of certain astronomers, the system of local time has been developed to the extent of placing posts along the railways to mark out each minute of difference of time from Berlin. Thus there is an alteration of one minute in time reckoning for every ten miles eastward or westward, and even with the low rate of speed of German trains, this can hardly be an unimportant quantity for the engine-drivers and guards, who have to alter their watches one minute for every ten miles they have travelled east or west. This would seem to be the *reductio ad absurdum* of local time.

In this country the difficulty as to the time reckoning to be used on railways was readily overcome by the adoption of Greenwich time throughout Great Britain. The railways carried London (*i.e.* Greenwich) time all over the country, and thus local time was gradually displaced. The public soon found that it was important to have correct railway time, and that even in the west of England, where local time is about 20 minutes behind Greenwich time, the discordance between the sun and the railway clock was of no practical consequence. It is true that for some years both the local and the railway times were shown on village clocks by means of two minute-hands, but the complication of a dual system of reckoning time naturally produced inconvenience, and local time was gradually dropped. Similarly in France, Austria, Hungary, Italy, Sweden, &c., uniform time has been carried by the railways throughout each country. It is noteworthy that in Sweden the time of the meridian one hour east of Greenwich has been adopted as the standard, and that local time at the extreme east of Sweden differs from the standard by about 36½ minutes.

But in countries of great extent in longitude such as the United States and Russia, the time-question was not so easily settled. It was in the United States and Canada that the complication of the numerous time standards then in use on the various railways forced attention to the matter. To Mr. Sandford Fleming, the constructor of the Inter-Colonial Railway of Canada and engineer-in-chief of the Pacific Railway, belongs the credit of having originated the idea of a universal time to be used all over the world. In 1879 Mr. Fleming set forth his views on time-reckoning in a remarkable paper read before the Canadian Institute. In this he proposed the adoption of a universal day, commencing at Greenwich mean noon or at midnight of a place on the anti-meridian of Greenwich, *i.e.*, in longitude 180° from Greenwich. The universal day thus proposed would coincide with the Greenwich astronomical day, instead of with the Greenwich civil day which is adopted for general use in this country.

The American Metrological Society in the following year issued a report recommending that, as a provisional measure, the railways in the United States and Canada should use only five standard times, 4, 5, 6, 7, and 8 hours respectively later than Greenwich, a suggestion originally made in 1875 by Prof. Benjamin Peirce. This was proposed as an improvement on the then existing state of affairs, when no fewer than seventy-five different local times were in use on the railroads, many of them not differing more than 1 or 2 minutes. But the committee regarded this merely as a step towards unification, and they urged that eventually one common standard should be used as railroad and telegraph time throughout the North American continent, this national standard being the time of the meridian 6 hours west of Greenwich, so that North American time would be exactly 6 hours later than Greeenwich time.

Thanks to the exertions of Mr. W. F. Allen, Secretary of the General Railway Time Convention, the first great practical step towards the unification of time was taken by the managers of the American railways on November 18, 1883, when the five time standards above mentioned were adopted. Mr. Allen stated in October 1884 that these times were already used on 97½ per cent. of all the miles of railway lines, and that nearly 85 per cent. of the total number of towns in the United States of over 10,000 inhabitants had adopted them.

I wish to call particular attention to the breadth of view thus evidenced by the managers of the American railways. By adopting a national meridian as the basis of their time-system, they might have rendered impracticable the idea of a universal time to be used by Europe as well as America. But they rose above national jealousies, and decided to have their time-reckoning based on the meridian which was likely to suit the convenience of the greatest number, thus doing their utmost to promote uniformity of time throughout the world by setting an example of the sacrifice of human susceptibilities to general expediency.

Meanwhile Mr. Sandford Fleming's proposal had been discussed at the Geographical Congress at Venice in 1881, and at a meeting of the Geodetic Association at Rome in 1883. Following on this a special Conference was held at Washington in October 1884, to fix on a meridian proper to be employed as a common zero of longitude and standard of time-reckoning throughout the globe. As the result of the deliberations it was decided to recommend the adoption of the meridian of Greenwich as the zero for longitude, and the Greenwich civil day (commencing at Greenwich midnight and reckoned from 0 to 24 hours) as the standard for time reckoning. In making this selection the delegates were influenced by the consideration that the meridian of Greenwich was already used by an overwhelming majority of sailors of all nations, being adopted for purposes of navigation by the United States, Germany, Austria, Italy, &c. Further, the United States had recently adopted Greenwich as the basis of their time-reckoning, and this circumstance in itself indicated that this was the only meridian on which the Eastern and Western Hemispheres were likely to agree.

The difficulties in the way of an agreement between the two hemispheres may be appreciated by the remarks of the Superintendent of the American Ephemeris on Mr. Sandford Fleming's scheme for universal time (which was subsequently adopted in its essentials at the Washington Conference):—"A capital plan for use during the millenium. Too perfect for the present state of humanity. See no more reason for considering Europe in the matter than for considering the inhabitants of the planet Mars. No; we don't care for other nations, can't help them, and they can't help us." [1]

As a means of introducing universal time, it has been proposed by Mr. Sandford Fleming, Mr. W. F. Allen, and others, that standard times based on meridians differing by an exact number of hours from Greenwich should be used all over the world. In some cases it may be that a meridian differing by an exact number of half-hours from Greenwich would be more suitable for a country like Ireland, Switzerland, Greece, or New Zealand, through the middle of which such a meridian would pass, whilst one of the hourly meridians would lie altogether outside of it.

The scheme of hourly meridians, though valuable as a step towards uniform time, can only be considered a provisional arrangement, and though it may work well in countries like England, France, Italy, Austria, Hungary, Sweden, &c., which do not extend over more than one hour of longitude, in the case of such an extensive territory as the United States difficulties arise in the transition from one hour-section to the next which are only less annoying than those formerly experienced, because the number of transitions has been reduced from seventy-five to five, and the change of time has been made so large that there is less risk of its being overlooked. The natural inference from this is that one time-reckoning should be used throughout the whole country, and thus we are led to look forward to the adoption in the near future of a national standard time, 6 hours slow by Greenwich, for railways and telegraphs throughout North America.

