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MEDIÆVAL GEOGRAPHY.

The Dawn of Modern Geography. Part ii. A History of Exploration and Geographical Science from the close of the Ninth to the Middle of the Thirteenth Century (*c.* A.D. 900–1260). Pp. xix+651. By C. Raymond Beazley, M.A., F.R.G.S. (London: John Murray, 1901.) Price 18*s*.

IN the present volume of Mr. Beazley's work on the beginnings of modern geography, the author takes us from the time of the irruption of the Northmen into the Middle Sea to the days of the first western travellers in the Far East, the precursors of the Polos. He traces the gradual and painful regaining by the semi-barbarians of the early Middle Age of the earth-knowledge which their civilised forefathers had possessed, but which had been lost during the Dark Ages, until all that had once been known was known again and renascent Europe stood on the brink of discoveries of which Phœnicians, Greeks and Romans had hardly dreamed; with Marco Polo, Prince Henry the Navigator and Columbus, the third part of Mr. Beazley's work will deal.

The central fact of this period, as Mr. Beazley makes quite clear to his readers, is the Crusades. That the attack of Western Europe on the East was inspired by the spirit of the Northmen there can be little doubt. The urging of the Church would have fallen upon deaf ears had there not been abroad in the world a spirit of adventure and aggression, a will to dare and to do, which the older world had not known. This was not the spirit of Roman conquest, for it was ignorant, and had no definite consciousness of a mission to absorb and to reorganise; its desire was to do battle with the unknown, to court danger and to win renown in mortal combat with the devils and sorcerers of the East, the Paynim followers of Mahound, who was to all intents and purposes identified with the Arch-Fiend himself. If Mediæval Europe did not get this spirit of attack from the Romans, still less did she get it from their barbarian conquerors. The Ostrogoth and the Vandal, having overthrown the Empire, were suffocated and buried in its ruins. The Dark Age followed. Western Europe lay stupid, immobile, almost without an idea. Suddenly the inspiration came like a keen wind from the North; the Scandinavian descended in his multitudinous keels upon all the coasts of Europe; he conquered half England and a good part of France, he beleaguered Paris four times in forty years, he swept with the wind in his sails through the Straits and into the Middle Sea, he waged war in Sicily, and finally established himself in Miklagarth ("the great city," Constantinople) itself as the chosen *Vaering* or protector of the Byzantine Emperor. Here he held out a hand to his brethren who had imposed their rule upon the Slavs of Russia, and so the Roman world was girt about and shot through and through with the spirit of the Vikings. And by this time Roman Europe had itself influenced the Northman; it had Christianised him. He became as fierce a Christian as he had been a heathen. He gave to Christian Europe the spark of virility, the desire to dare and to do the uttermost for its faith, which it had lacked; it was now ready for the colossal adventures of the Crusades.

Mr. Beazley does not lay so much stress upon the Scandinavian origin of the Crusading spirit as we have done; with what he says, however, on p. 137, as to the general results of the Crusades we are in entire agreement. As he remarks,

"the land-travels of men who started from the Latin Kingdoms of the East" undoubtedly "led to a decisive and abiding extension of knowledge and civilisation. . . . European life was not impoverished, but enriched by the religious wars; and the only doubt must be whether it was necessary through such tribulation to enter into the brighter age of the great discoveries."

On pp. 407, 408, Mr. Beazley proceeds to exhibit one of the most striking results of the Crusades, and that one which marks a third epoch in the progress of geographical knowledge—the rise to power of the maritime republics of the Mediterranean. They supplied the necessary transport to the Crusaders, and so

"by serving the cause of Christendom they served their own; they multiplied, many times over, their carrying trade; they largely increased their export and import commerce; above all, they acquired a privileged, a more than half political, position on the coasts of the Levant. As time went on, and they became more indispensable to the Crusading princes, they were able to dictate their terms more freely, until the main burden of the Holy War rested upon them as the chief holders of power."

Thus were laid the foundations of the power of Venice and Genoa in the Nearer East, which for many centuries warded off from Western Europe the danger of Mohammedan conquest; Venice remained to the last a Crusading State, even down to the beginning of the eighteenth century, when her successful defence of Corfu under Schulemburg marked the final failure of the return-attack of the Crescent upon the Cross. From that siege dates the political decadence of Islam, and with it the political mission of the Venetian Republic also came to an end; there was no further need for her existence.

Even before the period of the Crusades, the Holy City had been the magnet which attracted hundreds of pilgrims from the West, despite the dangers of the way and the tyranny of the Saracen; the scanty accounts of their travels which have come down to us are of the greatest possible value as showing how knowledge of the Eastern Lands was gradually and painfully regained for the West; the epoch of the Crusades itself is naturally rich in such accounts of pilgrim-journeys. The impulse to far-journeying which was given by the Crusades naturally gained largely in strength in the post-Crusading period; emissaries of the republics and kingdoms of the West penetrated far into the East, and the Holy See itself did not hesitate to dispatch its representatives to the court of the Grand Cham of Tartary. These last missions were, however, hardly of the same character as those of Przhevalski or Sven Hedin; they were dictated by no desire of discovery or longing for more knowledge—for this we have to wait until the time of Prince Henry the Navigator—their aim and object was simply and solely to urge the Mongols, who were now shaking the Muhammedan power in the East to its foundations, to do the work which Christendom had been unable to do, and to destroy the common enemy of Christian and Heathen

alike. These missions, which are well described by Mr. Beazley (p. 275 *ff.*), added to geographical knowledge the outlines of a new chapter, soon to be filled up by Marco Polo.

It is noticeable that one or two of these missions, notably that of Rubruquis, were dispatched by Louis IX., King of France. Here we have the first hint of a new order of things; the domination of the Mediterranean republics in matters of commerce with, and discovery in, far-away lands was already threatened as early as the close of Mr. Beazley's period (about the middle of the thirteenth century) by the rise of the new kingdoms of Western Europe.

"As this period draws to a close," writes Mr. Beazley (p. 425), "the growth of great centralised inland kingdoms both in France and Spain was already foreshadowing a new period; when the most wealthy and unscrupulous of mercantile republics would find itself overmatched by superior resources and equal craft; and when, under the patronage of the new continental States, navies of even greater power would arise, and discoveries ruinous to Italian trade would be made in distant seas."

In fact, it was only the patronage of the Great States that made the discoveries of Prince Henry, of Columbus and of Cabot possible.

This, then, is the period of which Mr. Beazley's second volume treats; it begins with the descent of the Northmen, its central point is the Crusades, its end is marked by the impending eclipse of the trading republics by the organised power of the continental kingdoms. All else is in the nature of epilogue or addendum; the chapter on "Geographical Theory and Description" is as much an appendix as the "Appendix on Maps."

The author has known how to make his book extremely interesting; this is especially the case in the sections which deal with the deeds of the Northmen. He tells again the great story of the discovery of Vinland by Leif Ericsson of Brattahlid, of the coming of Thorfinn Karlsefne to Leif's Booths and the Long and Wonderful Beaches, of the fights with the Skraelings, of the birth of Snorre Thorfinnson, the first white American—that "finest story in the world" which should be known by heart by every Englishman, but which, we fear, is better known in Vinland itself than it is in England. He tells the tale well, and his discussion of the various theories as to the position of Vinland is very useful; he comes to the conclusion that Thorfinn's furthest south is to be placed at Mount Hope Bay in Massachusetts, in lat. 41° 24′ 10″. It is a pity that, as was of course to be expected in America, so many cranks and inexperienced 'prentice hands have busied themselves with a question which they are incompetent to solve, with the result that scientific investigation has not seldom fought as shy of Vinland as it has of Bacon-Shakespeare, anti-vivisection, or any other pseudo-scientific folly. We must, then, remember that even though the Writing Rock on the Taunton River is not a Runic inscription, but an Indian screed which "has certainly been tampered with in very modern times" (p. 75), though the Old Stone Mill at Newport is probably not more than two hundred years old and Longfellow's "Man in Armour" is a very doubtful piece of evidence, yet there is no doubt that the Norsemen reached the mainland of America and in all probability got as far south as Massachusetts, founding settlements there—shortlived indeed—as early as the closing years of the tenth century, and that the tradition of their discovery was never lost by their descendants in Europe.

The adventures of the "Jorsalafarers," of Saewulf the Englishman, of Sigurd Magnusson, King of Norway, of the monk Daniel of Kiev, and many other pilgrims to the Holy Places, are well told by Mr. Beazley; the gradual improvement in their geographical knowledge is very noticeable. Of remarkable interest are the travels of Benjamin of Tudela and his fellow-rabbi, Moses Petachia, in the Levant towards the end of the twelfth century; to them Mr. Beazley devotes a special chapter (p. 218 *ff.*). To his description of the adventures of Rubruquis and other predecessors of Marco Polo in Tartary we have already alluded; in this connection we cannot but regret that he has made so very summary a reference to the very important journey of the Chinese Nestorian Rabban Bar-Ṣauma, born at Pekin, who was dispatched by the Tartar monarch Argôn in 1287 on an embassy to Constantinople, to the Pope and to the monarchs of the West in order to negotiate with them concerning an alliance for the reconquest of the Holy Land. Mr. Beazley's reference simply consists of a few lines in a footnote on p. 352, and he mentions Bar-Ṣauma merely as having been allowed by the Pope to celebrate Mass, &c. In reality his mission was very important, and the story of his journey to the West, his reception at Constantinople and at Rome, &c., as given in the Syriac "History of Mar Yahbh-Allâhâ and of Three Other Catholici and of One Priest and of Two Nestorian Laymen," is of very great interest. In the same note, Mr. Beazley spells the name of Mar Yahbh-Allâhâ "Mar Jabalaba." Presumably the second *b* is a misprint, but Mr. Beazley should have found out that the French spelling "Jabalaha" is barbarous. In the same way "Arghun" in the same note is wrong; it should be Argôn.

This brings us to the weak point in Mr. Beazley's work. He is manifestly unfamiliar at first hand with oriental sources, and he never seems to devote sufficient attention to what they can tell him about the period with which he is dealing. Thus in this volume of his book an account of Arab commercial activity and Arab contributions to geographical knowledge in the early Middle Ages is practically wanting; the subject is almost entirely relegated to a footnote on p. 462, and even there it is treated in a most summary manner. In a second edition, this note should be incorporated in the main text and considerably expanded. On p. 240, Mr. Beazley, speaking of the Assassins, says that

"the title of *Ismaelites* or *Ismaelians*, also applied to them, was derived from Ismael, seventh Imâm in the line of Ali, a descendant of whom became founder of the Fatimites."

This statement is incorrect so far as the descent of the Fatimites is concerned. Mr. Beazley should know that the Maḥdi 'Obêdallâh, who founded the Fatimid dynasty, was in all probability an impostor, his descent from Âlî being in the highest degree suspect.

On p. 192, the words "God most High" are in a foot-

note supposed to be translated into Arabic as "*Allah kebir*"; but this (which in any case would be ordinarily phrased "*Allah hu akbar*," "God is most great") means "God *is great*," and the phrase to which John of Würzburg is alluding is *Allah al-'âlî*, الله العلي, "God the Exalted," one of the hundred beautiful names of God. In a review of the first part of Mr. Beazley's work which appeared in these columns five years ago (vol. lv. p. 555), comment was made on the curious manner in which the author often spelt oriental, and especially Arab, names; in the present volume he seems to have taken the hint then given him, and does his best to avoid Gallic misspellings of the "Jesus Jabus" or "Doul-Karnain" type, but we still find such an unscientific transliteration as "Shaykh" (p. 239) for *shêkh*, and such a distinct mistake as "Magreb" (p. 264) for *Mâghrib*; the word is spelt with the guttural *Gh*ain, not with a *G*im. Most English writers will spell Semitic names correctly enough, but will go irretrievably wrong over a Russian or Polish appellation; Mr. Beazley, however, apparently finds Arabic or Syriac words difficult, while his spelling of Slav names is always unimpeachably correct.

In fact, when he returns to subjects with which he is thoroughly familiar, we find Mr. Beazley as valuable and as interesting as before, *e.g.* in the section of chapter vii. which deals with the geographical work of Adam of Bremen, who, as a clerk at the court of the great Archbishop Adalbert (d. 1076), was in the best possible position for gathering in the varied lore of the seafarers of the North for use in a geographical treatise. Of this lucky position he made the best possible use, and the result is that his tract "On the Position of Denmark and of Other Regions beyond Denmark" is of prime importance in the history of geography.

The appendix on maps is hardly so good as it might have been. Mr. Beazley praises the Mosaic Map of Madaba very highly (p. 580), but to us it hardly seems to merit such praise; it suffers in the first place from being executed in mosaic, and can hardly be taken to give us a very good idea of what the maps of the old Imperial period were like. On the same page Mr. Beazley says that in this map "we have one of the oldest pictures yet discovered of Jerusalem (outside the Egyptian and Assyrian monuments)." This passage has puzzled us considerably, for there is no representation of Jerusalem upon any Egyptian monument whatever, not even one of the time of Sheshenk I. (Shishak), and the Assyrian bas-relief of a town with a name ending in . . . *alammu*, which exists in the British Museum, cannot be identified with Jerusalem with any confidence. Perhaps Mr. Beazley is thinking of the reliefs representing Sennacherib's siege of *Lachish*. In his next edition the misleading phrase between brackets should be deleted. Mr. Beazley does not give many references to modern experts in antique cartography; as in the former volume, no mention is made of the name of the late Mr. Coote, for example. In the review of the first volume it was stated that "the revision of the whole of chapter vi. [of vol. i.], on 'Geographical Theory,' together with Mr. Beazley's account of the history and use of mediæval maps for the whole book—although Mr. Beazley omits to state the fact—is due, we understand, to Mr. C. H. Coote, of the Map Department of the British Museum."

Mr. Beazley seems to have odd ideas as to the function of a footnote; he often uses it to convey some little piece of further information which could perfectly well have been inserted in the main text, *e.g.* on p. 130 we read that of the Crusade of Siegfried Archbishop of Mainz, out of "seven thousand only two[1] returned"; on referring to note[1] we find the laconic addition "thousand." There are other instances in the book of the same peculiarity.

Finally, we must, as before, protest against the insufficient indices with which Mr. Beazley provides his successive volumes. No doubt he will give us a proper index to the whole work when it is completed, but meanwhile we have nothing but a "short index of names," which is of little use. It would have been a better plan to have provided a full index for each volume.

Generally speaking, then, the chief fault we have to find with Mr. Beazley is his manifest unfamiliarity with Eastern matters, which sometimes causes him to make serious mistakes when dealing with the oriental side of his subject. For all else he is excellent, and, moreover, he has written a most interesting book.

SOIL AND SANITATION.

The Earth in Relation to the Preservation and Destruction of Contagia, being the Milroy Lectures delivered at the Royal College of Physicians in 1899, *together with other Papers on Sanitation.* By George Vivian Poore, M.D. (Lond.), F.R.C.P. Pp. 257. (London: Longmans, Green and Co., 1902.)

THIS book is the work of an enthusiast, but to find fault with enthusiasm in these days of rapid progress and fresh discoveries would be unwise. Mr. Rider Haggard, with his watchword "Back to the Land," and Sir Seymour Haden, with his advocacy of "superficial and coffinless burial," are both enthusiasts. Who will venture to say that Mr. Rider Haggard or Sir Seymour Haden or Dr. Vivian Poore are idle dreamers? None dare say this, and if in some directions the writer of this review ventures to dissent from Dr. Poore's conclusions, it must be understood that he does so in a spirit of tolerant sympathy with the author's main contentions.

In the first six chapters, the distinguished author seeks to show that such diseases as tetanus, anthrax, diarrhœa, dysentery, cholera, Malta fever, malaria and enteric fever have not been proved to be "soil diseases" in the proper sense of the term. That is, that the prominent part assigned to soil in the spread of disease among human beings is largely speculative in character. At the same time, the author freely admits that contaminated soil may occasionally (accidentally, as it were) be the means of causing isolated attacks or even localised outbreaks of certain diseases. Nevertheless, he refuses to regard the soil as a "breeding ground" for pathogenic microbes or as capable of exerting any sustained power of spreading disease. On the contrary, he considers the soil effective in bringing about the dissolution of harmful germs.

Chapter vii. deals with the Maidstone epidemic, and is an intelligent, but not wholly unbiassed, criticism of the

conclusions arrived at by the experts engaged in the inquiry. The author says :—

"The epidemic is remarkable, not only for its severity, but from the fact that six gentlemen, all eminent for their skill in bacteriology, failed to discover a single typhoid bacillus."

The failure to isolate the typhoid bacillus was in no way remarkable ; it is a matter of real difficulty to discover its presence in a typhoid stool. At Maidstone, the pollution of the implicated water with microbes of excremental origin was abundantly proved, and no bacteriologist of repute would consider that failure to isolate *B. typhosus* from an implicated water afforded any proof whatever that this microbe was in reality absent.

Chapters viii., ix. and x., dealing respectively with immunity, practical considerations and agriculture, contain many thoughtful passages. But the author, in the pursuit of his main thesis, which may briefly be described as a plea for the methodical deposition of fæces on well-tilled humus, advocates measures which, as regards water supply, are open to some objection. But few will find fault with expressions of opinion such as the following :—

"Apart from the question of food-supply, it is, I believe, absolutely necessary to encourage agriculture in order that our race may be maintained in vigour."

"Anything which discourages or increases the difficulties of agriculturists can hardly be in the interests of the public health."

Chapter xi., on the maintenance of the fertility of the soil, is of considerable interest. The author quotes Sir William Crookes's famous address to the British Association (1898), a fragment of which may here be cited :—

"In the United Kingdom we are content to hurry down our drains and watercourses into the sea fixed nitrogen to the amount of no less than 16,000,000*l.* per annum."

True ; but in how many million pounds of adventitious material is this store of potential wealth concealed? Moreover, it may be good economy to allow to run to waste a potentially valuable substance if its retention (assuming questions of practicability and commercial gain) involves serious risk of danger to human beings.

In chapter xii., Dr. Poore interests the reader with an instructive account of sanitation in Holland.

Practical sanitarians would do well to read chapter xiii., describing the experiments conducted under the auspices of the city of Manchester as regards the disposal of refuse on Carrington Moss. The case may be an exceptional one, but the figures given by Dr. Poore are most instructive.

Dr. Poore's conclusions are given in chapter xiv., which contains also an interesting account of the author's experiments at Andover, in which the ordure and refuse of about 100 persons have been applied for fourteen years to rather more than one acre of land with conspicuous success as regards the amount of produce extracted from the soil. The author, by implication if not by direct statement, appears to consider that what is, under the superintendence of a master spirit, possible and practicable in the country must of necessity apply also to the complex conditions attending the disposal of excremental matters in the neighbourhood of large towns. The remark that

"the nineteenth century closed with the spectacle of a Royal Commission still discussing the best way of *destroying* the potentialities of life and prosperity"

might well have been omitted ; and it is to be regretted that the writer throughout his book so often seems to view a grave and serious problem through the wrong end of the telescope. But opinions such as the following will excite the sympathy of many readers :—

"At present he who advocates any attempt to entice a fair proportion of the people 'back to the land' is regarded as a Utopian dreamer. I feel convinced that the only chance of getting a living from agriculture lies in the due enrichment of the soil."

Chapters xv. to xviii. deal with an address to the Royal Medical and Chirurgical Society on enteric fever, and in chapters xix. to xxii. various papers on sanitary matters by the author are considered. They contain much useful and original information, and will repay careful perusal.

In conclusion, it may be said that the book is a noteworthy one. It is the work of a distinguished physician, an original thinker, and a lucid and polished writer. It is not free from defects, some dogmatic statements and one-sided opinions ; and the author's sanitary teachings do not always seem to the writer of this review to be of a wholly sound character. But a colourless reproduction of orthodox doctrines and the opinions of other men makes dull reading ; and no one who studies the book will regret having done so, nor will he fail to find in its pages many new and original thoughts, and fresh ways of interpreting old facts. That the book will add to the high reputation already enjoyed by Dr. Poore is certain.

A. C. HOUSTON.

STEEL-WORKS ANALYSIS.

The Analysis of Steel-Works Materials. By Harry Brearley and Fred Ibbotson. With Illustrations. Pp. xv + 501. Price 14*s.* net. (London, New York and Bombay : Longmans, Green and Co., 1902.)

ANALYSIS in the laboratories attached to works necessarily differs widely from the analysis of schools or that of research. To compare them is to compare the work of professionals with that of amateurs. The works chemist is already familiar with the methods he has to use, as well as with the general principles on which they are based, before he begins his daily round of endless determinations. Consequently, the best book for him will, in general, be shorn of philosophic considerations, of lengthy descriptions of ordinary manipulations, and of accounts of obsolete processes, though they may be of great educational value and historical interest. He needs a terse, accurate description of processes that he can use, with references to the difficulties that may be encountered and to the limitations that cannot be avoided. He must be able to find out quickly all that he wants to know, and he must not be misled. It is difficult to imagine a book which would be equally suitable for schools and works, but most treatises on analysis are compromises. The book now under review, which, by the way, is the second

on the subject that has emanated from Sheffield, is no exception to the rule, though certainly better adapted for steel-works chemists than for students.

The book is divided into thirteen parts—the first four, containing 185 pages, being devoted to the chemical analysis of iron and steel and their alloys; and the succeeding five, comprising 45 pages, to the analysis of refractory materials, slags, fuel, boiler water and scales. These are of the greatest value. In the preliminary summaries placed at the beginning of each section, a general view of the various methods is given which will be found extremely useful in aiding the chemist to decide on his course of action in any particular case. The methods are described carefully and in sufficient detail, without needless repetition and with a freedom from error which cannot be too highly praised. Especially interesting are the pages devoted to rapid analysis at the furnace. Cases arise, for example, in the preparation of armour plates when the percentage of a number of elements must be determined while the charge of fused metal is still in the furnace. It will be a matter for surprise to many analysts that an expert operator was found to occupy only eight and a quarter minutes in the estimation of manganese, and that twelve minutes is considered enough for the estimation of silicon.

Part x., dealing with the analysis of the alloys of copper and the "white metals," is little less satisfactory than the preceding parts, but the remaining sections show a distinct falling-off from the high standard reached in the earlier pages. The micrographic analysis of steel is not well described. The lack of detail and some misleading statements prevent the article from being of use to a beginner, and an experienced worker will find nothing here to help him, except in the bibliography, which, unfortunately, stops short in the beginning of the year 1898! The illustrations are poor, perhaps owing to the fact that most of them are not photographs, but merely hand sketches, and the absence of reproductions of the structures to be observed under high magnifying powers is noticeable. The weakest part of the book, however, is the meagre and unpractical account given of pyrometry, which is not written by either Mr. Brearley or Mr. Ibbotson. Only the Le Chatelier thermocouple is described, and the modern forms of pyrometers in which it is used, as well as other types of instrument, are either ignored or barely mentioned. A clumsy and inconvenient method of recording the indications of the thermocouple is described, a method which was devised some years ago and abandoned everywhere, unless it is still in use in Sheffield, within a few months of its introduction. In future editions, this section should be either omitted or revised and extended.

At the end, there is a valuable bibliography of papers on steel-works analysis, which occupies 139 pages and seems to be fairly exhaustive. It is compiled by Mr. Brearley, and includes papers which appeared up to the end of 1901.

The book, in spite of its uneven merit, can be confidently recommended. The publishers have done their part of the work well in all respects. The authors write readable English, with a touch of the vigour on which Sheffield prides itself, manifested, for example, in a certain contempt for what they are pleased to call "hoary assertions."

LECTURES ON CELESTIAL MECHANICS.

Die Mechanik des Himmels. Vorlesungen von Carl Ludwig Charlier, o. Professor an der Universität Lund. Erster Band. Pp. viii + 488; mit zahlreichen Figuren. (Leipzig: Veit and Co., 1902.) Price Mk. 18.

THE number of text-books on the subject of celestial mechanics is by no means so large but that an addition ought to be warmly welcomed. More especially is this the case when the author is one who has himself made many valuable contributions to this difficult branch of analysis. Prof. Charlier's original work is characterised by great clearness and, as far as possible, simplicity. These qualities are not wanting in the lectures which he has delivered in the University of Lund since the autumn of 1898, and of which a first volume is now published. One cause for some regret may perhaps be mentioned. Prof. Charlier has shown, in several papers which he has recently published, that he can write excellent English. It is a pity, from our point of view, that in the case of his lectures he has preferred to publish in German, for there does not exist in our language a work of the same scope. Let it be said, however, that the German is exceptionally simple and should cause little difficulty to a reader whose knowledge of the language is slight.

The scheme of the lectures is to give a simple exposition of the present position of researches in celestial mechanics, so far as the motions studied do not depend on the dimensions and figures of the celestial bodies. In the selection of his subject-matter, the author's aim has been two-fold, namely, to lay stress on the results of the greatest astronomical importance and to illustrate the clearness and elegance characteristic of modern methods of analysis. The numerical examples which have been introduced for the sake of the former object might, perhaps, have been augmented with advantage. Prof. Charlier freely acknowledges the incompleteness of his work, and finds an explanation in the transition period in which astronomy stands and in which it is difficult to distinguish what is essential from what is unessential. The excuse is unnecessary, for it would be unfair to expect a systematic treatise in what does not pretend to be more than a course of lectures. And as such the book will be found interesting and suggestive, because it forms an introduction to recent developments of theory which have in many cases been accessible only in the original memoirs themselves.

The scope of the work will be best understood by a brief glace at its contents. This first volume contains the results of a more general character in the problems of two and three bodies. It is divided into seven sections. The first section contains preliminary theorems in pure mathematics and mechanics which would probably be familiar to the class of English reader who would attempt to use the book. At least, this is so in the case of paragraphs dealing, for instance, with the theory of determinants, the properties of functional determinants, linear substitution and Lagrange's equations. Yet it is useful to have such theorems actually at hand for reference, especially in a book which is genuinely

elementary in the sense that no excessive demands are made on the reader's knowledge at the outset. Here is introduced the canonical form of equations which is destined to play a predominant part in the sequel, and earlier is a sketch of the theory of linear differential equations with periodic coefficients as developed by Hermite, Floquet and Poincaré.

In the second section, the partial differential equation of Jacobi is discussed and Stäckel's important theorem on the possibility of solving it by separating the variables is given. This leads to the consideration of motions determined by one degree of freedom, and in particular of forms of motion termed "Libration" and "Limitation," the latter being of the nature of Poincaré's asymptotic solutions. An account follows of conditionally periodic motions, based on the researches of Staude.

The third section treats of the motion of a particle attracted by two fixed Newtonian centres of force. This problem provides illustrations of the theory of the previous section. Otherwise it is a little inconsistent with the practical aim of the author, for its astronomical interest, as was frankly admitted by Lagrange, is very slight. A reference might here have been made to Prof. Greenhill's paper on the stability of such forms of motion (*Proc.* Lond. Math. Soc., vol. xxii.).

The problem of two bodies is treated in some detail in the fourth section, the Hamilton-Jacobi equation being made the basis of the discussion. The case of a repulsive force is also discussed, and this leads to a digression on the dynamical theory of the tails of comets.

The most important results in the general problem of three bodies are investigated in the fifth section. The general integrals and the different forms which they assume when expressed in different systems of co-ordinates are discussed. The method of variation of parameters is explained in conjunction with Jacobi's canonical elements and also in connection with relative coordinates. The chief results of Jacobi's classical memoir on the elimination of the nodes and of Laplace's theory of stability are given here. Finally, the equations of the problem are reduced to the form expressing four degrees of freedom.

The rest of the book is devoted to the theory of perturbations. In the sixth section, Poincaré's system of canonical elements is introduced, the form of the development of the disturbing function is described and a very brief sketch of Laplace's coefficients is given. The final section contains the theory of secular perturbations of a planetary system, which is treated in some detail. At the end of the volume will be found some useful numerical tables.

The second volume is promised for next year. It will contain the theory of periodic orbits in the problem of three bodies and researches on the convergence of series. H. C. P.

OUR BOOK SHELF.

Lexikon der Kohlenstoff-Verbindungen. By M. M. Richter. Pp. 2482. (Hamburg: Leopold Voss, 1899.) Price, 39 parts, 1.80 marks each.

NOTHING could illustrate more forcibly the rapid growth of organic chemistry than the increased dimensions of the new edition of Richter's "Tabellen der Kohlenstoff-Verbindungen," published in 1884, which now appears for the first time under the title of "Lexicon."

The first edition, the publisher tells us, accounted for 16,000 compounds; in the present volume, which is brought down to the first quarter of 1899, 67,000 compounds are described, so that in fifteen years organic chemistry may be said to have multiplied more than four-fold. It is not surprising to learn that the stupendous labour of collecting and arranging this enormous mass of material has taken ten years to complete.

The lexicon contains all the known carbon compounds, arranged in order of their molecular formulæ on an ingenious system, which is fully set forth in the introduction. The name and a few physical constants are given, but the chief information is contained in the very full references to the original literature and to Beilstein's well-known "Handbuch." Since the first edition of the book appeared, the nomenclature of the Geneva Commission has been introduced, and in many cases the new and the old names appear side by side.

There is also an index of the names of the different compounds at the end of the volume.

Where organic research is being pursued with the almost feverish rapidity which is in vogue, more especially in the German laboratories, involving in the process the production of many compounds, both old and new, it is easy to understand the time and trouble which might be expended in fixing the identity of these compounds. One object of the lexicon is to lighten the labours of the investigator in this direction.

This becomes more imperative where the number of isomerides is large, for it is not uncommon to meet with 50, 60, or even 100 substances with the same molecular formula. For example, an experimenter who happened in the course of his research to obtain a compound of the formula $C_7H_{10}O_4$ would be confronted with a choice of 59 substances among compounds already known. By reference to the lexicon, he would see from the physical properties whether the compound had already been prepared, or, failing this, he could at once refer to the literature on the subject.

Richter's "Tabellen" is sufficiently well known among chemists and its utility long enough proved to ensure an excellent reception for the new edition and to render superfluous any further description of its use or its merits.

The author complains (and who does not) of the present system, or lack of system, of chemical nomenclature.

Organic chemistry has, in fact, outgrown its mother-tongue. It can no longer express itself clearly in the language of its childhood. An attempt was made by the Geneva Commission of 1892 to introduce reforms, and some excellent proposals were made, and have since been to some extent adopted on the continent. The author adds, "it is and remains deplorable, the fact that the resolutions arrived at at Geneva have no prospect of being generally adopted." It is to be hoped that before many more thousands have been added to the still growing number of organic compounds, the confusion which is rapidly impending through the want of a universally recognised system of nomenclature will be averted by a complete and thorough revision, more especially of the names of ring compounds.

J. B. C.

Ueber Harmonie und Complication. By Dr. Victor Goldschmidt. Pp. 136; with 28 figures. (Berlin: Julius Springer, 1901.) Price 4 marks.

MANY attempts have been made to associate the forms occurring in music with forms which manifest themselves to senses other than that of hearing. If the term "harmony" is used to include all such groupings and arrangements as give us pleasure, then we have harmonies

of form, harmonies of colour, and so forth. Dr. Goldschmidt's object appears to us to be to reduce all such harmonies to a common formula, and he considers that the different kinds of harmony are governed by a common law, the "law of complication."

As an example of the arguments employed, a series of numbers is obtained from the intervals of the musical scale which coincide with numbers in another series alleged to be obtainable from crystallography. But the numbers in the case of the music do not represent actual intervals, but are derived from them by a homographic transformation, according to which the keynote and its octave are represented by 0 and ∞ and the major fifth by 1, and the series is incomplete unless the minor seventh be included in the list. And the identity of the two series is by no means complete; for there are terms in the series derived from music which are absent from that obtained from crystallography.

It is easy to find connections as close as those dealt with in the present work between phenomena which have nothing whatever in common. For a considerable period, the number of wranglers in the Cambridge mathematical tripos was observed to be intimately related to the frequency of sun-spots, and anyone who should seek to establish a connection between the notes of the musical scale and the courses of a *table d'hôte* dinner might easily make out a very strong case. What is most surprising is that the analogy which *a priori* exists between musical intervals and colour intervals, both of which depend on ratios of vibration-frequency, appeals but little to our senses, so little, in fact, that certain writers have even sought to establish relations between chords and colours quite independently of the known relations of pitch. As for the connection which no doubt exists between a love of music and a talent for mathematics, its cause is not difficult to find. A mind like that of Beltrami, who could discover in the purely abstract ideas of geometry and algebra truths applicable to spaces other than that in which we live, was necessarily well trained to appreciate that beauty of form dissociated from worldly matters which exists in the sonatas and symphonies of the older composers. In order, on the other hand, to make it more palatable to a mind that wants to grasp something tangible, music is commonly associated with such mundane ideas as love, vice, battle and murder, and sudden death, the triumph of the victorious, the wails of the vanquished.

Opere Matematiche di Francesco Brioschi. Vol. ii. *Opere Matematiche di Eugenio Beltrami.* Vol. i. Pp. 456 and 437. (Milan: Ulrico Hoepli, 1902.) Price 25 lire.

THE second volume of Brioschi's works contains thirty-five papers contributed to the *Annali di Matematica pura ed applicata*, series 1 and series 2, vols. i.–xiv., between the years 1858 and 1887. These papers have all been carefully revised by Profs. Cerruti (Rome), Gerbaldi (Palermo), Loria (Genoa), Pascal (Pavia), Pittarelli (Rome), Reina (Rome) and Tonelli (Rome). A considerable number of them deal with linear differential equations, but elliptic and hyperelliptic functions, curvilinear coordinates, binary forms and many other subjects are treated; and the papers also include obituary notices of Borehardt and Chasles.

After the death of Prof. Beltrami, in 1900, the Faculty of Science of the University of Rome resolved to establish a memorial of the distinguished mathematician, and it was decided that the most fitting form for the memorial would be a complete edition of Beltrami's collected works; to quote Prof. Tonelli, *monumentum aere perennius*. In this case, the work of preparing the volumes has been carried out entirely under the direction of Profs. Cremona, Castelnuovo and Tonelli, as representatives of the Roman Faculty of Science, who have been aided by the collaboration of Profs. Bianchi, Burgatti, Cerruti, Dini, Pittarelli, Reina and Volterra. The order of arrangement differs from that adopted for Brioschi's works. Instead of being grouped according to journals, Beltrami's papers are arranged in strict chronological order, and this volume represents the work of eight years, from 1861 to 1868. That these first eight years of Beltrami's career as a mathematician were productive of work of great value is shown by the list of titles, which include researches on analysis applied to geometry, the flexure of ruled surfaces, resolution of the problem of transforming geodesics on a surface into straight lines in a plane, complex variables on any surface, fundamental theories of space of constant curvature, and last, but not least, the "Saggio d'interpretazione" of non-Euclidean geometry. The portrait of Beltrami which forms the frontispiece is due to Prof. Pittarelli.

Beltrami's works are published in uniform style with those of Brioschi, and both are printed by the Mathematical Press, of Palermo.

Handbook of the Trees of New England. By L. L. Dame and Henry Brooks. Pp. xv + 196. (Boston, U.S.A.: Ginn and Co., 1902.)