We may then naturally expect that by the same process which we have witnessed in England, France, Italy, Sweden, and other countries, railway time will eventually regulate all the affairs of ordinary life. There may of course be legal difficulties arising from the change of time-reckoning, and probably in the first instance local time would be held to be the legal time unless otherwise specified.

It seems certain that when a single standard of time has been adopted by the railways throughout such a large tract of country as North America, where we have a difference of local times exceeding five hours, the transition to universal time will be but a small step.

But it is when we come to consider the influence of telegraphs on business life, an influence which is constantly exercised, and which is year by year increasing, that the necessity for a universal or world time becomes even more apparent. As far as railways are concerned, each country has its own system, which is to a certain extent complete in itself, though even in the case of railways the rapidly increasing inter-communication between different countries makes the transition in time-reckoning on crossing the frontier more and more inconvenient. Telegraphs, however, take no account of the time kept in the countries through which they pass, and the question, as far as they are concerned, resolves itself into the selection of that system of time-reckoning which will give least trouble to those who use them.

For the time which is thus proposed for eventual adoption throughout the world, various names have been suggested. But whether we call it Universal, Cosmic, Terrestrial, or what seems to me best of all, World Time, I think we may look forward to its adoption for many purposes of life in the near future.

The question, however, arises as to the starting-point for the universal or world day. Assuming that, as decided by the great majority of the delegates at Washington, it is to be based on the meridian of Greenwich, it has still to be settled whether the world day is to begin at midnight or noon of that meridian. The astronomers at Rome decided by a majority of twenty-two to eight in favour of the day commencing at Greenwich noon, that is, of making the day throughout Europe begin about mid-day. However natural it might be for a body of astronomers to propose that their own peculiar and rather inconvenient time-reckoning should be imposed on the general public, it seems safe to predict that a World Day which *commenced* in the middle of their busiest hours would not be accepted by business men. In fact, the idea on which this proposal was founded was that universal time would be used solely for the internal administration of railways and telegraphs, and that accurate local time must be rigidly adhered to for all other purposes. It was conceded, however, that persons who travelled frequently might with advantage use universal time during railway journeys. This attempt to separate the travelling from the stationary public seems to be one that is not likely to meet with success even temporarily, and it is clear that in the future the latter class may be expected to be completely absorbed in the former. Another argument that influenced the meeting at Rome was the supposed use of the astronomical day by sailors. Now it appears that sailors never did use the astronomical day, which begins at the noon *following* the civil midnight of that date, but the nautical day, which begins at the noon *preceding*, *i.e.* twenty-four hours before the astronomical day of the same date, ending when the latter begins. And the nautical day itself has long been given up by English and American sailors, who now use a sort of mongrel time-reckoning, employing civil time in the log-book and for ordinary purposes, whilst, in working up the observations on which the safe navigation of the ship depends, they are obliged to change civil into astronomical reckoning, altering the date where necessary, and interpreting their a.m. and p.m. by the light of nature. It says something for the common-sense of our sailors that they are able to carry out every day without mistake this operation, which is considered so troublesome by some astronomers.

In this connection I may mention that the Board of Visitors of Greenwich Observatory have almost unanimously recommended that, in accordance with the resolution of the Washington Conference, the day in the English Nautical Almanac should be arranged from the year 1891 (the earliest practicable date) to begin at Greenwich midnight (so as to agree with civil reckoning, and remove this source of confusion for sailors), and that a committee appointed by them have drawn up the details of the changes necessary to give effect to this resolution without causing inconvenience to the mercantile marine.

The advantage of making the world day coincide with the Greenwich civil day is that the change of date at the commencement of a new day falls in the hours of the night throughout Europe, Africa, and Asia, and that it does not occur in the ordinary office hours (10 a.m. to 4 p.m.) in any important country except New Zealand. In the United States and Canada the change of date would occur after four in the evening, and in Australia before ten in the morning. This arrangement would thus reduce the inconvenience to a minimum, as the part of the world in which the change of date would occur about the middle of the local day is almost entirely water, whilst on the opposite side we have the most populous continents.

The question for the future seems to be whether it will be found more troublesome to change the hours for labour, sleep, and meals once for all in any particular place, or to be continually changing them in communications from place to place, whether by railway, telegraph, or telephone. When universal or world time is used for railways and telegraphs, it seems not unlikely that the public may find it more convenient to adopt it for all purposes. A business man who daily travels by rail, and constantly receives telegrams from all parts of the world, dated in universal time, would probably find it easier to learn once for all that local noon is represented by 17h. U.T. and midnight by 5h. (as would be the case in the Eastern States of North America), and that his office hours are 15h. to 21h. U.T., than to be continually translating the universal time used for his telegrams into local time.

If this change were to come about, the terms noon and midnight would still preserve their present meaning with reference to local time, and the position of the sun in the sky, but they would cease to be inseparably associated with 12 o'clock.

[1] *Proceedings* of the Canadian Institute, Toronto, No. 143, July 1885.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 2, 1886.—On the galvanic conductivity of some easily fusible metallic alloys, by C. L. Weber.—On the electric conductivity of double-salts, by E. Klein.—On the galvanic polarisation of lead, by F. Streintz and E. Aulinger.—Experiment to determine the maximum of galvanic polarisation, by A. Föppl.—On the electro-magnetic rotation of the polarisation of light in iron, by A. Kundt.—Electro-magnetic rotation of natural light, by L. Sohncke.—On determination of the capillary constants of liquids, by S. Quincke.—On the relative permeability of different diaphragms and their availability as dialytic partitions, by A. Zott.—On the influence of temperature and concentration on the fluidity of liquid mixtures, by K. Novak.—On the dispersion-equivalent and coefficient of expansion of sulphur, by A. Schrauf.