THE interest connected with the flora of the New England States lies in the fact that situated between Canada and the Alleghany Mountains they furnish the meeting point of a northern and a more southern flora. Since the book is limited to such a relatively small part of the country, it does not possess the general interest which would attach to one which included, for instance, the trees of all the eastern States. What it loses in comparative value, perhaps it gains in definiteness; it contains useful and succinct descriptions, good illustrations specially drawn, and states the horticultural value of all the indigenous species. The Latin nomenclature is satisfactory and correct, except in the case of a species of Acer, and for *Quercus Muhlenbergii*, which is considered by some authorities to be a variety of *Quercus prinus*; but the popular names are in utter confusion, and we cannot agree with the authors that it is wiser "to record what is, and not what ought to be." Taking *Populus balsamifera* as an illustration, the names recorded are "Balsam. Poplar. Balm of Gilead." Now this tree is certainly not a balsam, and *Populus candicans* is the real Balm of Gilead; while the name balsam-poplar would be sensible and correct. Apart from this and within its limits, the book may be recommended either to enable one to identify the trees or to ascertain their characteristics. English readers will find that only about half-a-dozen species are the same as those indigenous to this country.

Lake-Country Rambles. By William T. Palmer. Pp. viii + 334. (London: Chatto and Windus, 1902.) Price 6*s*.

MR. PALMER has here collected a series of papers he has from time to time contributed to various magazines. For many years the author has been a rambler in the lake-country, and has learned to love its inhabitants and to study its varied scenes. The essays are good examples of descriptive writing, but the aspects of nature and the incidents of outdoor life are treated rather from the point of view of the general observer than that of the inquiring naturalist.

Junior Arithmetic Examination Papers. Arranged by W. S. Beard. Pp. vi + 106. (London: Methuen and Co., 1902.) Price 1*s*.

THE ninety examination papers contained in this collection cover all the parts of arithmetic generally studied in schools. The first third of the papers gradually increase in difficulty from paper 1, on the first four rules, to paper 30, on the mensuration of rectangular solids. The remaining papers are made up of mixed questions and are all well graduated. The questions should be useful to teachers.

LETTERS TO THE EDITOR.

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

Classification of Quartic Curves.

THE best method of classifying curves is to commence with one which is founded on properties which are unaltered by projection. We thus obtain ten principal species of quartic curves, viz. *anautotomic*, *uninodal*, *unicuspidal*, *binodal*, *nodocuspidal*, *bicuspidal*, *trinodal*, *binodocuspidal*, *nodobicuspidal* and *tricuspidal*; but each of these species admits of a variety of subsidiary divisions, owing to the fact that all curves of a higher degree than the third may possess compound singularities.

Anautotomic, unicuspidal, bicuspidal and tricuspidal quartics admit of a subsidiary division depending on the number of points of undulation they possess; and it must be borne in mind that, although it is convenient to use the term point of undulation, it is the tangent at this point and not the point itself which is the actual singularity.

Uninodal quartics admit of *three* primary subdivisions, according as the double point is an ordinary node, a flecnode or a biflecnode.

Binodal quartics admit of *seven* primary subdivisions, six of which depend on the character of the node, whilst the seventh arises from the fact that the two nodes may unite into a tacnode.

Nodocuspidal quartics admit of only *four* primary subdivisions, three of which depend on the character of the node, whilst the fourth arises from the fact that the node and cusp may unite into a rhamphoid cusp.

Trinodal quartics admit of *ten* primary subdivisions, and in order to particularise them, we shall denote the different singularities which involve a double point by their initial letters, except that *tp* and *tc* will be used to denote a triple point and a tacnode cusp respectively; so that the nomenclature n, n, n and n, n, f will indicate that the quartic has three nodes or two nodes and a flecnode respectively. We shall then have the following ten species:—(1) n, n, n; (2) n, n, f; (3) n, n, b; (4) n, f, f; (5) b, b, b; (6) t, n; (7) t, f; (8) t, b; (9) o; (10) *tp* of the first kind.

Binodocuspidal quartics admit of *eight* primary subdivisions, which are as follows:—(1) c, n, n; (2) c, n, f; (3) c, f, f; (4) t, c; (5) r, n; (6) r, f; (7) *tc*; (8) *tp* of the second kind.

Nodobicuspidal quartics admit of *three* primary subdivisions, which are:—(1) c, c, n; (2) c, r; (3) *tp* of the third kind.

Whenever any of these primary species represents a curve which has two or more points of inflection, a further subdivision may usually be made which depends upon the number of points of undulation it can possess. Thus the species n, n, n may possess two, one or no points of undulation; whilst the species c, c, n may possess one or no such points.

A fourth subdivision may sometimes be made which depends upon whether the quartic is capable of being projected into a curve which is symmetrical or hemisymmetrical with respect to a pair of rectangular axes. In some cases, the possibility of the projection involves the existence of compound singularities, and thus the curve belongs to one of the species already considered; but in other cases, the necessary conditions do not affect the singularities. Thus all trinodal quartics which are capable of projection into symmetrical curves must belong to the species n, n, b; b, b, b; or t, b, in which three respective cases the quartic can be projected into the inverse of an ellipse or hyperbola with respect to its centre, the lemniscate of Bernoulli or the lemniscate of Gerono. On the other hand, the possibility of projecting any quartic with three double points into a hemisymmetrical curve depends upon whether it can be projected into the inverse of a conic with respect to a point in its axis. The conditions for this do not necessarily involve compound singularities, since these will only exist for special positions of the centre of inversion.

There is no necessity to adopt a classification founded on the nature of the branches at infinity, since all the results can be obtained by projection. Thus, if a straight line cutting in four real points any quartic, which is unipartite and perigraphic, be projected to infinity, the projection will be quadripartite and will have four real asymptotes; and by taking special positions for the line to be projected, a variety of special results can be obtained. By projecting a triple point or a pair of crunodes to infinity, it is at once seen that a quartic can have three parallel or two pairs of parallel asymptotes. Also, if the polar cubic of a point o breaks up in to a conic and a line cutting the quartic in four ordinary points and the line be projected to infinity, the projection will have four asymptotes meeting in a point.

A quartic having three acnodes is the limiting form of an anautotomic quartic in which the acnodes are replaced by three perigraphic curves; and if a line cutting the fourth portion in four real points be projected to infinity, the projection will be septipartite. From this it appears that the partivity of a curve of the nth degree cannot be less than $n+\frac{1}{2}(n-1)(n-2)$.

A. B. BASSET.

Fledborough Hall, Holyport, Berks, November 14.

The Conservation of Mass.

APROPOS of the recent discussion on the conservation of mass at the Belfast meeting of the British Association, the following calculation may be of interest; it relates to the loss of weight undergone by a body when raised vertically.

If g is the acceleration of gravity at a specified point on the surface of the Earth, m the mass of a body of weight w, then

$$w = mg.$$

Now let the centre of gravity of the body be raised through a vertical distance d; g will be changed into

$$g' = \left(\frac{R}{R+d}\right)^2 g,$$

R being the radius of the Earth (supposed spherical), and the corresponding weight of the body will be

$$w' = mg'$$

on the supposition of the conservation of mass.

The loss of weight is thus

$$\delta = w - w' = w\left\{1 - \frac{R^2}{(R+d)^2}\right\}$$

$$= w\left\{1 - \left(1+\frac{d}{R}\right)^{-2}\right\} = \frac{2dw}{R},$$

neglecting second and higher powers of $\frac{d}{R}$.

As a particular example, take $w = 1$ kilogm., $d = 10$ cm. and R approx. $= 6357 \times 10^5$ cm.

Then

$$\delta = 0{\cdot}00003 \text{ gm.}$$

[The term involving $\left(\frac{d}{R}\right)^2$ would have the first significant figure in the fifteenth place, and therefore we were justified in this case in neglecting it.]

This small difference is, I believe, of the same order as those which Prof. Landolt found; but the ratio of the difference to the whole weight (*i.e.* $2d : R$) must have been much greater in his experiments. Although Prof. Landolt's discrepancies may receive a perfectly different explanation, it is quite conceivable that a balance could be constructed which would detect such small differences. It is scarcely necessary to point out that, in the actual performance of the experiment, the scale-pan containing the counterpoising weights must be at the same height during the two weighings.

D. M. Y. SOMMERVILLE.

St. Andrews, November 12.

A Simple Experiment in Diffraction.

M. G. FOUSSERAU describes, in the *Journal de Physique* for October, a simple apparatus for viewing diffraction and interference phenomena, a modified form of which I have experimented on with success. In the latter form, the source of light was obtained by placing a diaphragm on the stage of a microscope, on which sunlight was concentrated by means of the mirror and condenser, and the diffraction effects were produced by placing perforated pieces of tinfoil on the top of the microscope tube where the eye-piece is usually placed. On placing the eye close up to the tiny hole in the tinfoil, various diffraction patterns were seen. The difficulty of piercing a hole that is truly circular in tinfoil made it hard to obtain perfect rings, but the "failures" were often very interesting. A rectangular aperture

was easily got by cutting slits in two pieces of tinfoil with a razor and placing one over the other with the slits at right-angles, while for a triangular aperture three strips of tinfoil placed so as to leave just a tiny triangle open gave good results.

G. H. BRYAN.

The Secular Bending of Marble.

THE fluidity of marble under pressure, of which Dr. See mentions an instance in NATURE (p. 56), has, I believe, been well established by laboratory experiments. Another instance of secular bending, similar to that quoted by Dr. See, was to be seen in two alabaster slabs which formed the jambs of a doorway in the Alhambra. Owing to the pressure brought to bear on these by the settlement of the building, they had bulged out from the wall by as much (if I remember right) as 6 or 7 inches. The slabs were about 7 feet long and a foot wide, their thickness being, perhaps, a couple of inches. Whether they are to be seen there still, or not, I do not know.

SPENCER PICKERING.

Summer and Winter.

CONCERNING the relation of summer and the following winter referred to on p. 63, a few facts from Greenwich records of the last sixty-one years may be acceptable. We find this:—

Summer warm,		winter severe,	9	cases.
,,	,,	,, mild,	19	,,
,,	cold	,, severe,	17	,,
,,	,,	,, mild,	12	,,

(This leaves four cases with average values.)

It thus appears that warm summers have been distinctly more often followed by mild winters than by severe ones; but the difference in the other case, of cold summers, is less pronounced. In this representation, wet is left out of account, the mean temperatures of summer and winter being alone considered, and in relation to the averages. But we might limit our attention to summers that have been both cold and wet, as this last summer has been. (Cold summers have not always an excess of rain.) Of such there appears to have been nineteen. Now taking all those with a mean temperature under 60°·5 (the average mean temperature of summer below 61°·2), I find that nine were followed by severe winters and only three by mild winters; total, twelve. As the past summer comes in this group, the chances seem in favour of a severe winter. A. B. M.

Personal.

I DID not think it worth while to correct an error into which the reporters of the ephemeral Press fell in prefixing the words "his own" to the word "work" in the account of my recent speech at Liverpool, where I had said that my new sphere afforded me a larger opportunity for work: simply.

I do not know how best to correct it, or whether it is now possible, but I see it has been reproduced in your University Intelligence on p. 70, and an error incorporated in NATURE is of rather permanent character, and may be misleading to my friends. OLIVER LODGE.

Birmingham, November 21.

MATHEMATICS IN THE CAMBRIDGE LOCALS.

ON May 29 (vol. lxvi. p. 117), we announced an important change in the geometry of the *Oxford* local examinations for 1903. Quoting from the notice which had just been issued, attention was directed to the important statement that "Questions will be set so as to bring out as far as possible a knowledge of the principles of geometry, a smaller proportion than heretofore consisting of propositions as enunciated in Euclid. Any solution which shows an accurate method of geometrical reasoning will be accepted. No question will be set involving necessarily the use of angles greater than two right angles. Geometrical proofs of the theorems in Book ii. will not be insisted upon." We have now received the schedules in geometry that have been adopted for the *Cambridge* preliminary and junior local examinations in 1903. In these, we are glad to see that the Cambridge Syndicate has adopted to an even greater extent the reforms suggested by the recent British Association Committee. For the preliminary, junior and senior examinations:—"Any proof of a proposition will be accepted which appears to the examiners to form part of a logical order of treatment of the subject. In the proof of theorems and deductions from them, the use of hypothetical constructions is permitted." No schedule will be published for the senior examination. The importance of the schedules now published for the preliminary and junior examinations will be apparent when it is considered that they may be said to cover the work done by the boys and girls in all secondary schools up to the age of sixteen years, and the work of such older boys and girls as are not trying for marks of distinction. Their influence is great, and we heartily welcome the important change that they place much greater stress upon observation, measurement and experiment than on abstract reasoning. It is to be observed also that there is no mere pretence of accuracy:—"Every candidate must be provided with a ruler graduated in inches and tenths of an inch, and in centimetres and millimetres, a small set square, a protractor, compasses furnished with a hard pencil point, and a hard pencil." This mention of the hard pencil is business-like; as soon as boys understand that in their measurements of lines they must not make errors of even one-hundredth of an inch, their true scientific education begins. As for demonstrative geometry, a great number of Euclid's propositions are left out altogether. Books ii. and iv. have completely disappeared. Twenty-eight out of the forty-nine propositions of Book i. have to be studied for the preliminary and junior. Of the thirty-seven propositions of Book iii., only ten have to be studied for the preliminary and four more for the junior. Of the thirty-five propositions of Book vi., only thirteen are required for the junior. The most important part of the geometry examination is called practical geometry, and there is every inducement to all teachers now to dwell largely on experimental geometry, as all good teachers have done for many years.

We have reason to believe that in dealing with arithmetic, algebra and trigonometry, the syndicate will follow, as closely as it has done in geometry, the recommendations of the British Association Committee as drawn up by Prof. Forsyth. Should this be so, we are assured of a very great reform in the teaching of mathematics in all the secondary schools of England. This consummation will be further assured by recognition of the reform, which will surely come soon, on the part of the Civil Service Commissioners and all other examining bodies in the kingdom. We may say, then, that every average boy looking forward to a career in the Civil Service, in the Navy, in the Army, in any of the professions, will have had an incubus lifted from his life, and a much greater load will have been lifted from the spirits of his father and mother. Boys susceptible of being crammed for examinations will no longer have an unfair advantage over their far wiser and more sensible but reputedly stupid fellow competitors. There will, moreover, be a chance that boys from schools will be able to take better and fuller advantage of the instruction given in technical colleges.

To the educationist, the reform, however far-reaching in its results, may appear small; he may think that it should have been effected long ago. This view, however, does not in our opinion do justice to the services of the reformers. It leaves out of account the strength of the opposition. This reform needed that many men should work in an unhopeful, heart-breaking way for it for many years, and its importance is not diminished by its coming

at last quite suddenly, and as if miraculously, like the fall of the walls of Jericho.

In criticism of the schedules, we may perhaps be allowed to say that personally we wish the syndicate had not followed Euclid so closely. All the practical geometry of the syllabus is mere illustration of Euclid. There are, for example, other angles than 90° easily to be drawn; arithmetical computation and experimental mensuration give new avenues to geometrical ideas, and the more avenues we can offer to pupils the better. Where the syllabus says "division of straight lines into a given number of equal parts," there appears to us too much restraint. There is no reason why a line should not be divided into many parts in any proportions, and a most educational exercise it would be. And what is the use of hiding the fact that a "preliminary" candidate cannot be prevented from having a good working knowledge of Book vi., although it is wise enough to keep the demonstrations to a later stage? Any boy understands that maps may be drawn to different scales, and this is almost the whole of the sixth book of Euclid. As for construction of tangents to a circle and "construction of common tangents to two circles," we would let a student draw these without introducing any idea of difficulty and we would ask him, by dropping perpendiculars on tangents from centres, to find the real points of contact. As soon as a boy can draw a right-angled triangle, measuring the sides and using arithmetic to find sines, cosines and tangents, he ought to begin trigonometry. If he knows the mere definition of *tan* A, he ought at once, by merely exercising his common sense, to be able to draw the angle the tangent of which is given. A common-sense knowledge of right-angled triangles is really a knowledge of solution of triangles in general. But until the artificial bulkheads between the various water-tight compartments of mathematics are swept away, we suppose that it will not be possible to give to very young schoolboys the power to solve trigonometrical problems. If the syndicate would condescend to study the elementary syllabuses of Science Subjects I. and V_p of the Education Department, we think these courses of studies might become much easier and much more valuable.

But is not ingratitude the meanest of sins? And may it not show wisdom in the syndicate that it avoids changes which may seem to be too sudden and too great? Besides, it is to be recollected that almost every candidate who has followed this course has also taken a course in experimental science, into which weighing and measuring, the uses of squared paper and logarithms, and the ideas of the calculus have entered in all sorts of common-sense ways. Even taken by themselves, the schedules mark a great step in our experiment of finding a method of teaching mathematics suitable for boys of the Anglo-Saxon race. A beginning has been made in disenchanting the English school system of those pedagogic dogmas which have tied teachers and pupils hand and foot. Teachers and examiners will ask for more and more freedom as they find that it is altogether good. Hitherto, the average English boy has believed himself to be stupid because he was unable to reason about things unknown to him; hitherto, the average English teacher of mathematics has thought of himself as a dull, tired usher because he has had no interest in teaching; in future, pupils and teachers will feel with complacent pride that they have come to their inheritance as thinking, useful human beings. We look forward to very great results, and we are not going to give credit in particular to any one of the ten or twenty names that rise before us of the men who have helped to make this reform. Those who are dead had their reward in knowing that they helped towards a reform that was certain to come; those who are alive have the reward of knowing that they were commissioned to keep alight the torches lit by their much-loved predecessors.

With the exception of the Society of Arts, no institution of the country has been so successful in initiating scientific reform as the British Association. A Committee was appointed in 1874 (the present writer is proud to think he was a member of it) for improving science teaching in schools, and another for improving mathematical teaching, and although the members of these Committees were mostly men of influence, their efforts led to no important results for many years. But ten years afterwards, the report of a British Association Committee on the teaching of science acted on the scholastic world like the prince's kiss in the story of the Sleeping Beauty, and in 1901 the British Association proceedings in the new Education Section acted in much the same magical way in relation to the teaching of mathematics. Many mathematical masters were feeling hopeless about reform, but without jealousy, with great enthusiasm, with the most wonderful forgetfulness of differences in small matters, they joined together to assist the British Association Committee of Mathematicians. There can be no doubt that this evidence of a desire for reform among the schoolmasters had a great effect upon the members of the Committee who were not in immediate touch with the schools. All the tact, patience and resourcefulness of a chairman eminent for these qualities might have been unavailing in dealing with a Committee the members of which were all men of great individuality had it not been for the schoolmasters' memorial. Anyone who knows the history of this reform must recognise its peculiarly English characteristics—the conservative clinging to past methods because of the recognisable good in them, even among the most radical reformers; the efforts of individuals in low and high positions gradually making converts in spite of the seeming hopelessness of reform; the unwillingness of men in high positions to lend their names to the movement, the virtue of which they were aware of, so long as they thought that only unrest and disturbance could accompany it; and their concerted action as soon as it was evident that a great reform was possible. And now, because it has occurred in the English way, we know that the reform is real, that it will have a fair chance, that it will go on year after year for many a year to come. This is no case of a thin end of a wedge, for no force is really required. It would be bad policy to make too great a change at once. Freedom has been given to teachers, a freedom much sighed for, a freedom which will create enthusiasm. Those who are most determined to make the reform complete are most anxious to proceed cautiously and to smother intemperate zeal.

JOHN PERRY.

THE THEORY OF THE GAS MANTLE.

A NUMBER of papers have been recently published which deal, either directly or indirectly, with the cause of the high efficiency of the incandescent gas mantle.[1] Space does not permit us to enter at all fully into the details of these papers, but it is of interest to consider some of the questions which they raise.

The high luminosity of the mantle and its still more remarkable dependence on a particular composition have long been recognised as facts calling for some special explanation, and many have been the hypotheses advanced to account for them. The simplest of these is that which

[1] "Zur Theorie des Auerlichtes," by W. Nernst and E. Bose (*Physikalische Zeitschrift*, 1900, i. 289).
"Theory of the Incandescent Mantle," by A. H. White, H. Russell and A. F. Traver (*Journal Gas Lighting*), lxxvii. p. 879, and lxxix. p. 892).
"Theory of the Incandescent Mantle," by A. H. White and A. F. Traver (*Journ. Soc. Chem. Industry*, 1902, xxi. p. 1012).
"The Conditions Determinative of Chemical Change and of Electrical Conduction in Gases and on the Phenomena of Luminosity," by Prof. H. E. Armstrong, F.R.S. (*The Chemical News*, May 23 and 30, 1902).
"The History of the Invention of Incandescent Gas Lighting," by Auer von Welsbach (*The Chemical News*, May 30, 1902, p. 254).

regards the mantle's luminosity as an ordinary high temperature effect; as showing how the phenomena are accounted for by this explanation, we may quote the view put forward by Mr. J. Swinburne (*Journal* of the Inst. Elect. Eng., vol. xxvii. p. 161). Mr. Swinburne will have nothing to do with selective emissivity, but states that "all bodies" (presumably solid bodies) "at the same temperature give out light of the same colour." The Bunsen flame, he argues, in which the mantle is immersed, is extremely hot, and the mantle's luminosity is due to its very nearly attaining this temperature. A bad radiator (such as thoria) will reach the same temperature as the flame, but as it radiates so little energy will give but little light; what light it does give, however, will be of high luminous efficiency. A good radiator (such as ceria) will radiate energy so fast that it will not attain anything like the flame's temperature. It is, therefore, only necessary to add sufficient ceria to the thoria to increase the emissivity enough to get a good quantity of radiated energy, but not enough to lower the temperature unduly, in order to get a composition giving a brilliantly luminous mantle. This explanation does not appear to us sufficient, especially when one considers that it is polished, and not white, bodies which are bad radiators, so that if it is legitimate to argue from their behaviour at low temperature, thoria would be expected to be but little inferior as a radiator to ceria or even carbon. Also there seems some reason to think that selective emission is more probably the rule than the exception (see, for example, the work of Nichols and Blaker, published in the *Physical Review*).

Le Châtelier and also Nernst (*loc. cit.*), arrive at the same final result as Mr. Swinburne—namely, that the mantle is so bright because it more nearly approaches the temperature of the flame than any other body similarly placed—but by a different argument. The experiments which they made led them to conclude that the emissivity of the mantle is poor in the region of the red rays; hence there is little energy lost in non-luminous radiations, and the mantle can in consequence come up to the high temperature of the flame, at which it begins to radiate well, especially in the region from the green to the violet. The selective emissivity of the mantle material has therefore a double effect; it increases the luminosity at a given (high) temperature, and it enables the mantle to attain a higher temperature than a black body, because the total loss of energy by radiation is diminished. Bunte, on the other hand, claims that the assumption of selective emissivity is unnecessary, and that the mantle is at a higher temperature than the flame (*Berichte* Deut. Chem. Ges., 1898, i. 5). This view is supported by experiments he performed, in which different substances were raised to incandescence in pairs in the inside of an electrically heated tube; no appreciable difference could be observed in the light given by carbon, thoria, ceria or the material of the mantles. It remains to be explained how the temperature of the mantle can be higher than that of the flame. This is due, he and Killing suggest, to the catalytic action of the ceria, which, by oscillating between a low and high state of oxidation, increases the rate of combustion at the mantle surface and so raises its temperature. The thoria is necessary, according to Killing, to give a large surface over which the ceria molecules are spread: and Bunte suggests that it also acts as an insulator between the ceria molecules, enabling them to maintain the high temperature that their catalytic action produces.

Obviously, the simplest method of testing the accuracy of some of these different hypotheses is to measure the temperatures of mantles of different composition. An attempt to do this has been made quite recently by Messrs. White, Russell and Traver (*loc. cit.*). The temperatures were measured by means of small thermocouples, and (by making measurements with couples of different sizes and so obtaining data for extrapolation) they claim to have arrived at a method giving with considerable certainty the temperatures of flame and mantle. Even if the accuracy of the absolute values thus obtained be impugned, the relative results are not so subject to the same objections. These experimenters find that the temperature of the mantles and flame is from 1500° C. to 1700° C.; that the mantle is at a slightly lower temperature than the flame and at very nearly the same temperature whatever its composition; and, especially, that a pure thoria mantle is at a slightly higher temperature than one of thoria and ceria. Some actual results illustrating these points may be quoted from their paper:—

Composition of Mantle. Per cent	Temperature of Mantle. C.	Temperature of flame. C.	Candle-power per sq. in.
100 thoria	1560°	1630°	3·8
99·5 thoria & 0·5 ceria	1520°	1630°	34·0

The mantles used are said to have been identical in every respect except in their chemical composition. The differences in temperature are not very great, but, such as they are, they do not harmonise with the theory of le Châtelier and Nernst, since they show the thoria mantle to be the hotter; at the same time, they support this theory as against that of Bunte by showing the mantle to be at a lower temperature than the flame. The results also support the views of Mr. Swinburne, which require that the order of the temperature should be the same as that observed. In some other experiments, the results were less conclusive, the illumination varying from 2·5 to 48 candles with practically no temperature difference. Mantles with a high percentage of ceria were not tested. The authors themselves conclude that the illumination is to a greater degree a specific function of the material than it is of the temperature, and that the particular thoria-ceria mixture is a solid solution capable of transforming the heat of the flame into light more economically than any other substance yet known.

If this explanation is to be accepted, the mechanism by which this transformation is effected remains to be explained. In that part of the paper by Prof. H. E. Armstrong (*loc. cit.*) which deals with the question of luminosity, we find a suggestion as to what this mechanism is. Prof. Armstrong's paper is of a comprehensive and far-reaching character, dealing with many things besides luminosity in general and that of the mantle in particular, but it is only its bearing on these questions that we can consider here. Prof. Armstrong thinks that "luminosity and line-spectra are the expressions—the visible signs—of the changes attending the formation of molecules from their atoms, or, speaking generally, *that they are consequences of chemical changes*." Applying this to the Welsbach mantle, after referring to Bunte's hypothesis, he says, "this undoubtedly must be the case; but I would go further, and regard *the chemical changes* occurring at the surface as the direct seat, or origin as it were, of the luminosity. Probably a higher oxide is alternately decomposed and reformed—in other words, *the process is one of oscillatory or recurrent oxidation*." This process, then, gives direct birth to the luminous radiations and accounts for the high efficiency of incandescent oxides generally, such as the lime and zirconia light and the Nernst glower. A somewhat similar conclusion is arrived at by Dr. Auer von Welsbach (*loc. cit.*), who considers that the ceria when in one or other state of oxidation can form a compound with the thoria: hence "if reduction takes place, there is also decomposition, and if oxidation, there is recombination of these elements; these reactions may go on several million times a second, and molecular shocks are produced which give rise to luminous oscillations of the ether, and

the body becomes incandescent." Both Prof. Armstrong and Dr. Welsbach attribute the importance of the special composition of the mantle to this particular mixture forming a solid solution of a dilution favourable to the occurrence of the oscillatory changes.

We have endeavoured to put forward a summary, of necessity brief, of some of the principal theories which have been advanced to account for the luminosity of the mantle. Although it is true that some of these theories, if regarded as individually sufficient to account for the phenomena, lead to conclusions mutually inconsistent, yet there is no reason why they should not all contain some part of the truth, unless the experiments of Messrs. White, Russell and Traver be considered as sufficiently conclusive against the idea of the mantle being hotter than the flame. Such a result does not preclude the possibility of catalytic action, for the additional energy thereby developed may be all dissipated in luminous radiations. It seems that the most satisfactory explanation that the present experimental data justify is that the high luminosity is due to a combination of the good radiating power, the high temperature and the selective emissivity of the mantle. The first accounts for the high candle-power at the temperature attained; the second, which is due partly to the selective emissivity diminishing the useless radiation losses and partly, no doubt, to the catalytic action of the ceria molecules, is responsible for the high luminous efficiency of the light, so far as this is a function of the temperature; whilst the third, most probably due to the recurrent chemical changes, accounts for the high luminous efficiency so far as it is a function of the material. Thus all these causes, operating together and assisting one another, combine to produce one of the most efficient artificial illuminants that the ingenuity of man has devised.

MAURICE SOLOMON.

THE EXPLANATION OF A REMARKABLE CASE OF GEOGRAPHICAL DISTRIBUTION AMONG FISHES.

MOST text-books and papers discussing geographical distribution have made much of the range of a genus of small fishes, somewhat resembling trout, the Galaxias, commonly described as true fresh-water forms, which have long been known from the extreme south of South America, New Zealand, Tasmania and Southern Australia. The discovery, within the last few years, of a species of the same genus in fresh water near Cape Town, whence it had previously been described as a loach by F. de Castelnau, has added to the interest, and has been adduced as a further argument in support of the former existence of an Antarctic continent. In alluding to this discovery when discussing the distribution of African fresh-water fishes in the introduction to my work "Les Poissons du Bassin du Congo," in 1901, I observed that, contrary to the prevailing notion, all species of Galaxias are not confined to fresh water and that the fact of some living both in the sea and in rivers suffices to explain the curious distribution of the genus; pointing out that in all probability these fishes were formerly more widely distributed in the seas south of the tropic of Capricorn and that certain species, adapting themselves entirely to fresh-water life, have become localised at the distant points where they are now known to exist. Although as recently as October last the distinguished American ichthyologist D. S. Jordan wrote (*Science*, xiv. p. 20) "We know nothing of the power of Galaxias to survive submergence in salt water, if carried in a marine current," it is an established fact, ascertained some years ago by F. E. Clarke in New Zealand and by R. Vallentin in the Falkland Islands, that *Galaxias attenuatus* lives also in the sea. In New Zealand, it periodically descends to the sea, where it spawns, from January to March, and returns from March to May. In accordance with these marine habits, this species has a much wider range than any of the others, being known from Chili, Patagonia, Tierra del Fuego, the Falkland Islands, New Zealand, Tasmania and Southern Australia.

I now wish to draw attention to a communication made by Captain F. W. Hutton in the last number of the *Transactions* of the New Zealand Institute (xxxiv. p. 198), "On a Marine Galaxias from the Auckland Islands." This fish, named *Galaxias bollansi*, was taken out of the mouth of a specimen of *Merganser australis* during the collecting excursion to the southern islands of New Zealand made in January, 1901, by His Excellency the Earl of Ranfurly.

It is hoped that by giving greater publicity to these discoveries, the family Galaxiidæ will no longer be included among those strictly confined to fresh waters and that students of the geographical distribution of animals will be furnished with a clue to a problem that has so often been discussed on insufficient data. As observed by Jordan (*l.c.*), "all anomalies in distribution cease to be such when the facts necessary to understand them are at our hand."

Of the fresh-water species of Galaxias, eight are known from New Zealand and the neighbouring islands, seven from New South Wales, three or four from South Australia, one from West Australia, two from Tasmania, seven from South America, from Chili southwards, and one from the Cape of Good Hope.

G. A. BOULENGER.

LOCAL MAGNETIC FOCUS IN HEBRIDES.

IN the course of a recent survey in the Hebrides, Captain A. Mostyn Field, in H.M.S. *Research*, found and examined an area in the entrance of East

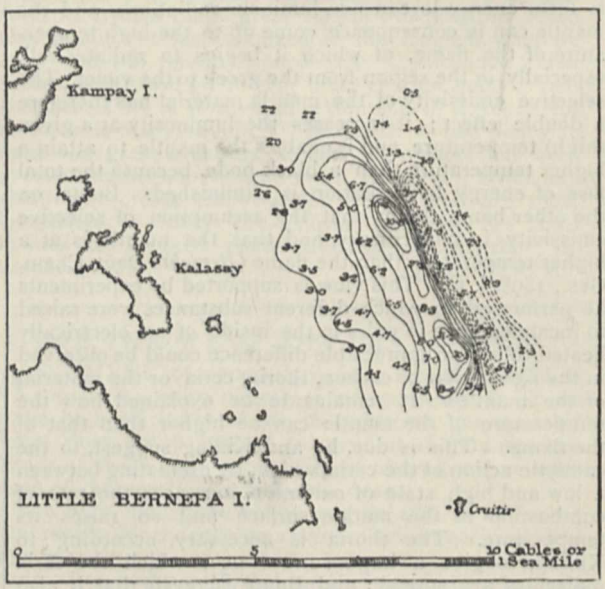


FIG. 1.—Examination in 1902 by H.M.S. *Research* of an area of magnetic disturbance in East Loch Roag, Lewis.
Lines of equal disturbance westerly from the norma declination shown in continuous line.
Lines of equal disturbance easterly from the normal declination shown in broken line.
Normal declination 22° W.
The figures express degrees and decimal parts.
Depth of water over area from 15 to 17 fathoms.

Loch Roag, Lewis, where there is considerable local magnetic disturbance. A plan showing the deviation from the normal declination of the compass needle at

different positions in the area is here given, and will probably be of interest. Unfortunately, no special magnetic instruments were on board, and therefore no observations on the dip or force could be made. It is hoped to complete the observations later. The maximum deviation is 11° W.

The remarkable point in this instance is not only the magnitude of the disturbing force, the depth of water and therefore the distance of the compass from the bottom being 100 feet, but that the north point of the needle is repelled from the apparent line of magnetic disturbance, and not attracted towards it as is usually the case in northern latitudes. W. J. L. WHARTON.

Admiralty, November 15.

THE NEEDS OF KING'S COLLEGE, LONDON.

A PUBLIC meeting was held on Wednesday, November 19, under the presidency of Lord Selborne, to assist the appeal being made to secure the adequate endowment and equipment of King's College, London. Many men prominent in every department of human learning were present, among whom may be mentioned the Bishops of London and Rochester, Lord Glenesk, Sir A. W. Rücker, F.R.S., Sir John Wolfe Barry, F.R.S., Sir Philip Magnus, Sir W. H. Preece, F.R.S., Mr. A. Siemens, Profs. Jeffrey Bell, W. G. Adams, F.R.S., J. M. Thomson, F.R.S., W. D. Halliburton, F.R.S., W. H. Hudson and D. S. Capper.

The following message from the King was read by the Bishop of London :—

"His Majesty is thoroughly in sympathy with the proposal to raise by subscription a large fund for the endowment of King's College as a constituent of the newly-developed University of London, and wishes the movement for that purpose all success."

The Prime Minister also sent a letter in support of the appeal. He remarked, in the course of the letter, that "It would be a serious misfortune to the interests of higher education in the metropolis if, through the burden of debt and the want of proper endowment, King's College was not able to do its part in the great work which I trust lies before the reconstituted University. Higher education cannot be made self-supporting, and is, nevertheless, one of the greatest of our national needs."

Lord Selborne, in explaining the objects of the meeting, referred in high terms of praise to the work accomplished in the past by King's College in training men adequately to undertake a noble part in the civilisation and humanisation of the world. During the course of his remarks, he referred to the value of science in the following words, which we quote from the *Times* report :—

They were met to try to help King's College to go on in the future preaching the gospel of learning and of work, the gospel of research and applied science on which the real strength of the Empire was built. Was it a great thing that King's College, with its history and distinctive features, should appeal to them for that endowment which was absolutely necessary? That effort was only part of a great movement through which they were passing at this moment. There was a fresh wave of enthusiasm for university teaching sweeping over the land. In London, in the provinces, there were movements for the extension of universities, for the founding of universities, for the development of higher education. Why? He thought it was because there was a general belief that in the university teaching of this country men were taught what they wanted to know by men who knew how to teach. They felt that the higher part of education was not lost sight of in these universities, certainly not in King's College.