Bulletin de l'Académie Royale de Belgique, December 1885.—Some remarks on Gen. Liagre's remarks and Baeyer's posthumous note on winter and summer tides, by M. Folie. The statements that the tides are higher in summer owing to the greater heat of the sun, and that for the same reason there is greater barometric pressure, are both shown to be groundless.—Note on the Middle Devonian rocks of Belgium: the Givet limestones, their stratigraphic relations and distribution, by E. Dupont. The pure limestones of the Givet epoch are classified as under: (1) Fossiliferous gray, with stromatopores, favosites, alveolites, &c.; (2) deep blue, rarely lilac, granular or sub-compact, occasionally schistoid; (3) blue sub-compact, with small spathose particles disseminated; (4) oolithic gray; (5) fissured gray. All these limestones are distinctly stratified.—The Cetaceans of the European waters, by P. J. Van Beneden. These Cetaceans, which are described in detail, are divided into three groups: (1) Balænidæ, or true whales, such as *B. biscayensis*, *Balænoptera sibbaldii*, &c.; (2) Ziphioidæ, or Cetodonts with teeth in the lower jaw only, such as the Cachalot (*Pyseter macrocephalus*), *Hyperoodon rostratus*, &c.; (3) Delphinidæ, or Cetodonts with two rows of teeth piercing the gums, such as *Phocæna communis*, *Globiceps melas* (the Grindewall of the Orkneys), *Orca gladiator*, *Grampus griseus*, &c.—The Camiguin volcano, by A. Renard. A full description is given of the geological constitution and other natural features of this volcanic island, one of the most remarkable in the Philippine Archipelago.—Note on the meteoric display of November 27, and on an enigmatical luminous phenomenon observed on November 28, 1885, by F. Terby. In a field of observation about one-fifth of the celestial horizon the author observed, at Brussels, 1806 meteors in 57 minutes, or a mean of 31·7 per minute, which for the whole sky would give a mean of 158·4 per minute. The moment of maximum intensity appeared to be 6.16 p.m., when the meteors passed at the rate of forty-nine per minute. At 7.50 the following evening, during a violent storm accompanied by heavy rain, the observer noticed, at about 60° above the southern horizon, a very luminous region of spherical form, with a diameter of from 5° to 8°. The phenomenon, which returned at 8.5, lay evidently behind the clouds, by which it was more or less obscured. Its altitude and position seemed to connect it with the needle of magnetic inclination, and it may have been associated with an aurora borealis partly concealed by the clouds.—On a new method of separating and effecting a quantitative analysis of cadmium and copper, by Dr. Leo Backenlandt.—On the Bacteria of bread fermentation, by Emile Laurent. It is shown that viscous bread is produced by *Bacillus panificans*, which renders the albuminoids soluble, feeding on saccharose, and at a depth of 7 or 8 mm. resisting the baking process. It abounds in ordinary bread, and, after the baking, may attack the starch when not sufficiently acid, transforming it to a substance analogous to erythrodextrine. The formation of viscous bread may be prevented by the addition of a sufficient quantity of organic acid.

Rivista Scientifico-Industriale, January 31.—Notes on the three comets recently discovered by Fabry, Barnard, and Brooks, by Prof. Tempel. The last-mentioned already passed its perihelion in November, but the two others will both be visible simultaneously and not far apart from each other during the second half of April and the first of May next. It is possible that Fabry's may even be projected on the solar disk on April 26 and 27.—Description of a new polarimeter (three illustrations), by Prof. Augusto Righi. The apparatus here described belongs to the penumbra type of polarimeters, which are now universally preferred, especially for measuring the rotation of vibrations. The inventor believes it to be as sensitive as those of Jellet or Laurent, while combining in itself the special advantages which are separately possessed by those two instruments.—New facts on etherification by double decomposition, by Dr. Giacomo Bertoni. Berthelot having stated that the analogies between the ethers and the salts are superficial and that profound differences exist between them, supporting this view by the assertion that direct metathesis at a cold temperature has not been obtained on organic compounds, the Italian chemist, on the contrary, here demonstrates that metathesis between organic bodies really takes place in the same way. Thus is demonstrated the extension of Berthelot's own law to organic compounds, and the principle being in perfect harmony with thermo-dynamics, in no way contradicts the laws of thermo-chemistry. With these brilliant researches Dr. Bertoni not only illustrates the theoretical aspect of modern chemistry, but also opens a wide field for new and useful applications.

Rendiconti del Reale Istituto Lombardo, February 4.—On the birational transformations of three geometrical forms of the second species, by Prof. G. Jung. The subject is treated under three separate heads. In the first are generalised some properties of the geometrical forms of the second species; in the second is given a new demonstration of two familiar formulas which occur in the theory of birational transformations; in the third the aforesaid properties are discussed in connection with some analogous subjects recently treated by several writers, especially with the question of undetermined analysis solved by De Jonquières (*Comptes rendus*, November 2 and 9, 1885) and the researches of Autonne on the groups of birational substitutions.—On the reciprocal linear correspondences in a linear space of any species, by F. Aschieri. It is shown that two fundamental forms of h species in a linear space $Sn - 1$ will be reciprocal if one is obtained from the other with a finite number of operations (projections and sections), and will constitute a polar system in respect of a general quadrature belonging to one of said forms.—A theorem on the functions each term of which is a function of $z(= x + iy)$, by Prof. Giulio Ascoli.—Meteorological observations made at the Brera Observatory, Milan, during the month of January.

Sitzungsberichte der physikalisch-medizinischen Societät zu Erlangen, Heft 17, 1885.—On alkaline fermentation of urea, and on "urea-ferment," &c., by W. Leube.—The diffraction-phenomena of a circular aperture and a circular shield, by E. Lommel.—On reducible curves, by M. Noether.—On some syntheses in the pyrrol series, by L. Know.—Projection of the interference of liquid waves, by E. Lommel.—Visible representation of the focus of the ultra-red rays by phosphorescence, by the same.—The discriminants of the binary form of the sixth degree, by R. Gordan.—On calomel, by R. Fleischer.—On partial arching of the tympanum with moderate increase of the air-pressure in the outer auditory passage, by W. Kiesselbach.—On an anomaly of the lower *vena cava*, by L. Gerlach.—On a new way of making glass windows in the shell of birds' eggs before or in the first stage of incubation, by L. Gerlach.