It was unanimously resolved, on the motion of Sir R. Jebb,

"That, in view of the distinguished services which have been rendered by King's College to higher education and research in London, it is of the highest importance that the work of the College, in its new connection with the University of London, should receive support adequate for its effective continuance and progress."

In seconding the resolution, Sir J. W. Barry said :—

It was necessary to bring before all interested in the wellbeing of the University of London the absolute necessity of the cultivation of science and the promotion of research. They knew the story of the exultant professor who said he was investigating a subject which could not be of any use to anybody, and that was why he was so much interested in it. But that was probably only a partial view of that professor, as experience showed that researches which appeared to be of no practical use often turned out to be most valuable adjuncts to human knowledge. What was wanted was not merely to educate workmen in a technical way, but to educate masters and directors. There was no longer a possibility of the great manufactures of this country being conducted successfully without scientific knowledge from top to bottom of the whole of the people engaged.

A resolution proposed by the Bishop of London and seconded by Sir Douglas Fox pledged the meeting to use every effort to raise a sum sufficient to secure "the liberation of the College from debt, the maintenance of the efficiency of the College in laboratories and equipment for higher teaching and research, and the adequate endowment of its professorships."

NOTES.

IT is with deep regret that we announce the death of Sir William Roberts-Austen, K.C.B., F.R.S., on Saturday last, at the age of fifty-nine.

THE Academy of Natural Sciences of Philadelphia has, on the recommendation of its special committee, consisting of Messrs. Theo. D. Rand, Amos P. Brown, R. A. F. Penrose, jun., and H. F. Osborn, has conferred the gold medal of the Hayden memorial geological award for 1902 on Sir Archibald Geikie, F.R.S.

THE trawling vessel s.s. *Huxley*, which has been chartered and fitted out by the Marine Biological Association for service in connection with the International North Sea Investigations, will be alongside Fish Wharf, Billingsgate (by London Bridge) during the afternoon of Tuesday next, December 2. The president of the Association has issued invitations to an inaugural inspection of the vessel to be held on that day.

A NEW building to accommodate the French Academy of Medicine was opened on Tuesday, M. Loubet and M. Chaumié, Minister of Education, being among the guests present. Dr. A. Riche, president of the Academy, gave an address upon the history of the Academy and the contributions made to medical science by its members. "The Academy is happy," he is reported by the *Times* correspondent to have said, "to take possession of a dwelling worthy of France, which it owes to the liberality of the Government of the Republic, and whereby it obtains the means of better serving the interests of the public health."

THE formation of a British committee to take part in the movement for the erection of a memorial statue of the late Prof. Virchow at Berlin was referred to a fortnight ago (p. 35). The inaugural meeting of the committee was held on Friday last, when Lord Lister, who was in the chair, described the origin of the movement and the ready support that has been given to it. A general committee has been formed containing nearly one hundred names of men distinguished by their work in various branches of natural science and medicine ; and a form of appeal

has been decided upon. At Friday's meeting, Lord Lister was appointed chairman of the memorial committee; Lord Avebury hon. treasurer; and Sir Felix Semon hon. secretary. It is to be hoped that the response to the appeal for subscriptions will be prompt and generous, so that Great Britain may take a worthy share in the erection of a monument to a man whose genius was used to benefit the whole world. Contributions should be sent to "the Hon. Treasurer of the Virchow Memorial, care of Messrs. Robarts, Lubbock, and Co., 15 Lombard Street, London, E.C.," who will send an acknowledgment to the individual contributors. When the list has been closed, the hon. treasurer will forward the amount to the treasurer of the Berlin committee, together with a list of the contributors, but the amount of the individual contributions will not be stated. All who appreciate Virchow's services to science and humanity should, therefore, not hesitate to pay their tribute to the memory of one of the greatest men of our time.

THE Liverpool correspondent of the Central News states that the Nobel prize of 3000*l.* for researches in connection with malaria will be a personal one to Major Ross, principal of the Liverpool School of Tropical Medicine. According to the Stockholm correspondent of the *Daily Chronicle*, the prize for medicine will be awarded to Prof. Finsen, the Danish discoverer of the treatment by red light for lupus, and the prize for physics to Prof. S. A. Arrhenius.

THE directors of the Ben Nevis Observatories intimated, in a memorandum dated June, 1902, that the observatories at the top of Ben Nevis and in Fort-William were to be discontinued at the beginning of October, 1902. But, in consequence of a proposal by the Treasury to make an inquiry into the administration of the grant to the Meteorological Council, it was widely felt that an effort should be made to keep the observatories at work until the inquiry had been completed. The directors are now able to state that they have succeeded in obtaining the necessary funds, and that there will be no stoppage of the work at the observatories until October, 1904; that is, the work will go on as hitherto for at least two more years. One generous donor is to provide the whole funds necessary for the second year. This prolongation will give ample time to make such arrangements as may be consequent on the report of the committee of inquiry.

A VIOLENT shock of earthquake is reported to have occurred during the night of November 20 at Oued Marsa, in Algeria.

DR. GILBERT T. MORGAN has succeeded Prof. W. P. Wynne, F.R.S., as editor of the *Journal* of the Chemical Society.

THE inaugural address prepared by Mr. J. Swinburne, president of the Institution of Electrical Engineers, will be delivered at an extra meeting, to be held on Thursday, December 4. Mr. Swinburne's illness prevented the address from being read at the meeting of the Institution on November 13.

OWING, it is supposed, to a defect in the heating apparatus, a fire broke out at midnight of November 18 in the Zoological Gardens at Amsterdam. The outbreak started in the birds' gallery, the centre of which is occupied by rare apes. Fortunately, the loss of life was not great, though Keetje, the popular female orang-utan, was suffocated.

LORD EDMOND FITZMAURICE, M.P., chairman of the Wilts County Council, at the last meeting of the Council made a statement with regard to his negotiations with Sir Edmund Antrobus respecting Stonehenge. Though nothing has yet been definitely decided upon, Lord Edmond expects to be able to place before the Council, in February next, a scheme to arrange satisfactorily for the future of Stonehenge.

PROF. GUIDO CORA informs us that a severe snowfall has occurred in several parts of Piedmont. At Costigliole d'Asti, during the morning of November 19, the snow attained a height of a foot (30 cm.) in the most exposed spots. Another fall of snow took place on November 20–21. During the nights, the temperature has been very severe, and in the morning of November 23, at 8 a.m., the thermometer reached -7° C., an extraordinarily low temperature for such a season. In Alessandria and Ivrea, also on November 19, the fall of snow was 20 cm. and 30 cm. thick.

A CREMATORIUM, established by the London Crematorium Company (Limited), was opened at Golder's Green, Hendon, on November 22, when an address was given by Sir Henry Thompson. The crematorium at Woking is too far from London to be of much use to the metropolis, but it is hoped that the institution now available, being within five miles of the Marble Arch, will do much to supply a real deficiency.

THE *Athenæum* announces that the Vienna Academy of Sciences is making the necessary preparations for a fifth expedition out of the funds placed at its disposal by the Treitzsche Stiftung. It is to start in January, 1903, under the leadership of Hofrat Franz Steindacher, the director of the Vienna Natural History Museum. Dr. Pentor, of the same institution, will accompany the expedition as entomologist, and Othmar Reiser, the director of the Bosnian Museum at Sarajevo, as ornithologist. The expedition will land at Paranagua, in Brazil, and thence proceed to the study of the fauna of the hitherto unexplored districts of Piauhy and Maranhao.

A CORRESPONDENT writes:—"A semi-official announcement in the *Transvaal Leader* of October 23 records the formation of a regularly constituted Department of Agriculture in the Transvaal, with Mr. F. B. Smith, the recently appointed agricultural adviser to Lord Milner, as director. Forestry will be represented on the staff by Mr. Chas. E. Legat, of Edinburgh University, from the Cape Forestry Department; fruit by Mr. Davis, late manager of Mr Rhodes's fruit farms; and poultry by Mr. Bourlay, from England. A veterinary branch has been created, but the appointment of principal veterinary surgeon has not been filled. The *Agricultural Journal* was taken in hand some little time back, Mr. Burton being editor. The appointment of a forester has not been made a moment too soon, for he must select a suitable place and set about establishing a Government nursery of fruit and forest trees on the lines of the Government nurseries at Tokai, near Cape Town, where special attention is paid to the propagation of the splendid indigenous timber trees of South Africa. It is much better to plant stretches of veldt with wattles and gums than not to plant them at all; but where these grow, yellow-wood, laurel, assegai, Cape ash and white pear will also grow, than which there is no better timber for cabinet and waggon work. Afforestation should go hand in hand with irrigation in conserving the rainfall of the country."

IN the opening address which Sir William Preece delivered at the Society of Arts on November 19 (published in the *Journal* of the Society for November 21), he showed that the commercial conduct of industrial processes arising from the practical application of discoveries follows distinct laws, which may be said to constitute a science of business. Selecting the industries of water, gas, railways and telegraphs, a series of diagrams was given to exhibit graphically the comparative rates of growth of capital, revenue and expenditure. Several directions in which advance is necessary if Great Britain is to compete successfully with other progressive nations were mentioned. In the course of his address, Sir William Preece said:—"The Germans have an admirable Intelligence Department all over the world. If

any electric development is foreshadowed or suggested in any one of our colonies, especially those in which my firm acts as consulting engineer, we at once receive intimation of the fact from Germany and often from America. We never once have received similar information from any British source! I have endeavoured, to the best of my ability, on every occasion to point out that the retardation in commercial progress in the United Kingdom is not due so much to want of scientific education in the men as in the masters. It is the masters who have allowed the Americans and the Germans to oust them out of their own markets, not by any superiority in the quality of their goods, but by lower prices, by superior knowledge of the demands of the markets, by the establishment of new markets, by better direct communication with foreign countries, by superior methods of business ways, by establishing regular intelligence departments, and, above all, by possessing and exercising superior commercial technical knowledge. There is a science in business as in manufacture. We want our business men to be technically educated. Their brains must be trained as the Germans have been trained—to guide their business habits by language, observation, generalisation and common sense. They must lay aside the habits of their fathers. It is very satisfactory to find our new Universities establishing commercial faculties."

WE have received from Mr. G. G. Davis, director of the Meteorological Service of the Argentine Republic, vol. xiv. (1901) of the *Anales* (xi + 520 large quarto pages). At the time of the last published organisation report (1897), the system embraced 156 stations of various classes, including a few in Paraguay; six stations are provided with self-recording instruments of the most approved patterns, and the observations are all taken and reduced with much care. At four of the principal observing stations, elaborate discussions of the climate, under each element, are published in the volume in question, and form a very valuable contribution to the meteorology of South America.

WE learn from the Report on the administration of the Meteorological Department of the Government of India in 1901–2 that at the end of the year the total number of observatories was 235, of which 186 were maintained by the Government. Seven only were of the first class, furnished with automatic instruments for continuous records of the various meteorological elements. Rainfall was observed at 2389 stations, and seismological observations were satisfactorily recorded by means of Milne's self-registering instrument at three stations; the curves of the latter have been forwarded to the Earthquake Investigation Committee of the British Association. The movements of the upper clouds by means of photogrammeters have already been published for Allahabad; similar observations have recently been made at Simla, and the results are ready for publication. The important work of collection of observations from ships' logs has been continued with much activity at Bombay and Calcutta, and the results are utilised in the preparation of pilot charts, giving month by month the normal meteorological conditions over the Indian seas. These seas were remarkably free from severe storms during the year ending March 31, 1902, there being only seven disturbances, of which four were of slight intensity; due warning was given in all cases to the ports concerned.

THE most recent addition to the valuable series of wind charts published and in preparation by the Meteorological Office shows the mean direction and force of winds round those parts of the coasts of South America which lie south of the equator ("Wind Charts for the Coastal Regions of South America," Meteorological Office Official Publications, No. 159). The coastal regions are broken up into areas from two to five degrees "square," and in each is shown a wind rose, represented by arrows which fly with the winds and show the frequency of the winds by their length, and the force by their thickness. The charts embody the results of 264,639 observations of wind, the numbers ranging from 20,033 for September to 24,072 for January. In addition to the wind roses, mean isobars are given for the same areas. The atlas forms an advance part of the series of charts for the South Atlantic Ocean and the eastern margin of the South Pacific Ocean, in course of preparation under the direction of Commander Campbell Hepworth. Maps of this kind furnish material to the investigator as well as to the navigator which is absolutely inaccessible elsewhere. As illustrating the unique value of such charts, the light thrown on the distribution of cyclonic winter rainfall far up the east coast of South America may be mentioned, a distribution which no charts of mean pressure would account for. We look forward with the more interest to the completed charts of the South Atlantic, inasmuch as they will give a still more extended opportunity of studying the external relations and internal economy of an oceanic area of low mean pressure.

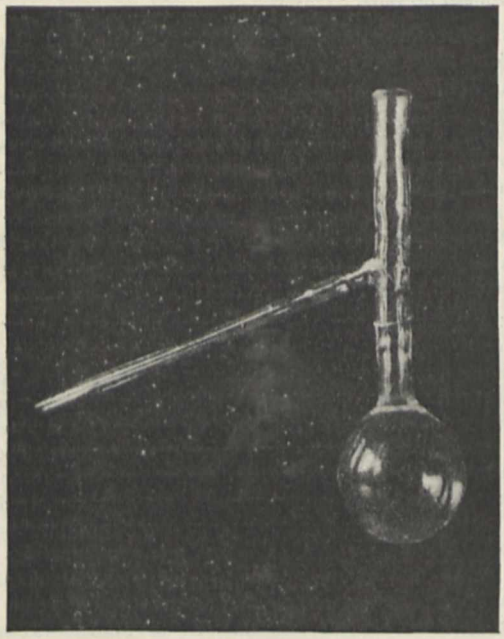
WE have received from Messrs. J. W. Gray and Son a pamphlet on scientific protection against lightning, written by Mr. A. Hands. The writer gives a careful explanation of the principles which must be observed in erecting lightning conductors; as the pamphlet is written in non-technical language, it is to be hoped it may be the means of disseminating information amongst the public, since there are few subjects on which more ignorance and superstition exist. The importance of careful protection may be gathered from the fact that Mr. Hands estimates the damage caused annually by lightning in this country alone at from 50,000*l.* to 100,000*l.*

THE *Engineering Magazine* for November contains an interesting review of wireless telegraphy from the pen of Mr. A. F. Collins. The writer gives a brief historical *résumé* and explains the theoretical basis of the subject, and then proceeds to a detailed examination of the different systems of Hertzian telegraphy which have been developed in the past few years. Those who have attempted to follow the development know that the number of workers has been large and that each has evolved a system having certain distinctive features, and they will welcome an account which describes and illustrates the peculiarities of each. Mr. Collins describes the systems worked out by Mr. Marconi in England, Messrs. Slaby and Arco and Braun in Germany, Messrs. Popoff and Ducretet in France, Messrs. Fessenden and de Forest in America, Senor Severa in Spain, and the repeating system tried by M. Guarini in Belgium.

Die Zeitschrift für das gesammte Brauwesen publishes a highly interesting notice, by Dr. Klöcker, of Prof. Emil Chr. Hansen, written on the occasion of the celebration of the twenty-five years' connection of the eminent investigator with Carlsberg. Hansen's early years shadowed nothing of the career which he ultimately carved out for himself in the scientific world; indeed, a talent for portrait painting led him to migrate from his home at Ribe to Copenhagen with the intention of studying art. Here, however, he worked hard at science, and after passing his examinations at the Polytechnik, he devoted his ability and indomitable energy to botanical studies, and in 1876 he obtained the gold medal of the University for his treatise on Danish manure-moulds. In 1879, he was appointed director of the physiological department of the Carlsberg Laboratory, founded by the enlightened brewer, J. C. Jacobsen. Hansen's work on yeasts has made his name known in every quarter of the globe, and his methods and discoveries have inaugurated a new era in the history of brewing. In the new Fermentation Institute opened about two years ago, of which Hansen is director, neither money nor skill has been spared to supply him

and his able assistants, Drs. Klöcker and Schiönning, with very possible facility for carrying on researches which have rendered Carlsberg so famous. The scientific world, indeed, is apt to forget, dazzled by the renown of the laboratory, that a successful brewery exists at Carlsberg which originally called into existence and supplied the wherewithal for the equipment and conduct of Hansen's Institute.

THE firms of Heraeus, of Hanau, and Dr. Siebert and Kühn, of Cassel, have undertaken the commercial manufacture of flasks, &c., from quartz. The quartz is melted in an oxyhydrogen furnace, and worked and blown to the desired shape. At present, the cost of these quartz vessels is somewhat high, but if their use becomes at all general, it is hoped that it will be possible to considerably reduce it. The accompanying photograph, taken from the *Zeitschrift für Elektrochemie* of November 13, shows one of the vessels made by these firms; it will be seen that the art of turning out such finished work as in glass blowing has not yet been attained. We recently pointed out some of the



valuable properties that quartz vessels possess, in a note on a paper by Mr. Hutton on the fusion of quartz in the electric furnace; we do not know whether Mr. Hutton's process has been taken up as yet with a view to its commercial use. It is a matter for regret that this new and possibly very important industry is apparently to be added to those which our manufacturers at home lack either the ability or energy to tackle with success.