Revue d'Anthropologie, tome i. fasc. 1, Paris, 1886.—M. Topinard, editor of the *Revue*, treats at great length of the measurements made by Dr. P. Broca, of various crania derived from the so-called Baye Caverns in the valley of Petit-Morin (Marne). These caves, of which M. de Baye has thoroughly explored 120, have been excavated by the hand of man in the chalk, both as habitations and as places of burial, and from the appearances of the two hundred and odd skulls that have already been brought to light, and the general character of the finds, these deposits may be referred to the polished stone age. Dr. P. Broca's hitherto unpublished measurements of forty-four of these crania, and his explanations of the methods adopted in his determinations, together with his remarks on the evidence favouring his opinion that two mixed races were represented in the remains of the Marne caves, are accepted by M. Topinard as incontrovertible proof of an augmentation in the mean cephalic index among the successive races who advanced from the south to the north of France during the Neolithic period. The general mean of the index of the forty-four crania was found by Broca to be 78·1, while he gives 72·6 for the Cave-men of L'Homme Mort, and 79·5 for the men of the dolmen of Vauréal, near Paris, the Baye Cave skulls thus presenting a mean between these extremities. The present paper, which is a sequel to the series published by the Society from the mass of materials left by Broca in a more or less complete condition, will be followed by others of similar interest.—On the Cro-Magnon race, their migrations and descendants, by M. le Dr. Verneau. The author is of opinion that the Cro-Magnon type was not effaced in the Glacial period, and that it still survives in many parts of France and Italy, and nowhere in greater purity than among the Western Basques, while recent researches in Spain and Portugal show that a race presenting identical cranial characteristics had spread from one extremity of the peninsula to the other. M. Verneau believes that their presence may be traced from the valley of the Vézère, with its Cave-men, to the dolmen regions of North-West Africa, and even to the Canary Isles, and that the race, which was one of hunters, migrated from north to south in pursuit of the game on which its existence depended.—The Kirghis, by M. Nicolas Seeland.

The author, from his position as Medical Director for the province of Sémiretchie, where the Kirghis population numbers more than 550,000, has had exceptional opportunities for observing the social and domestic habits of the people; and his carefully-conducted craniometric and other measurements, together with his exhaustive remarks on the physical, moral, and intellectual characteristics of the people, their language and literature, religion and superstitions, and the past and probable future effects on the race of closer contact with Western civilisation, supply valuable materials towards the history of these ancient tribes, whose numbers are computed at upwards of a million and a half.—On the so-called cup-like excavations, "Pierres à Cupules," by M. de Nadaillac. The author passes in review the most remarkable of these stone-markings, which have been found in the most widely-separated parts of the globe since they first attracted notice in Switzerland in 1849. In Brittany, where such stone-markings and depressions have of late years been found in great numbers, they appear to be contemporaneous with the dolmen age. M. de Nadaillac is of opinion that the general similarity of the markings, of which he gives various clear drawings, cannot be accepted as a proof of any ethnic connection between the various peoples who designed them, and is probably only to be referred to a general similarity of intelligence among men at one and the same stage of their respective courses of development.—Contributions to the history of muscular anomalies, by M. Ledouble. In the present paper, which is a sequel to the author's articles in last year's *Revue* on the major and minor pectorals, he treats specially of the variations of length and breadth in the abdominal muscles, considering each anomaly from a comparative anatomical point of view.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 28.—"On the Development of the Cranial Nerves of the Newt." By Alice Johnson, Demonstrator of Biology, Newnham College, Cambridge, and Lilian Sheldon, Bathurst Student, Newnham College, Cambridge. Communicated by Prof. M. Foster, Sec. R.S.

February 25.—"On Radiant Matter Spectroscopy: Note on the Earth Yα." By William Crookes, F.R.S.

Among the samarskite earths which concentrate towards the middle of the fractionations there is one (or a group) which presents in the radiant matter tube a well-marked phosphorescent spectrum differing from those I have already described.

The measurements of the bands and lines are given below:—

Scale of spectroscope	λ	$\frac{1}{\lambda^2}$	Remarks
10·325	6446	2407	Approximate centre of a red band shaded off on the least refrangible side.
10·310	6415	2430	Somewhat sharp edge of the red band.
10·185	6189	2611	Approximate centre of a very faint orange band.
10·130	6094	2693	A sharp narrow orange-red line.
10·05	5970	2806	Approximate centre of a narrow bright orange band. (Between this line and 2693 is a fainter semi-continuous orange band).
9·840	5676	3104	Approximate centre of a narrow bright green band.
9·790	5613	3174	Approximate centre of a narrow green band, not quite so bright as 3104.
9·690	5495	3312	Approximate centre of a bright green band, wider than the other three green bands.
9·610	5406	3422	Approximate centre of a narrow bright green band.

The earth giving the above spectrum, when sufficiently purified, presents all the characteristics of the earth discovered by Marignac, and provisionally called by him Yα (*Comptes rendus*, xc. p. 899). Through the kindness of M. de Marignac I have been enabled to compare a specimen of Yα of his own preparation with the earth described above. The two earths agree in their chemical characteristics, and their phosphorescent spectra are practically identical.

No name has yet been given to this earth, as the discoverer appears to be in some doubt whether it is not identical with J. Lawrence Smith's earth mosandra (*Comptes rendus*, lxxxvii. p. 145; lxxxvii. p. 831; lxxxix. p. 480). A specimen of mosandra prepared by J. Lawrence Smith, and sent me by M. de Marignac, gave a phosphorescent spectrum showing that it was compound, and that yttria was one of its constituents.

"On a Comparison between Apparent Inequalities of Short Period in Sunspot Areas and in Diurnal Declination Ranges at Toronto and at Prague." By Prof. Balfour Stewart, F.R.S., and William Lant Carpenter, B.A., B.Sc.

The authors discuss these inequalities in precisely the same manner in which they discussed those of a previous communication (*Proc.* Roy. Soc., vol. xxxvii. p. 290), and are led to the following conclusions:—

(α) When disturbances are excluded as much as possible, both the Toronto and the Prague declination inequalities exhibit signs of duplicity of phase, the predominant maximum at both observatories occurring shortly after the sunspot maximum for inequalities around twenty-four days.

(β) On the other hand, for inequalities around twenty-six days the predominant maximum for both observatories more nearly coincides in time with the subsidiary maximum of the twenty-four day inequalities.

(γ) The short-period inequalities of this paper are as nearly as possible equally developed and equally traceable for temperature and for declination ranges.