FROM the Report of the Medical Officer of Health for the City of London, we gather that a commendable sanitary supervision is being exercised within the City area. A detailed inspection of kitchens of restaurants, &c., was commenced early in the year. With regard to tuberculosis, the Medical Officer says:—"Although probably not the most important, there can be little doubt as to the causal effect of tuberculous meat and milk," and 24 samples of milk were examined by Dr. Klein for the presence of the tubercle bacillus, but with negative results. During 1901, of 392 samples of milk analysed, 21·2 per cent. were found to be adulterated; but of 30 samples of milk taken from the churns on their arrival at the railway stations from the country, all were of excellent quality, showing that it is the City dealer who is the delinquent.

We have received from the author, Dr. R. von Wettstein, a copy of an essay on neo-Lamarckism and its relation to Darwinism, published in the *Sitzungsberichte* of the German Association of Naturalists and Artists.

The whole of parts iii. and iv. of the *Bulletin* of the Society of Naturalists of Moscow is devoted to an elaborate and profusely illustrated memoir, by Monsieur N. K. Koltzoff, on the development of the skull of the lamprey, *Petromyzon planeri*, in relation to the doctrine of the segmentation of the vertebrate head. It is concluded that the lampreys and their immediate relatives are descended from an ancestral form—the hypothetical Octotrema—furnished with eight pairs of gill-slits. This, in turn, was derived from an earlier form with a still larger number of slits.

To the issue of *La Belgique Coloniale* of November 9, Dr. Forsyth Major contributes some important notes on the okapi skins and skeleton received from the Congo Free State in Belgium, and placed at his disposal for description. The specimens appear to demonstrate that there are two forms of okapi, distinguishable from one another by size, colour, the striping on the legs and the proportions of the skull. For the one represented by the Belgian examples, the author suggests the name *Ocapia lebrechtsi*, in honour of the Secretary of the Interior for Belgium. This form is now definitely known to be horned in the male and hornless in the female; but the author does not at present consider himself justified in stating that the same condition obtains in the form represented by the mounted hornless skin in the Natural History Museum.

IN a paper published in the *Bulletin* of the American Museum (vol. xvi. art. 25), Dr. J. E. Duerden emphasises the importance of boring algas in the disintegration of corals. "Nearly every fragment of dead coral in the West Indies is marked by a number of green specks, indicating the tunnels of an alga, and these in time lead to the breaking up of the whole mass." The author is inclined to believe that boring algas have more to do with the formation of lagoons in coral islands than has the solution of the coral-substance by the carbonic acid contained in the water. "It is just in such quiet spots as lagoons that the various boring algæ would be expected to grow most favourably, and by their incessant ramifications lead to the ultimate disintegration of any block of coral, following it even when reduced to fragments." Nevertheless, it is not to be assumed that this is by any means the sole agency in lagoon-formation.

THE whole of parts i. to iii. of vol. xxvi. of *Notes* from the Leyden Museum is occupied by an important paper on the fresh-water fishes of Borneo, by Prof. L. Vaillant, of the Paris Museum. It appears that the expedition recently dispatched to Borneo by the Society for the Encouragement of the Scientific Exploration of the Dutch Colonies succeeded in ascending a river on one side of the island and descending by another on the opposite side, thus effecting a complete traverse. In spite of many difficulties, a large collection of fresh-water fishes was made, which includes a number of new species. The importance of the collection lies, however, in the proof afforded, that the fresh-water fish-fauna of Borneo differs essentially from that of Celebes—notably in the presence of carps (Cyprinidæ) and cat-fishes (Siluridæ), which are totally wanting in the latter island. It is incidentally mentioned that the fresh-water fishes of Palawan and Balabac are intermediate between those of Borneo and the Philippines, with a preponderance of Bornean types.

THE publications in a European language of the Earthquake Investigation Committee of Japan have now reached their eleventh number. This last issue, which is by Dr. F. Ōmori,

treats of the macro-seismic measurements made in Tokio between September, 1887, and July, 1889. These measurements, which are given in tabular forms, refer to the periods, amplitudes, directions and durations of different earthquakes. One map shows the origins of the earthquakes which were felt in Tokio, many of which are within a radius of 30 miles from that city, whilst all, with the exception of two or three, originated at a distance of not more than 75 miles. A second map shows the distribution of origins of earthquakes which were not felt in Tokio. The distance of these from that town approximately vary between 10 and 130 miles. These various origins may be divided into zones. One of them, which is suboceanic, runs parallel with the eastern coast line. The remainder are inland, and practically run from the backbone of the country at right angles to the Pacific coast.

AMONG the recently published memoirs of the Geological Survey are two relating to the coal-fields of North Staffordshire and South Wales. Both are explanatory of the new series Geological Survey maps. "The Geology of the Country around Stoke-upon-Trent," by Mr. Walcot Gibson and Mr. C. B. Wedd, is accompanied by two editions of the map, sheet 123, one with and one without the drift deposits, and both are colour-printed. This is a distinct improvement on the old hand-coloured maps, and the execution by the Ordnance Survey leaves nothing to be desired. The price also (1*s.* 6*d.*) is very moderate. The memoir contains a concise account of the Pottery Coal-field, and it will be noticed that the higher portions of the Coal-measures, previously regarded as Permian, are now subdivided and represented on the maps. The recognition of their true position has a very important bearing on further explorations for coal in the northern-midland area. The Triassic and superficial deposits are described, and there is a chapter on economic and applied geology. "The Geology of the South Wales Coal-field, part iii., the Country around Cardiff," is by Mr. A. Strahan and Mr. T. C. Cantrill. It is likewise an explanation of the geological map, sheet 263, which at present has been issued only in the hand-coloured form. The area described is just outside the limits of the great coal-field, but it includes the bordering rocks of Lower Carboniferous and Old Red Sandstone, and a little area of Silurian rocks by the Rhymney River. It also takes in a small portion of Somerset, near Weston-super-Mare. Resting irregularly on the older formations are the Keuper conglomerates and marls, the Rhætic beds and the Lower Lias. A particular description is given of the Rhætic beds, as they first received recognition by the Geological Survey in the conspicuous headland of Penarth. The Glacial and post-Glacial deposits, the water-supply and economic products receive due attention, and there is a full bibliography of geological books and papers relating to the South Wales Coal-field.

THE Irish gold ornaments which a few years ago were acquired by the British Museum have been the source of much departmental correspondence and opposed opinions, the excitement being due to the fact that these valuable and interesting specimens are lodged in the British Museum rather than in the Irish National Museum in Dublin. One argument for their retention in London was that, although they were found in Irish soil, there was no proof that they were of Irish manufacture. In the current number of the *Journal* of the Royal Society of Antiquaries of Ireland (part iii. vol. xxxii. p. 211), there is a paper by Mr. R. Cochrane which conclusively proves that these are genuine Irish objects, and Mr. Cochrane concludes that these *ex voto* objects, especially the golden boat, were connected with St. Columba's voyage to Drumceat, in A.D. 575 or 596, when he was accompanied by the Scottish King Aedan, and their deliverance from the dangers of shipwreck may have furnished the *motif*. There is a note substantially to the same effect, by the Rev. J. M'Keefry, in the same *Journal* (p. 266). Mr. Cochrane's paper is illustrated by a map and several illustrations borrowed from Mr. Arthur J. Evans's paper "On a Votive Deposit of Gold Objects found on the North-west Coast of Ireland" (*Archaeologia*, vol. lv. p. 391).

THE first part (pp. 424, figs. 412) of a new "Lehrbuch der vergleichenden Anatomie," by Prof. B. Haller, of the University of Heidelberg, has just been published by the house of Gustav Fischer, Jena. The work will be reviewed when it has been completed.

THE September issue of *Himmel und Erde* contains a very readable article, from the pen of Dr. H. Wagner, on natural colouring matters. Many interesting facts concerning the early history of these colouring matters are detailed, and the successful attempts at the replacement of several of these by synthetic products are described. In another article, by Herr Kürchhoff, an account is given of the trials which have been made with turbines as motive power on ships.

A FOURTH edition, revised and enlarged, of Prof. R. C. Carpenter's book on "Heating and Ventilating Buildings" has recently been published. In the review of the first edition of the work, in our issue for February 27, 1896, the author was congratulated on producing a really good book on a subject seldom treated scientifically. It is gratifying to find that the book has met with the success it deserves. In its revised form, it should continue to be used largely by heating engineers and architects. The book is published in this country by Messrs. Chapman and Hall, Ltd.

THE little book edited by Prof. Perry, F.R.S., containing an account of the discussion on the teaching of mathematics which took place at the Glasgow meeting of the British Association in 1901, has reached a second edition. The book is enlarged by the addition of the Report of the British Association Committee upon the Teaching of Elementary Mathematics (drawn up by the chairman, Prof. Forsyth, F.R.S.) which was presented at the Belfast meeting this year, and of the letter addressed to this committee by twenty-two mathematical masters in public schools. The book is published by Messrs. Macmillan and Co., Ltd., at 2*s.* net.

THE first part of a new volume (the third) of the "International Catalogue of Scientific Literature" has been published. The subject is "Physiology, Including Pharmacology and Experimental Pathology," and the second part of the volume referring to it will be issued shortly. The publication of the physiology volume in two parts has been considered advisable, instead of waiting until all the material for the year 1901 has been collected, but in future years, when the organisation of the work has been fully developed, the volume on physiology will be issued as one publication each year. The general scheme of the "International Catalogue" may be judged from the notices of the two volumes on botany and chemistry in NATURE of July 3 and September 4 (vol. lxvi. pp. 217 and 436). The first annual issue will consist of thirteen complete volumes and four volumes made up of two parts each. Three instalments have now been published, and of the remainder of the issue four are announced as in the press and fourteen in preparation. The price of the complete issue is 18*l.*

THE products of the decomposition of normal cupric acetate under the influence of heat have been frequently investigated, but no perfectly definite results have been obtained. Messrs. Harcourt and Angel, as the result of a very careful research, have found that the decomposition products are acetic acid, water, cuprous acetate, carbon dioxide, carbon monoxide and a residue containing copper, carbon and small quantities of oxygen and hydrogen. A trace of acetone is also obtained as a result of the decomposition.

SOME interesting facts concerning the velocity of crystallisation have been found as the result of an investigation by Dr. von Pickardt, published in the current number of the *Zeitschrift für physikalische Chemie*. The velocity of crystallisation of supercooled benzophenone is diminished to the same extent when equimolecular quantities of the most various substances are dissolved in it. The diminution of the velocity for any one dissolved body is, moreover, not proportional to its concentration, but to the square root of this. The regularities which have been observed may be utilised in a practical way for the determination of the molecular weights of substances dissolved in the crystallising medium.

A NEW fortnightly journal—the *Biochemisches Centralblatt*—is to make its appearance very shortly. The editor is Dr. Carl Oppenheimer, and the directors of the undertaking are all men well known for their contributions to biochemistry. It is not intended that the new journal shall serve as a medium for the publication of original papers; its chief object will be to give an abstract of all papers dealing with biochemical subjects published in other journals. The only original contributions which will find a place in the *Centralblatt* will be reviews of the condition and progress of small specialised branches of the subject, and it is proposed that each fortnightly issue shall contain such a *résumé*. The first number will appear early in December. The publishers are Gebrüder Borntraeger, Dessauer Strasse 29, Berlin S.W., and the yearly subscription is 30 marks.

THE examination of the electrical conductivity of a large number of substances dissolved in liquid hydrocyanic acid by Messrs. Kahlenberg and Schlundt (*Journal of Physical Chemistry*, October, 1902) has shown that while some salts are not such good conductors as their corresponding aqueous solutions, others conduct much better. Solutions of acids in liquid hydrocyanic acid are generally much poorer conductors than aqueous solutions, and the authors conclude that electrolytic conducting power is essentially determined by the specific nature of the compound formed when solute and solvent act on each other to form the solution. Certain chemical changes which have been investigated in hydrocyanic acid solution present remarkable peculiarities. It is found, for instance, that whereas trichloracetic acid readily attacks metallic magnesium and sodium carbonate, it has no action on zinc or calcium carbonate.

THE question of the influence of moisture on the combination of hydrogen and chlorine has been advanced another stage by the recent experiments of Messrs. Mellor and Russell. Great precautions were taken to ensure the purity of the gases used in the experiments, the hydrogen being prepared by the action of steam on metallic sodium and the product purified by absorption in palladium. Pure chlorine was obtained by the electrolysis of fused silver chloride. After the gases had been left in contact with phosphorus pentoxide for nine months in the dark, it was found that a small spark at once caused a violent explosion, and complete combination took place. The mixture of dry gases could, however, be heated to 450° C. without explosion taking place, whereas a moist mixture in a similar bulb exploded at about 260° C. With the dry mixture it was further found that in sunlight no explosion takes place, but that the combination of the gases is very slow. The experiments show clearly that the presence of moisture has very considerable influence on the union of the two gases.

THE additions to the Zoological Society's Gardens during the past week include a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, presented by Mr. W. A. Filbert; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. C. A. Rawlins; a Lanner Falcon (*Falco lanarius*) from Egypt, presented by Dixon Bey; a Globose Curassow (*Crax globicera*) from Central America, presented by the Hon. Mrs. Lawly; a Stone Curlew (*Œdicnemus scolopax*) European, presented by Mr. A. W. Arrowsmith; eight Dwarf Chameleons (*Chamaeleon pumilus*) from South Africa, presented by Miss Kay; a Horned Lizard (*Phrynosoma cornutum*) from Mexico, presented by Mr. C. W. Farquharson; seven Viperine Snakes (*Tropidonotus viperinus*) European, presented by the Rev. F. W. Haines; two Smooth-headed Capuchins (*Cebus monachus*) from South-East Brazil, a Macaque Monkey (*Macacus cynomolgus*) from India, six Mountain Witch Ground Doves (*Geotrygon cristata*) from Jamaica, two Changeable Lorikeets (*Ptilosclera versicolor*) from North-West Australia, a Suricate (*Suricata tetradactyla*) from South Africa, deposited; an English Wild Cow (*Bos taurus*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN DECEMBER:—

Dec. 1. 6h. 37m. to 10h. 19m. Transit of Jupiter's Sat. III. (Ganymede).
1. 5h. 15m. Minimum of Algol (β Persei).
4. 7h. 38m. to 8h. 33m. Moon occults β Capricorni (mag. 3·4).
5. 7h. Moon in conjunction with Jupiter. Jupiter, 5° 52′ S.
10. 7h. 8m. to 8h. 22m. Moon occults ζ^1 Piscium (mag. 4·2).
10. 20h. Venus in conjunction with Uranus. Venus, 0° 8′ S.
11–12. Epoch of Geminid meteoric shower.
13. 13h. 53m. to 14h. 56m. Moon occults δ^1 Tauri (mag. 4·0).
13. 14h. 27m. to 15h. 23m. Moon occults δ^2 Tauri (mag 4·7).
14. 16h. 52m. to 17h. 0m. Moon occults 120 Tauri (mag. 5·3).
15. Venus. Illuminated portion of disc = 0·998, of Mars = 0·904.
15. 18h. 24m. to 18h. 42m. Moon occults 26 Geminorum (mag. 5·1).
16. 3h. 34m. to 8h. 29m. Transit of Jupiter's Sat. IV. (Callisto).
16. 5h. 49m. to 6h. 32m. Moon occults λ Geminorum (mag. 3·6).
16. 12h. 27m. to 13h. 20m. Moon occults 68 Geminorum (mag. 5·0).
17. 18h. 37m. to 19h. 36m. Moon occults A^2 Cancri (mag. 5·8).
18. 10h. 9m. Minimum of Algol (β Persei).
21. 6h. 58m. Minimum of Algol (β Persei).
21. 15h. 0m. Moon in conjunction with Mars. Mars, 4° 22′ N.
22. 7h. 0m. Sun enters Capricornus. Winter commences.
30. 0h. 6m. to 3h. 49m. Transit of Jupiter's Sat. III. (Ganymede).
31. 5h. 0m. Moon in conjunction with Saturn. Saturn, 5° 20′ S.

EARLY OBSERVATIONS OF NOVA PERSEI.—In *Circular* No. 66 of the Harvard College Observatory, Prof. Pickering details the results which have been obtained from the measurement of the photographs of the region of Nova Persei which were obtained during the years 1890, 1893 and 1894.

These measurements indicate that the star on the Harvard photographs, which was pointed out by Father Zwack, of the Georgetown College Observatory, and also announced by M. S. Blakjo (*Astronomische Nachrichten*, 157, 193), is a variable which for several years has oscillated between the thirteenth and fourteenth magnitudes, and they also lead to the conclusion that it was, for that period, within one or two seconds of arc of the Nova's position, the difference in position being less than the probable errors of measurement.

COMET 1902 *c* (GRIGG).—A communication from Mr. P. Baracchi, director of the Melbourne Observatory, to No. 3828 of the *Astronomische Nachrichten* states that a search was made for this comet on the first available evening after Mr. Grigg's announcement of its discovery, but without success; nor has the comet been found by any of the Australian observatories. This may be accounted for by the prevalence of bright moonlight on the available nights and by the statement of Mr. Grigg that the object was an extremely faint one.

Enclosed with this communication is a list of the observations made by the discoverer. These observations state that the comet, when first seen, appeared as a faint nebula and was about twice the diameter of Jupiter, the atmosphere never being quite clear. Fourteen observations were made between July 23, when the comet was first seen, and August 3, but after the latter date, bad weather and bright moonlight prevented any further observations.

The instrument used was a 3½-inch refractor, and the N.A. clock stars β, γ and δ Virginis, and ν Virginis, were observed as "near" stars, the apparent position of the last named being taken as 11h. 40m. 52s. + 7° 4′·5.

From the observations made on July 24, 27 and 30, Mr. Grigg has computed the following corrected elements:—

$$T = 1902 \text{ June } 20{\cdot}33 \text{ G.M.T.}$$

$$\omega = 301^\circ\ 46'{\cdot}1$$
$$\Omega = 217\ 31{\cdot}4$$
$$i = 16\ 42{\cdot}9$$
$$\log q = 9{\cdot}76618.$$

The position for August 3 as computed from these elements differs by + 1m. 36s. and + 4′ from the observed position on that date.