(δ) When disturbances are excluded as much as possible, corresponding phases appear to take place at Toronto three or four days before they take place at Prague.

March 4.—The Bakerian Lecture.—"Colour Photometry." By Capt. W. de W. Abney, F.R.S., and Major-Gen. Festing, R.E.

One of the authors of this paper has already communicated to the Physical Society of London (*Phil. Mag.* 1885) a method by which a patch of monochromatic light can be thrown on a screen. This formed the starting-point of the present investigation, which was to ascertain whether it was practicable to compare with each other the intensity of lights of different colours.

The authors describe various plans they adopted to effect this purpose, and finally found that, by placing a rod in front of the patch of monochromatic light, and by casting another shadow by means of a candle alongside the first shadow, the intensities of the two lights which illuminated the two shadows could be compared by what they term an oscillation method. It is known that on each side of the yellow of the spectrum the luminosity more or less rapidly decreases. By placing a candle at such a distance from the screen that the luminosity of the two shadows appears as approximately equal, it is easy to oscillate the card carrying the slit through which the monochromatic rays of the spectrum pass. (The slit is in the focus of the lens which helps to form the spectrum.) The shadow of the rod cast by the candle can thus be made to appear alternately "too light" or "too dark" in comparison with the shadow of the rod cast by the parts of the spectrum falling on the screen. By a moderately rapid oscillation the position of equality of the two shadows can be distinguished with great exactness. The authors describe their method of fixing the position of the rays employed and the source of light with which the spectrum is formed. They also enter into details as to the comparison light, the receiving screen, and the comparative value of the light as seen by them respectively. The curve of the intensity of the spectrum of the light emitted from the positive pole of the arc light as seen by their eyes, which they call the normal curve, is then described. The question as to the effect of an alteration of the colour of the comparison light is then discussed, as is the effect of the brightness of the spectrum.

The next point touched upon is as to the value of mixed light as compared with its components. It is found that the following law holds good, viz.: *that "the sum of the intensities of two or more colours is equal to the intensity of the same rays when mixed."* This law is applied to Hering's theory of colour.

The authors next state that with the majority of people the curve of luminosity of the spectrum is identical with the normal curve, but that in some cases slight differences may be observed, of which one example is given. Such slight deficiency does not constitute colour-blindness, since the want of appreciation of any colour is but very partial. They next describe observations made by four colour-blind persons, and show that there is a remarkable divergence in their curves from the normal. The deficiency curves are shown, from which it appears that two of the observers are totally blind to red, whilst the other two are partially so. They then show that such observers would not give a true value for any light which is not of identically the same colour as the comparison light they might employ. It also appears that the intensity of illumination felt by a colour-blind is really less than that perceived by a normal-eyed person.

Two examples of the curves for sunlight are then given, one taken on a day in July by the method of separating close lines by varying the illumination, and the other in November by the method described above. Their results are compared with Vierordt's curve, obtained by extinguishing colour with white light.

In order to ascertain the effect of the turbidity of a medium through which light passes (for instance, of air on sunlight), the authors compared the intensity of the spectrum after passing through clear water and turbid water, and found that the absorption agreed with Lord Rayleigh's theoretical deductions that

$$I' = I_0 \epsilon^{-kx\lambda^{-4}},$$

where I' is the intensity after passing through a turbid medium, I_0 the intensity after passing through clear water, x the thickness of the turbid layer, k a constant independent of λ, λ being the wave-length.

The authors conclude their paper with a discussion of the intensity curves of the spectrum of carbon filaments electrically heated.

Chemical Society, February 18.—Dr. Hugo Müller, F.R.S., President, in the chair.—The following papers were read :—The constitution of undecylenic acid as indicated by its magnetic rotation ; and on the magnetic rotation, &c., of mono- and di-allylacetic acids and ethylic diallylmalonate, by W. H. Perkin, F.R.S.—Reactions supposed to yield nitroxyl or nitryl chloride, by W. Collingwood Williams, B.Sc.—The condition of silicon in cast iron, by A. E. Jordan and Thomas Turner.—Certain aromatic cyanates and carbamates, by H. Lloyd Snape, B.Sc.—The oil obtained from lime-leaves, by Francis Watts.

March 4.—Dr. Hugo Müller, F.R.S., President, in the chair.—A new element : germanium, by Clemens Winkler.—The influence of temperature on the heat of chemical combination, by S. U. Pickering.—The salts of tetrethylphosphonium and their decomposition by heat, by Prof. E. A. Letts and Norman Collie, Ph.D.—The formation of acids from aldehydes by the action of anhydrides and salts, and the formation of ketones from the compounds resulting from the union of anhydrides and salts, by W. H. Perkin, F.R.S.—A new method of preparing tin tetrethide, by Prof. E. A. Letts and Norman Collie, Ph.D.—Contributions to the history of cyanuric chloride, by Alfred Senier, M.D.—The action of naphthylamine on cyanuric chloride, by Harold H. Fries.—Sulphine salts containing the ethylene radicle ; part i., diethylenesulphide-methyl-sulphine salts, by Orme Masson, M.A., D.Sc.—Sulphine salts containing the ethylene radicle ; part ii., on Dehn's reaction between ethylene bromide and alkyl sulphide, by Orme Masson, M.A., D.Sc.

Zoological Society, March 16.—Prof. W. H. Flower, F.R.S., President, in the chair.—Mr. F. D. Godman, F.R.S., exhibited some examples of a butterfly, *Danais plexippus*, from various localities, and made remarks on its distribution, which of late years seemed to have become very widely extended.—Prof. Bell made some remarks on the *Balanoglossus* recently discovered in the Island of Herm, Channel Islands, of which he had exhibited a specimen on a former occasion.—A communication was read from the Rev. H. S. Gorman, F.Z.S., containing descriptions of some new genera and species of Coleoptera of the family Endomychidæ from various localities.—A communication was read from Dr. R. J. Anderson, F.Z.S., of Queen's College, Galway, containing observations on the pelvisternum in certain Vertebrates.—Prof. F. Jeffrey Bell read a paper on the generic characters of Planarians, basing his observations mainly on a specimen of a Planarian recently found living in this country, and believed to be referable to *Bipalium kewense*.—Mr. F. E. Beddard read a note on the structure of a large species of earthworm from New Caledonia, of which examples had been recently received from Mr. E. L. Layard, F.Z.S., H.B.M. Consul for New Caledonia.

Physical Society, March 13.—Prof. Balfour Stewart, President, in the chair.—Prof. U. S. Pickering and A. C. Hayward were elected Members of the Society.—The following communications were read :—On the growth of filiform silver, by Dr. J. H. Gladstone. It has long been known that if a piece of metallic copper be placed in a solution of nitrate of silver, replacement of one metal by the other will take place, the silver being deposited in the crystalline form, sometimes having a resemblance to fern-leaves, or as superposed hexagonal plates, or knobs. It was observed, however, as far back as 1872, by the late Mr. Tribe and the author, that if nitrate of silver were decomposed by suboxide of copper instead of the metal, the silver presented itself in threads, which rarely, if ever, bifurcate, but frequently turn at sharp angles or twist in every direction. This was described in the British Association *Report* for 1872, and it was observed that the same forms occurred in native silver. More recent observations have shown that the particular character and rapidity of formation of these threads depend very much upon the strength of the solution and the condition of the suboxide. Hydrated suboxide will scarcely decompose a 2 per cent. solution, even after standing. The threads, which bend at a sharp angle, usually do so at 60° or 120°. Other threads, however, are symmetrically curved ; but, especially in strong solutions, they are given to twisting about in every direction, and generally terminate in irregular knobs of silver. As a rule a thread continues to grow of the same thickness as it commenced, but it sometimes enlarges for a while into a flat plane, or becomes incrusted for some distance with small crystals of silver. When the solution is very nearly exhausted of silver, fine arborescent forms appear ; but with the suboxide there are never produced the fern-leaved forms, or hexagonal plates, or the other distinctly crystalline structures which characterise the growth from metallic copper. During the reaction the suboxide is changed into black protoxide and metallic copper, which dissolves ; and the change will take place as well with the acetate and sulphate as the nitrate. If a mixture of suboxide and metallic copper be employed, not only do the distinctly crystalline and the filiform forms make their appearance, but strange intermediate forms come into existence.—Apparatus for measuring the electrical resistance of liquids, by Prof. Reinold. The apparatus consists of two bottles connected by a horizontal tube. The whole is filled with the liquid to be examined, and immersed in water, by which means, and by thermometers inserted in each bottle, the temperature may be regulated and accurately ascertained. The electrodes are platinum plates, one dipping into each bottle. Two fine tubes terminate near the ends of the connecting-tube, and electrodes are fitted into them at some distance from the ends ; by connecting these to a quadrant electrometer or a condenser and galvanometer, the difference of potential between the ends of the tube can be compared with that at the ends of a known resistance in the same circuit.—On chromatic photometry, by Capt. Abney and Lieut.-Col. R. Festing. (This paper had been previously communicated to the Royal Society.) A series of experiments have been made by the authors to determine the comparative luminous effect of different parts of the spectrum. A monochromatic light from any part of the spectrum of the electric arc was obtained by a method devised by Capt. Abney, and previously described by him to the Society [Physical Society, June 27, 1885, NATURE, vol. xxxii. p. 263]. The photometric effect at different parts of the spectrum was compared with that due to a candle at different distances by Rumford's photometer. In using this it was found best to place the candle in a given position, and obtain a balance by moving the slide upon which the spectrum was formed, and through a slit in which part of the light was allowed to pass rapidly to and fro. For each position of the candle there are thus two corresponding positions of the slit. From the results of these observations a curve may be drawn, showing the luminosity at different points. From the method by which it is obtained it is evident that the curve of one observer is not directly comparable with that of another, since a deficiency of perception in any part of the spectrum would affect the light of the candle as well as that examined. Since, however, the curves obtained by a great number of persons coincide very closely with those obtained by the authors, they have felt justified in adopting them as the normal curves. In the case of the electric arc the normal curve attains a maximum rather nearer the red end of the spectrum than the blue. Assuming the normal curve, any other curve may be compared with it by increasing or decreasing its ordinates, so that no part of it shall lie without the normal curve. In curves thus obtained, several of which were shown, deficiency in colour-perception is often very clearly marked. By the use or two or more slits in the movable slide, experiments were made upon mixtures of colours, and it was found in all cases that the luminous effect of a mixture of colours was the sum of the luminous effects of its components. It was also found that the colour of the comparison and the quantity of light admitted to form the spectrum were without effect upon the form of the curve. Light from the sun and from an incandescent lamp were similarly examined, though it should be observed that the result for sunlight differs notably from that given by Maxwell. An examination has also been made of light after passing through a turbid medium, and an expression of Lord Rayleigh's—

$$I' = Ie^{-x\lambda^{-4}},$$

where I is the original radiation, I' that after passing through the medium, λ the wave-length of the light, and x a constant depending upon the medium, has been closely verified.

Royal Microscopical Society, March 10.—Rev. Dr. Dallinger, President, F.R.S., in the chair.—Mr. J. Beck described his recent visit to the Naples Zoological Station, and exhibited some Tubularia and other organisms with expanded tentacles.—Dr. Crookshank exhibited an elaborate micro-photographic apparatus by Messrs. Swift.—Mr. Crisp exhibited Helmholtz's vibration-microscope for observing the vibration of tuning-forks, strings, and other bodies, Thoma's microscope for examining the circulation of the blood in the mesentery of dogs and other small mammals, and various other microscopes and apparatus, including Prof. Exner's new micro-refractometer for detecting differences in the structure of blood-corpuscles, insects' cornea, &c.—An important communication was read from Prof. Abbe, of Jena, announcing the construction of a new kind of glass, by which the secondary spectrum in objectives was eliminated. Two new objectives were exhibited, which were found to present a considerable advance upon those hitherto constructed.—Notes on a new mounting media of high refractive index, and on a process for obtaining diatoms, were read.—Mr. A. D. Michael read a paper on the life-history of an Acarus, one stage whereof is known as *Labidophorus talpæ*, Kramer, and on an unrecorded species of Disparipes. In 1877 Kramer described a creature which he found parasitic upon the mole, and treated as a new species, naming it as above; it resembled Koch's *Dermaleichus sciurinus*; it was, however, suspected that both were immature, hypopial forms. In 1879 Haller discovered the adult form of *D. sciurinus*; he found it upon the squirrel in considerable numbers and in all stages, Koch's supposed species being the hypopial nymph. For some years Mr. Michael has been trying to trace the history of Kramer's Labidophorus, which he frequently found on the mole, but which he could not get to thrive away from its host; less fortunate than Haller, he could not find on the mole any Acarus which could be the adult stage. Last December it struck him that he might succeed by getting the moles' nests; here he found adult males and females of what he thought might be the species; he also found immature Acari in the ordinary nymphal stage, which he suspected belonged to the same species. By keeping these in confinement and carefully watching them he was enabled actually to see the hypopial nymph, *Labidophorus talpæ*, emerge from the cast skin of the young ordinary nymph, and the adult males and females emerge from the cast skin of the fully-grown ordinary nymph. Mr. Michael proposes to call the species *Glyciphagus crameri*. It is a singular species, the males having remarkable comb-like longitudinal ridges under the front legs. Mr. Michael also described the life-history of a new Disparipes, to be called *D. exhamulatus*.