The computed position at perihelion was $\alpha = 113^\circ\ 34'$, $\delta = +15^\circ\ 23'$, about 10° north of Procyon, the apparent distance from the sun being 25° E., 6° S. The longitude of the comet from the sun would then increase, and the comet would pass through Cancer towards Regulus until it reached Virgo at the time of its discovery by Mr. Grigg.

APPARENT DEVIATIONS FROM NEWTON'S LAW OF GRAVITATION.—In a paper read at the Göttingen meeting of the Astronomische Gesellschaft on August 4, Herr Peter Lebedew reviewed the various theories which have ever been proposed to account for the apparent contradiction to the law of gravitation as observed in the repulsion of comets' tails from the sun, and he finally accepts the theory of Kepler, which attributes the repulsive force to solar radiation.

The author stated that he had recently confirmed the quantitative relation expressed in the formula for this repulsion, due to Maxwell and Bartoli.

For a spherical body, the diameter of which is great as compared with the wave-lengths of the solar radiation, the resulting action (F) is expressed, in gravitational units, by the formula

$$F = 1 - \frac{1}{10{,}000} \cdot \frac{1}{r\delta}$$

where r is the radius in centimetres and δ is the density of the body as compared with that of water. For dust particles, the diameters of which are comparable with the wave-lengths of the solar radiation, the above relation does not hold good.

This relation explains the varying behaviour of different parts of a comet, for it is obvious that, in a cometary nucleus made up of meteorites of various dimensions and densities, we should expect varying values of F.

TOTAL LIGHT OF ALL THE STARS.—Mr. Gavin J. Burns contributes to No. 3, vol. xvi. of the *Astrophysical Journal* an interesting account of some results he has obtained whilst attempting to estimate the total light of all the stars.

In the first place, he determined the relative brightness of different parts of the sky by observing these different parts through varying thicknesses of ordinary clear glass, and then determining what proportion of the total incident light was transmitted by a unit thickness of glass. He found that the luminosity of the Milky Way varies from two to three times the luminosity of the rest of the sky.

Secondly, he compared the luminosity of the stars with that of the normal sky by the method of putting the star image out of focus until its apparent brightness was equal to that of the surrounding sky; by this process he deduced, from the mean of several independent observations of various stars, that half a square degree of non-Galactic sky gives as much light as a fifth-magnitude star. From further observations, Mr. Burns found that, given a perfectly black background, stars as faint as the eighth magnitude would be readily visible.

WEST INDIAN VOLCANIC ERUPTIONS.

AS a panacea for much ignorance, the subtle fluid of Franklin stands next to superstition. If you cannot explain the angry workings of a volcano by a Pluto, a Vulcan or the struggles of the damned, tell the man in the street that it is due to electricity and he is happy. At the present moment, in seventeen columns of the *Revue Scientifique* of September 6, M. Arthur Tarquin offers to the world an electrical theory of volcanic action which, to a great extent, is novel. At the outset we are told that the earth is entirely governed by the sun, and as its energy varies so will various activities on the earth vary. In establishing such a connection for volcanic activity, M. Tarquin, however, poses as a special pleader. In Tokio, for example, he says that earthquakes (*sic*) are most numerous about the times when sun-spots are at a maximum and *at a minimum*. Dr. E. Naumann, who examined the earthquake registers of Japan, however, failed to find such a connection, and others who have worked with materials relating to other countries have arrived at similar conclusions. As another example of incompleteness in statement, we are told that at the "*moment précis*" of the eruption in Martinique, with a mathematical exactitude magnetic needles at observatories throughout the world were violently disturbed. Even if we admit this to have been the case, we fail to see why similar phenomena were not observed with the more violent eruption which took place the day previously in St. Vincent.

As solar energy penetrates denser and denser layers of the earth's atmosphere, the same becomes warmer and warmer; why, therefore, asks M. Tarquin, should not the internal heat of the earth be explained by similar reasoning? This heating he apparently regards as the result of an increasing resistance to the passage of electricity. The oceans are regarded as vast accumulators. Electric potential is greater where ocean currents meet with obstacles, as, for example, where the Gulf stream passes the Antilles, and it is, therefore, in such places where volcanic activity is pronounced.

So convinced was M. Tarquin of the truth of his theory that he brought the same to the notice of M. le Ministre des Colonies, but it apparently received but small consideration. An official commission was sent to Martinique, but it neither foretold the eruption of July 9 nor that of August 27. On the contrary, it concurred in the return of the inhabitants to their deserted homes and the establishment of brigades of soldiers at Morne Rouge and other places, whilst the chief of the scientific mission issued in the official journal a letter assuring the inhabitants of safety.

This advice M. Tarquin holds to have been based on classical but false hypotheses respecting the cause of volcanic activity, and the exposition of these views lulled many into a feeling of security which they paid for with their lives. The theory of the "pyrophiles" is dangerous to humanity.

The *Revue Scientifique* of September 13 contains a report by the delegates of the Paris Academie des Sciences on the eruption in Martinique of May 8.

This first refers to a chronological account of the eruptions and various volcanic manifestations before the destruction of St. Pierre, and gives a description of the crater of Mont Pelée. By the eruption many fissures were formed, the existence of which is recognised by lines of steam vents. These continued beneath the sea, and accounted, no doubt, for the interruption of the cables and the numbers of dead fish observed on May 5. From these fumaroles steam and sulphuretted hydrogen escape, and round their orifices crystals of sulphur and sal-ammoniac are found. Their temperature at a depth of 0·10m. is about 400° C. Along the beds of the rivers Blanche and Sèche, and particularly near their mouths, these vents are very vigorous, but they vary in their activity and give rise to variations in the temperature of the water in the rivers.

The cinders which fell at Prêcheur formed a layer about 25 centimetres in thickness. At Carbet lapilli one centimetre in diameter were common. Some fragments were larger, and were

similar to those which fell at Fort de France and François on May 8 and 20. On July 9 the character of the ejectamenta became more pumiceous. Bombs 1·3m. in diameter were projected 800 metres. There does not appear to have been any change in the depth of the ocean near to St. Pierre.

On May 8 at the time of the eruption the sea at Fort de France receded 1m., and there were five or six undulations at intervals of about five minutes. Similar movements were also observed on May 20 and 26, June 6 and July 9. From May 7 to May 10 an unusually strong current was observed on the west coast. Each eruption was accompanied by a barometric oscillation from 1 to 3mm. in amount.

In *McClure's Magazine* for August, and in the *Fortnightly Review* for September, Prof. Angelo Heilprin contributes an article on "Mont Pelée in its Might."

For the first time we are told that for three months before the fatal explosion of May 8 Pelée had been rumbling, and that there had been occasional emissions of steam. The hour at which this explosion took place is fixed by the s.s. *Pouyer Quertier* and by the cable office at Fort de France at 8h. 2m. a.m., but according to the dial of the Hôpital Militaire of St. Pierre the time was 7h. 52m. a.m.

The first explosion would therefore appear to have resulted in ruin the distribution of which was quaquaversal. It might, for instance, have been produced by the explosion of a gas cloud. The latter, which left ruins with a definite orientation, may have had the character of a blast propagated in one direction.

No doubt, Prof. Heilprin concludes, there were numerous electric explosions, unmistakable evidence of which is found in perforated pottery and metal wares.

In the *Popular Science Monthly* for August, Dr. Thomas A. Jaggar gives an account of his visit to Martinique and St. Vincent. His first landing at St. Pierre was on May 21, the day after the second great eruption of Mont Pelée. Masonry had been completely destroyed, there was an absence of large volcanic fragments, and "everything was coated with a green-grey powder or sand." No sign of molten rock was found either here or in St. Vincent. At the latter island La Soufrière was ascended twice, after which Dr. Jaggar proceeded to Barbados to learn something of the dust showers which had covered that island.

At Walliabou and Richmond the same fiery blast swept down from La Soufrière as that which swept down on St. Pierre, and just as St. Pierre is buried so is Richmond buried, the ashes at the northern end of the town being 45 feet in thickness and three feet at the southern end. The masonry in the village was swept over, and 5-foot blocks of the same were blown to distances of 40 feet. On the west sea front of the Soufrière there are now vertical walls of earth in certain places 50 feet in height where before there was a village.

M. M. Ballou, in his "Equatorial Africa," writing in 1892, says that "it is confidently predicted (that Mont Pelée) will one day deluge St. Pierre with ashes and lava, repeating the story of Pompeii," a prediction, Dr. Jaggar remarks, based on "well-authenticated data."

Before this last eruption, so far back as January, the lake in the crater at Pelée was warm and the odour of sulphuretted hydrogen was perceived. In April, steam was emitted and rumblings were heard. From April 24 there were actual eruptions.

In St. Vincent, local earthquakes had been on the increase for a year, and so far back as May, 1901, people were frightened away from the north-west slope of the Soufrière by rumblings and quakings. The lake bubbled and sulphurous coatings were found on the rocks. In short, the signals were so pronounced that the leeward slopes of the Soufrière were abandoned, and hence the small loss of life. Had the Governments of both islands maintained vulcanological stations, the records of "tremors, sounds, sights, smells and temperatures" would no doubt have formed an increasing series of warnings.

In the Blue-book (Cd. 1201) we find 144 official communications relating to the volcanic eruptions in St. Vincent and Martinique in May, 1902. These, as may be expected, are varied in their character. Some refer to earthquakes, others to eruptions. Many are requests for assistance, whilst others are expressions of sympathy. In communication No. 129, Mr. Secretary Chamberlain calls the attention of the Board of Trade to the bravery of Captain Freeman and suggests that it should not be allowed to pass without recognition. The reply to this states that the Board has decided to award Captain Freeman a piece of plate in recognition of his gallantry. Other communications deal with the mineralogical character of the ejectamenta, personal experiences within the devastated zone, pecuniary losses and other matters. Although many of the notes in this volume have but a small scientific value, there yet remains much not to be overlooked by those who compile the history of these terrible disasters.

Dates of Volcanic Eruptions in Central America and the West Indies (Rockstroh-Fuchs).

1552	...	1699	...	1785—	...	1852—
1526—	...	1705—	...	1797×—	...	1853—
1541	...	1706	...	1798—	...	1854—
1565—	...	1707	...	1799—	...	1855—
1581	...	1709—	...	1802×—	...	1855—
1582—	...	1710	...	1803—	...	1856—
1585-6—	...	1717—	...	1809—	...	1857—
1614	...	1718×—	...	1812×—	...	1858—
1623	...	1723	...	1821—	...	1860
1643	...	1726	..	1828	...	1865
1651—	..	1732—	...	1829—	...	1867—
1664	...	1737—	...	1833	...	1868
1668—	...	1764	...	1835—	...	1869—
1670	...	1766×—	...	1836×—	...	1870
1671	...	1770	...	1844—	...	1873
1677—	...	1772	...	1847—	...	1880—
1686	...	1775	...	1850	...	1883
1692×—	...	1775	...	1851×—	...	1902×—

West Indian eruptions are marked ×.
Unusual seismic disturbances are marked —.

From the above, which is chiefly compiled from the writings of Rockstroh and Fuchs, it will be noticed that *all* the West Indian eruptions have been accompanied by unusual seismic disturbances either in the West Indies themselves or in neighbouring rock folds. J. MILNE.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—In consequence of the large number of students in the department of anatomy, it is proposed to appoint two additional demonstrators, to be paid from the fees received for instruction.

The State Medicine Syndicate report that ninety candidates have been examined by them in the present year; of these, fifty-two were successful in obtaining the University diploma in public health. The Syndicate propose that a second grant of 1000*l.* be made from the funds in their hands toward the new Medical School buildings, in which provision will be made for teaching and examinations in sanitary science.

The Sedgwick Memorial Museum of Geology is nearly ready for occupation; the building syndicate estimate the cost for structure and fittings at more than 45,000*l.* Of this, some 27,000*l.* comes from the accumulated subscriptions to the memorial fund, 3000*l.* will be obtained from the University Press profits, and the balance probably from the benefaction fund.

THE Right Hon. Sir William Hart Dyke, Bart., M.P., will distribute the prizes at the Merchant Venturers' Technical College, Bristol, on Friday, December 12.

THE *Athenaeum* announces that Sir William Muir has resigned the post of principal of the University of Edinburgh, which he has held since 1885.

IN his inaugural address at the opening of the session of the Royal College of Science, Prof. Perry expressed his anxiety for the creation of a fund to provide bursaries to assist the national scholars and other Government students. We are glad to hear that this fund has been started with a gift of 100*l.* from the Drapers' Company, to be divided equally among ten of the scholars. The Company do not pledge themselves to continue this help.

LOCAL museums and local natural history societies can be of much assistance to nature-study in schools by directing attention to observations of natural objects. We are, therefore, glad to see that there will be a conference on nature-study at the Stepney Borough Museum on December 3, at 5.30 p.m.,

when Mr. A. D. Hall, director of the Rothamsted Agricultural Experiment Station, will give an address. The chief object of the conference is the development of the work of the museum with the schools.

ABOUT six hundred teachers and school managers from all parts of the East Riding met at Beverley on Saturday last, at a conference on nature-study. Lord Herries, chairman of the Technical Education Committee of the East Riding County Council, presided, and an address was given by Prof. Miall, who advised his hearers not to use stuffed animals and dried plants in the class-room, but wherever possible to study living animals and plants. A representative committee was elected to promote nature-study in the East Riding and Hull.

WE learn from the *British Medical Journal* that the Board of Trustees of the Johns Hopkins University, Baltimore, has accepted an offer made by Dr. and Mrs. Christian Herter, of New York, to give 5000*l.* to found a memorial lectureship in the medical department of the University, "designed to promote a more intimate knowledge of the researches of foreign investigators in the realm of medical science." This end is to be secured by inviting each year some eminent worker in physiology or pathology to deliver one or more lectures at the Johns Hopkins University upon a subject with which his name is associated. The lecturer will receive as an honorarium the annual income of the endowment. The selection of the lecturer will be made by a committee consisting of Dr. Welch, Dr. Osler and Dr. Abel.

THE Gordon Memorial College at Khartoum, which Lord Kitchener opened recently, is now ready for the chemical and bacteriological research laboratories presented by Mr. Henry S. Wellcome during his recent visit to the Soudan. The fixtures and appliances, made in England, have already been shipped. The equipment for scientific work is most complete in every detail, and will be equal to that in any similar laboratories in Europe. The Sirdar has appointed as director of these research laboratories Dr. Andrew Balfour, of Edinburgh, who has done good work in bacteriology. The Soudan presents exceptional opportunities for the study of tropical diseases, especially malaria, typhoid and dysentery, and it is anticipated that the results of the investigations of Dr. Balfour and his staff will be of the greatest importance. Apart from the original researches and general sanitary work, Dr. Balfour and his staff will devote their attention to the study of the cereals, textile fibres and various matters affecting the development of the agricultural and mineral resources of the country. Dr. Balfour leaves England on December 11, and will be entertained at dinner at the Princes' Restaurant, Piccadilly, on December 8.

A POST-GRADUATE course for the training of teachers in secondary schools will be commenced in January at the London Day Training College, Clare Market, W.C. Candidates for the one year's course of professional training must be graduates, or must have undergone a course of university study and passed an examination equivalent to that for a university degree in arts or in science. All students will receive instruction in the theory, history and art of education, so as to prepare them for the examination for the teacher's diploma of the University of London, and will also go through a course of practical work in approved secondary schools. All the principles studied in the lecture room will be exemplified in the schools, and visits of observation will be made to schools of marked excellence or of special educational interest. Candidates should make application for admission to the course for graduates not later than December 8. Applications should be addressed to the Secretary of the Technical Education Board of the London County Council, 116 St. Martin's Lane, W.C.

THE report of the Indian Universities Commission, to which attention was directed in these columns on September 4, has given rise to many expressions of dissatisfaction in the native Press of India. A resolution explaining the attitude of the Governor-General in Council towards the report was recently circulated among local governments and administrations with a view to evoke full discussion, so that, before coming to a final conclusion, the Government of India may know exactly what is thought by all persons concerned in Indian education. The resolution makes it quite clear that neither the Government nor the Commission desires to initiate a policy tending to make education the monopoly of the rich. At the same time, it is pointed out that a certain minimum standard of efficiency is necessary, and this is only possible if the expenditure reaches a certain amount which entails fees that some would-be students may find it difficult to pay. The Government, however, contemplates the provision of scholarships for the more able boys and an endowment to cheapen education for poor students. The *Pioneer Mail* is of opinion that the resolution may indefinitely postpone the thorough reform of Indian university education.

ON Monday afternoon, Lord Dudley, in laying the foundation-stone of a new technical institute at Belfast, remarked that if we are to hold our own in the great war of the world, we must see that the soldiers of industry are equipped with the best training that can possibly be given. Replying to the toast of his health at a dinner on Monday evening, Lord Dudley is reported by the *Times* correspondent to have said that the scheme of technical instruction in Belfast was, he understood, incomplete in respect to the fact that it did not include opportunities of learning all that modern science had to tell about the different subjects included in its course. How this defect could be remedied was a subject for careful consideration on their part. The most obvious course would be to make their scheme culminate in the Queen's College and to link that college to their institute. The great obstacle was one of expense; but he could promise them, if they put forward a scheme of that nature, and it was sufficiently supported by local efforts, that the Irish Government would consider it carefully on its merits and bring before the Treasury its claims for assistance from the public funds.

SCIENTIFIC SERIALS.