Anthropological Institute, March 9.—Mr. John Evans, F.R.S., Vice-President, in the chair.—The election of Maccullough Bey was announced.—Mr. Arthur J. Evans read a paper on the flint-knapper's art in Albania. During a recent journey through Epirus Mr. Evans was so fortunate as to observe, in a street of Joannina, an old Albanian flint-knapper practising his art, and described his method of working. The place where he obtained his flints is about two hours' journey from Joannina. The flints were mostly of tabular shape, scattered in profusion about the summit of a limestone plateau, but Mr. Evans was unable to discover any signs of their having been used for manufacture in ancient times. The strike-a-lights, as exposed for sale, are partially cased in ornamental lead sheaths studded with glass gems and otherwise adorned with something not unlike the ancient "honeysuckle" pattern. Compared with old English, French, and German forms, the Albanian flints show the peculiarity of being chipped on both faces instead of presenting one flat side, and they are fashioned with a minute care that recalls the beautifully even surface-chipping of Neolithic times.—The following communications were read by the Secretary:—Notes upon a few stone implements found in South Africa, by W. H. Penning, F.G.S.; and notes on some prehistoric finds in India, by Bruce Foote, F.G.S.—Dr. Garson exhibited and described Broca's stereograph and some other anthropometric instruments.

Paris

Academy of Sciences, March 22.—M. Jurien de la Gravière, President, in the chair.—On the constitution of the earth's crust, by M. Faye. It is argued that the surface of the globe cools more rapidly and to a greater depth under the oceans than on the continents, because heat radiates more freely through liquid than through solid bodies. And as this discrepancy has existed for millions of years, the crust of the earth must now be denser under the waters than under dry land. Hence, in the pendulum observations and other calculations made relative to the figure of the globe, no account should be taken of the attraction of the continental masses lying above sea-level, this excess of matter being compensated lower down by a corresponding diminution of density. In the same way no account should be taken of the feeble attraction of the oceans, because this also is compensated a little lower down by the greater density of the solid crust under the oceanic basins. The same conclusion is pointed at by the now completed triangulation of India, Col. Clarke remarking that it would seem that these pendulum observations have established the fact (previously indicated by the astronomical observations of latitude in India) that there exists some unknown cause, or distribution of matter, which counteracts the attraction of the visible mountain masses.—On the flexion of prisms, by M. H. Resal. A source of error is detected and corrected in the memoir on the flexion of prisms published by M. de Saint-Venant in 1856, the last in which he occupied himself with the subject.—Description of an instrument intended to produce at pleasure an invariable quantity of electricity, by M. Marcel Deprez. This invention, which has already been successfully tested in several experiments conducted by M. Minet at Creil, has for its object the easy reproduction of the unit of electric quantity known by the name of *coulomb* at all times and under all conditions of temperature and pressure.—Account of a spherical absolute electrometer, by M. Lippmann.—Note on the poisons normally present in animal organisms, and particularly on those of the urine, by M. Ch. Bouchard.—On the development of a holomorphous function in a series of polynomes in any area, by M. P. Painlevé.—On the calorimetric study of metals at high temperatures, by M. Poinchon. In this paper the author continues the researches of Pouillet, Weber, and Violle, and here deals more especially with the common metals and some alloys of platina.—On effluvography, a method of obtaining images by effluvium, by M. D. Tommasi. The author submits the first results of his researches on a process for obtaining, by the sole action of electric effluvium, the effects realised by the employment of light in photography. His experiments tend to show that the effluvium produces the same effects as the ultra-violet rays, and that there must consequently exist a connection between the two extreme ends of the spectrum. This connection is constituted by what he provisionally calls *electric rays*.—On the separation and quantitative analysis of copper, cadmium, zinc, nickel, cobalt, manganese, and iron, by M. Ad. Carnot. Having already shown how copper may be separated from cadmium, and cadmium from zinc, by means of the hyposulphite of ammonia and soda, the author explains his process for separating zinc, nickel, or cobalt, manganese, and iron by means of sulphuretted hydrogen, the state of the liquids being modified by successive precipitation.—On the elements of sugar of milk in plants. In continuation of his previous paper the author shows that the mucous substances of plants, gums, pectine, mucilage, &c., contain galactose identical with that of the sugar of milk; and further, that these mucous substances exist in vegetable aliments in such quantities that they are able to furnish the galactose which enters into the constitution of the sugar of milk secreted by the mammary glands of herbivorous animals.—On a new organ of sense in *Mesostoma lingua*, Osc. Schm., by M. Paul Hallez. The organ here described as a median ventral fosse would probably seem to be the seat of the sense of smell in these organisms.—Chlorophyll and the reduction of carbonic acid by plants, by M. C. Timiriazeff.—Note on some xylenic derivatives, by MM. Albert Colson and Henri Gautier.—On the oxidation of the acids of fatty substances, by M. H. Carette.—On a synthesis of the cyanide of ammonium by effluvium, by M. A. Figuier.—Fresh researches on the toxic or medicinal substances by which hæmoglobin is transformed to methæmoglobin, by M. Georges Hayem.—Description of the excreting apparatus and nervous system of *Duthiersia expansa*, Edm. Perrier, and of *Solanophorus megalocephalus*, Creplin, by M. J. Poirier.—On the selenides of potassium and of sodium, by M. Charles Fabre. The formulas are given for the heat of formation and the heat of dissolution of these selenides.—On *Sigillaria Menardi*, in reply to the strictures of M. Weiss, by M. B. Renault.—On the disposition of the crystallised and archæan rocks in West Andalusia, by MM. Michel Lévy and J. Bergeron.—On the slope of the isothermal layers in the deep waters of the Lake of Geneva, which are shown to be inclined at an angle and not superimposed horizontally, as hitherto supposed, by M. F. A. Forel.—On the probable origin of earthquakes, by M. Ch. Lallemand. The author reverts to Elie de Beaumont's theory of a central fluid, which, in combination with Lowthian Green's more recent views on the chilling process ("Vestiges of the Molten Globe"), supplies, he thinks, an adequate explanation of all the underground phenomena and igneous eruptions.

BERLIN

Physical Society, January 8.—Dr. Lummer had subjected De Lalande's element to an examination, and communicated some provisional results of this investigation. The element consisted of an iron vessel, the bottom of which was covered with peroxide of copper; the neck was closed by an india-rubber stopper, through which a zinc cylinder passed; the fluid with which it was filled was potash lye. The chemical process in the cell consisted in the formation of zincate of potassium (*Kaliumzinkat*) and of metallic copper. The electromotory force of the element was found to be equal to from 0·5 to 0·8 Daniell. In one case, however, there were two elements which appeared perfectly alike, one of which yet showed an electromotory force of 0·8 Daniell, the other of more than 1 Daniell, though no ground for this difference was perceptible. The internal resistance of the element was found to be equal to about 0·1 Siemens, and the intensity of the current, the external resistance being 1 Siemens, was about 1 Ampère. Permanently closed with 1 Siemens, the element kept the same intensity for six full days. If the element was exhausted, the passage of a vigorous current from the dynamo-machine sufficed, according to the statements of the discoverer, to completely restore the element. This, however, could only happen, as Prof. von Helmholtz set forth at large in the discussion following the address, when such strong currents were applied that the iron became passive, and only the copper again got oxidised.—Prof. Börnstein reported on the sleety squall which blew through Berlin on January 5, at 2.20 p.m. He laid before the Society the curves marked at that time by the registering apparatus of the Agricultural High School of Berlin. The barograph first showed a sudden rise of about 1mm. in the pressure of the atmosphere. The thermograph marked just as sudden a depression of temperature. The anemograph indicated a sudden increase in the strength of wind, and at the same time a shower of sleet fell to the earth. The same day, at about 11.30 a.m., a squall was observed in Hamburg, which also coincided with a sudden rise in the pressure of the atmosphere and diminution of temperature. It was hardly to be doubted that this was the same squall which reached Berlin at 2.20 p.m., and which accordingly had overtaken the distance from Hamburg to Berlin in about 2¾ hours. In regard to the nature of these squalls, the speaker set forth the theory that they represented the state of the atmosphere after the occurrence of a small minimum with ascending current of air. On the back of this minimum the air fell to the ground, and produced both sudden rise of pressure and abatement of temperature, seeing that the upper cold air descended with its icy precipitate. The most important phenomena of the squalls—increase in pressure and in the strength of the wind, decrease of temperature and the precipitates—were in this way very readily explained. The somewhat lengthy discussion with which this address was followed up dwelt on the necessity of quite precise determinations of the time of each particular phenomenon embraced in the course of such a squall, in order to be able to distinguish the primary from the secondary phenomena, as also on the necessity of exactness in respect of the barographs, both quicksilver and aneroid.

BOOKS AND PAMPHLETS RECEIVED

BOOKS:—"Atlas de la Description Physique de la République Argentine;" Deuxième Section: Mammifères, by Dr. H. Burmeister (Buenos Aires).—"Calendar, Royal University of Ireland, 1886" (A. Thom).—"A Short Manual of Chemistry;" Vol. I. Inorganic Chemistry, by Dupré and Hake (Griffin).—"Burma," by J. G. Scott (Shway Yoe) (Redway).—"Upland and Meadow," by C. C. Abbott (Low).—"Manual of Surgery," 3 vols., edited by F. Treves (Cassell).—"Electricity," by L. Cumming (Rivingtons).—"Observations of the Southern Nebulæ made with the Great Melbourne Telescope from 1869 to 1885," Part I., by R. L. J. Ellery (Ferres, Melbourne).—"Mineral Resources of the United States 1883-84," by A. W. Williams, Jun. (Washington).—"The Fisheries and Fishery Industries of the United States;" Section I. Text and Plates, 2 Vols., by G. B. Goode (Washington).—"A Catalogue of the Library of the Chemical Society" (Harrison).—"Report of the Commissioner of Education, 1883-84" (Washington).—"The Cornell University Register, 1885-86" (Ithaca, N.Y.).—"A Treatise on Nature," by H. Collins (White).—"Euclid Revised," by R. C. J. Nixon (Clarendon Press).—PAMPHLETS:—"A New Graphic Analysis of the Kinematics of Mechanisms," by Prof. R. H. Smith.—"Die Ursache der Secularen Verschiebungen der Strandlinie," by Dr. F. Lörol (Prag).—"Goitre in the Himalayas," by W. Curran (Falconer, Dublin).—"Loss of Life and Property by Lightning at Home and Abroad," by W. McGregor (Robinson, Bedford).—"Report of Experiments on the Growth of Wheat," by Sir J. B. Lawes and J. H. Gilbert (Clowes).—"On the Valuation of Unexhausted Manures," by Sir J. B. Lawes and J. H. Gilbert (Murray).—"Experiments on Ensilage, Season 1884-85," by Sir J. B. Lawes and J. H. Gilbert (Harrison).—"Gyrating Bodies," by C. B. Warring.—"Liste Générale des Observatoires et des Astronomes, des Sociétés et des Revues Astronomiques," by A. Lancaster (Hayez, Bruxelles).

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