Journal of Botany, November.—The article by Mr. H. N. Dixon on new varieties of British mosses will interest bryologists. In addition, Mr. E. S. Salmon contributes some bryological notes. The monotypic genus Osculatia instituted by De Notaris is referred to Bryum, and three species of Schwetschkea, C. Müller, are confirmed, while a fourth is assigned to Leskea.—Mr. Spencer Moore describes South African plants, collected mostly by Mr. T. Ommaney and Capt. Barrett-Hamilton, of which several species are new.—The catalogue of British Algæ compiled by Mr. A. E. Batters continues the Rhodophyceæ which began in the last number.—There is presented a brief sketch and portrait of Mr. T. Comber, who made a special study of the Diatomaceæ.

American Journal of Science, November.—Observations on the eruptions of 1902 of La Soufrière, St. Vincent, and Mont Pelée, Martinique, by E. T. Hovey. The first ascent of La Soufrière after the eruption was made on May 7, when the crater was found to be practically unchanged in diameter. The "new" crater of 1812 appears to have taken no part in the eruptions, and although there are many ancient lava beds in the island, no stream of melted lava has issued from the Soufrière during the present eruption. The paper is accompanied by two maps, showing the devastated areas on the two islands, and sixteen photographs.—On the reflection of electric waves at the free end of a parallel wire system, by H. A. Bumstead.—The Upper Permian in Western Texas, by G. H. Girty.—The reduction of vanadic acid by the action of hydrochloric acid, by F. A. Gooch and L. B. Stookey. The reduction of vanadium pentoxide to the trioxide by the action of hot concentrated hydrochloric acid has been suggested as the basis of a quantitative method for the estimation of vanadic acid, but the results of previous work have been contradictory. It is shown by the author that, by the adoption of suitable precautions, the reaction can be made nearly complete, but the method is not a suitable one for the determination of vanadic acid, except when this substance is present in very small amount.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 14.—Prof. S. P. Thompson, president, in the chair.—A paper on the theory of the aluminium anode, by W. W. Taylor and J. K. H. Inglis, was read by Mr. Inglis. Aluminium is very slowly acted upon by dilute sulphuric acid even at moderately high temperatures. With dilute hydrochloric acid, the action is violent, and it is found that if a little hydrochloric acid or soluble chloride be added to dilute sulphuric acid, the action is as violent as with hydrochloric acid

of the same concentration. The object of the present paper is to find an explanation of this anomalous behaviour of sulphuric acid, and of the effect produced by the addition of chloride. It has long been known that, when an aluminium electrode is employed as anode in a solution of a sulphate or sulphuric acid, there is a very great resistance offered to the current, and that this resistance is due to a film which separates the electrode from the solution. If the aluminium is the kathode, or if other acids are substituted for sulphuric acid, this great resistance does not exist. It seems probable that the two phenomena are related, and that the film is also the cause of the slow action of sulphuric acid on aluminium. The authors have attempted to establish a theory which will explain these phenomena. The influence of certain salts of potassium in various concentrations was investigated, and the authors conclude that the presence of certain ions enables a large current to pass through the cell. The reason seems to be that the film of aluminium hydroxide with which the anode is covered is permeable to certain ions but impermeable to others. The anomalous behaviour in sulphuric acid would then be due to the impermeability of the film to the SO_4'' ions and also to the Al''' ions. Further experiments gave support to the view that the abnormal behaviour of aluminium anodes in sulphuric acid is due to impermeability.—A paper on a determination of the ratio of the specific heats at constant pressure and at constant volume for air and steam was read by Mr. Mackower. The method employed in this paper is similar to that used by Lummer and Pringsheim, and consists in allowing the gas under investigation to expand adiabatically and measuring the lowering of temperature caused by such expansion. The author's value for the ratio of the two specific heats in the case of air is 1·401. The observations with steam were similar to those in the preceding experiments, but special precautions were necessary to prevent the condensation of the steam in the tubes leading to the vessel. The results for steam were not sufficiently accurate to justify the application of corrections for radiation and for conduction and convection. The values of γ deduced from two series of experiments were 1·307 and 1·304.

Royal Astronomical Society, November 14.—Dr. J. W. L. Glaisher, F.R.S., president, in the chair.—Dr. Isaac Roberts read a paper on Sir W. Herschel's nebulous regions, compared with photographs of the same regions taken simultaneously with the 20in. reflector and 5in. Cooke lens. The results show that on forty-eight of the areas described by Herschel as nebulous there is no visible trace of diffused nebulosity, while on the remaining four there is nebulosity with very characteristic features. Photographs of these remarkable nebulous regions were thrown on the screen.—Prof. H. H. Turner read a paper on the suggestion made by Sir D. Gill that the brighter stars are, as a whole, rotating with respect to the fainter stars as a whole. A comparison of photographs taken at Oxford between 1892 and 1902 indicated a relative motion of the brighter stars of about the same amount as that found by Sir D. Gill, but in the opposite direction. Prof. Turner made the suggestion that the stars nearest to the sun may be, generally speaking, intrinsically fainter than those of the Milky Way, and there would thus for some regions be a discontinuity in the law by which fainter stars are, as a whole, more distant than brighter stars.—The secretary read a paper on the same subject communicated by the Astronomer Royal. A comparison has been made between Groombridge's catalogue (1810) and the Greenwich second ten-year catalogue (1890). The results, so far obtained, could not be taken as affording evidence of the cosmical movement suggested by Sir D. Gill.—Mr. E. T. Whittaker read a paper on the general solution of Laplace's equation and of the differential equation of wave-motions, and on an undulatory explanation of gravitation. The principal result was the general solution, by means of a definite integral, of the well-known partial differential equation which is satisfied by all Newtonian potential functions. It was then shown that a definite integral of a similar type furnished the general solution of the partial differential equation which occurs in the theories of light, sound and electromagnetic waves. From relations between the two solutions thus obtained, it was shown that any disturbance which can be represented by a solution of Laplace's equation can be compounded from simple uniform undulatory disturbances, and it was suggested that this analysis might furnish the explanation of the propagation of gravity.—Photographs of Perrine's Comet, taken at Greenwich, &c., were shown on the screen. On one of the Greenwich photographs, no less than seven tails were shown, one of them a degree in length.—A paper by Dr. Max Wolf on stereoscopic pictures of Perrine's Comet was read, and the photographs exhibited.—The secretary read papers by Mr. Percival Lowell on an expedition to determine the best situation for an observatory and on a proposed standard scale of "seeing."—Mr. H. C. Plummer gave a short account of his second paper on the images formed by a parabolic mirror.—Other papers were taken as read.

Geological Society, November 5.—Prof. Charles Lapworth, F.R.S., president, in the chair.—The secretary read a communication, transmitted by the Rt. Hon. the Secretary of State for the Colonies, from Mr. H. Powell, Curator, Botanic Station, St. Vincent, to Dr. D. Morris, C.M.G., Imperial Commissioner of Agriculture for the West Indies, referring to the eruption of the Soufrière on September 3 and 4. At 3 p.m. on September 3, the corrected barometrical reading was 29·947, and the attached thermometer 85° F. Mr. Powell was informed that during the day a lot of matter was ejected over the western lip of the old crater down the Laricor or Roseau Valley to the sea. At 9.55 p.m., as seen at the Botanic Station, the eruption commenced in earnest; flashes of flame and lightning were visible over the Soufrière at intervals of twenty to thirty seconds, with frequent longer intervals. At 10.30 p.m., the corrected reading of the mercurial barometer was 30·105 and the attached thermometer 81°·5 F. From about this hour, the discharges and accompanying noises increased in frequency and severity, and at 1.30 a.m. (September 4) the Soufrière was in full eruption. From this hour to 2 a.m., the eruption was more severe than on May 7, the explosions seeming to be louder and more continuous, and the electric discharges, owing, doubtless, to its being night, immeasurably grander and more awe-inspiring. At 2 a.m., the corrected barometrical reading was 30·045 and the temperature 81° F., and at 3 a.m. the corrected reading was 30·035. The marvellous electric display was checked by a heavy shower from the east, and the roar was correspondingly lessened. From about 1.30 a.m., a cloud black as gunpowder was seen advancing southward from the Soufrière, and at 2.30 this cloud had assumed a circular form and was overhead of the Botanic Station. The discharges from this cloud and to northward were exceedingly numerous and severe, and the appearance generally was as though myriads of long, fiery serpents were darting hither and thither, and a constant crackling noise was heard, in addition to the roar of the volcano. The chief disturbances seemed to be west of the Soufrière, in the direction of Martinique; and the writer is strongly of opinion, from observations at the time, that Mont Pelée and the Soufrière were in action together, but so far no news has come from Martinique. At 3 a.m. (September 4), the discharges and roar to the west nearly subsided, and the Soufrière alone seemed in action, but more on the windward side. From 3 to 4 a.m., the eruption gradually slackened, and at the latter hour had nearly ceased. The next morning, the barometer was normal at 29·950.—A second communication (also received through the Secretary of State for the Colonies) was read, dated Grenada, September 23, from Sir R. B. Llewelyn, Governor of the Windward Islands, expressing the hope that some scientific observers might be induced to go out to the West Indies and settle there for some time, in order to accumulate information as to volcanic and kindred phenomena.—The fossil flora of the Cumberland coalfield, and the palæobotanical evidence with regard to the age of the beds, by Mr. E. A. Newell Arber. The succession of Upper Carboniferous rocks in the region in question is apparently twofold—an arenaceous series, 600 feet thick, consisting of massive sandstones alternating with shales and fireclays, overlying argillaceous and carbonaceous deposits, the latter forming the productive portion of the coalfield and containing three great coal-seams, traceable throughout the district. The Upper or Sandstone series has yielded very few plant-remains from its upper division, but from the lower division a long list of plants is given. A consideration of the palæobotanical evidence has led to a reclassification of the rocks.—Some remarks upon Mr. E. A. Newell Arber's communication: on the Clarke collection of fossil plants from New South Wales, by Dr. F. Kurtz. Agreement was expressed with Mr. Arber's identification of *Rhiptozamites Goepperti*, which was taken to be a synonym of *Noeggerathiopsis Hislopi*. *Podozamites elongatus*, however, was regarded as different from *Noeggerathiopsis Hislopi*. It was not considered that there is sufficient evidence to warrant the separation of *Otopteris ovata* from *Rhacopteris inaequilatera*, in which species it may be retained, perhaps as a variety. *Rh. inaequilatera*

has been found in the Argentine, and has been described by Geinitz as *Otopteris argentina*.—On a new boring at Caythorpe (Lincolnshire), by Mr. Henry Preston. This boring, after piercing Northampton Sands, passed through 199 feet of Upper Lias, 19 feet of Marlstone, and into the Middle Liassic Clays. With the aid of other shallow wells in the Lincolnshire Limestone, this rock is shown to have a decided dip to the west down the face of the escarpment, as though it had settled down upon the eroded surface of the Upper Liassic Clay. This settlement is probably the cause of a continuous spring flowing from the junction, and it has given rise to an underestimate of the thickness of the Upper Lias.

Linnean Society, November 6.—Prof. S. H. Vines, F.R.S., president, in the chair.—Mr. H. J. Elwes, F.R.S., gave a lecture, illustrated by a specially prepared map and lantern slides, entitled "Notes of a Natural History Journey in Chile," which he performed in the winter of 1901-02, spending five months on the trip. The lecturer confined his remarks to the country which has only recently become accessible, between Mulchen and Puerto Montt. From Buenos Ayres to Santiago is a three days' railway journey, broken by the Andine pass between Puente del Inca and Salto de Soldado, which has to be performed on mules. It was evident that the forests which cover the mountains and extend into the plain had never clothed the outer valleys, though a six hours' ride into the mountains will bring the traveller to abundant groves of the Chilian "cypress," *Libocedrus chilensis*. The most striking plant is *Puya coerulea*. The lecturer visited the beautiful gardens of the late Madame Cousino at Lota; on the hill-sides, large plantations of the Californian *Pinus insignis* are rapidly changing the aspect of the country. Nothing is more striking in the central valley of Chile tranversed by the railway than the wonderful growth of introduced trees, which oust the natives. Lombardy poplars form avenues along the country roads; European oaks, thistles and introduced conifers give the aspect of Italy rather than of South America. This region may rival California as a fruit-producing country. The Agricultural College at Santiago is excellently found, its equipment surpassing anything in England. The lecturer visited the Baths of Chillan, at an elevation of about 6000 feet, where many plants and insects were collected; here the beech forests clothe the mountains, and here also a considerable quantity of the curious orchid Chloræa was obtained with some difficulty. The long fleshy roots were deeply buried in sand and stones amid the bushes and bamboo, *Chusquea andina*; those plants sent to Kew from Concepcion are growing fairly well. At Lolco, a farm on the Bio-bio river, may alpine plants were found. From Los Arcos past Lago Alumine to the Quillen river, few birds were noted, and mammals were very scarce. The extraordinary configuration of the rocks was mentioned. Early in February, the weather broke and several wet days ensued. San Martin is described as very beautifully situated, and will probably hereafter be much resorted to by visitors. The edge of the great Patagonian pampa was reached where the river Limay issues from the Nahuel-Huapi lake; from Puerto Blest to Puerto Montt, an easy track is now available, past the shores of Lago Frio, where *Fitzroya patagonica* was noted; from this lake, a magnificent view of Tronador volcano was obtained, the glaciers of which on the west side descend to about 2000 feet near Casapanque; avalanches were constantly falling from the mountain's precipices, with a noise which gave rise to its name. Here were beech trees, and a growth of *Gunnera chilensis* on the débris brought by the glacier, which was found to be of extreme interest. Lago Todos Santos is buried in forest.

MANCHESTER.

Literary and Philosophical Society, November 18.—Mr. Charles Bailey, president, in the chair.—A paper by Mr. Lionel Adams on a contribution to our knowledge of the mole (*Talpa Europaea*) was communicated by Mr. W. E. Hoyle. The writer, who has been studying the mole for the last four years in the neighbourhood of Stafford, called attention to the singular neglect of this interesting species by naturalists since the time of Le Court (the well-known scientific mole catcher) and Geoffroy Saint-Hilaire at the beginning of the last century, the statements of these observers having been accepted by subsequent writers—with trifling exceptions—without any attempt at verification. The mole has been credited with making its "fortress" on a uniform plan, with exactly the same number of galleries and runs communicating with the nest in precisely the same way, but the writer pointed out that, though he had dissected more than 300 fortresses, he had never found two alike or a single one corresponding to the time-honoured figure in the text-books. His observations showed that the tunnels in the interior of the fortress are not contrived as a means of escape from enemies, but are merely formed incidentally in the process of excavation and in piling up the superincumbent mound. There is, however, one exception to this, viz. the "boltrun," which is a tunnel leading out of the bottom of the nest. The conclusion was also arrived at that, though the mole is not actually blind, its power of vision is extremely limited and it finds its prey by scent alone. Instances were given of the mole eating the eggs of pheasants and partridges, after having undermined the nests, a fact which had hitherto escaped notice.—Mr. F. F. Laidlaw read a paper on some new species of marine planarians from Torres Strait and the Pacific.

PARIS.

Academy of Sciences, November 17.—M. Albert Gaudry in the chair.—On the impurities in compressed oxygen, and on their effect on combustions carried out in the calorimetric bomb, by M. Berthelot. Commercial compressed oxygen appears to be made in three ways, from barium peroxide, peroxide of manganese together with an alkaline hydrate and by the electrolysis of water. Samples of gas prepared in these three ways were examined for oxides of carbon, hydrogen and hydrocarbons, with the result that the amounts of these impurities were found to be too small to have any effect on the use of the gas for calorimetric determinations, and even when used for the estimation of carbon and hydrogen no error is introduced except in the case of the oxygen prepared electrolytically, when an appreciable amount of hydrogen may be present for which a correction is necessary.—On the recent publications of the Observatory of Paris: "Stellar Catalogue," part iv.; "Photographic Catalogue," vol. i.; *Annales*, Observations of 1898; *Memoires* (23); and *Bulletin* of the International Committee (3), by M. Lœwy.—On the determination of the exact position of a mercury meniscus illuminated by a bundle of horizontal rays, by M. G. Lippmann. The difficulties of determining the exact position of a mercury surface are well known, and various devices have been suggested for overcoming them. The method suggested by the author is to illuminate the surface of the mercury by a bundle of horizontal light rays, formed by a collimator placed approximately in a line with the reading telescope. The outline of the mercury meniscus is then seen as a perfectly sharp line, and good observations can be made with a microscope furnished with a micrometer eyepiece. The extreme variation of a set of ten observations carried out in this way was 0·005 mm., with a mean error of about 0·0025 mm.—A simplification of Foucault's pendulum, by M. d'Arsonval. The form described was designed by M. Cannivel, and is noteworthy for its simplicity and cheapness.—The localisation of normal arsenic in some organs of animals and plants, by M. Armand Gautier. The author has applied the methods previously described by him to the examination of the feathers of birds, some marine and freshwater algæ, coal, sea-water and rocks. The conclusion is drawn that arsenic appears to be as widely spread as nitrogen and phosphorus. It is invariably found, although in small proportion, in primitive rocks, soil, sea-water, plants, especially in algæ, and in terrestrial and marine animals. In the latter, it is especially localised in those organs of ectodermic origin which are concerned with sensation and reproduction.—On the specific differences between the two diseases *Nagana* and *Mal de Caderas*, by MM. A. Laveran and F. Mesnil. These two diseases have many points of resemblance, but on close examination prove to be two specifically distinct diseases.—Effect of the excision of the madreporite in starfish, by M. V. Delage.—On the law of pressures in cannon, by M. E. Vallier.—On the analogy between the X-rays and the Hertzian oscillations, by M. P. Duhem.—On the recent sunset glows at Bordeaux, by M. E. Esclangon. The facts observed do not fit in with the hypothesis of cosmic dust either of terrestrial or extra-terrestrial origin. The effects produced can be better explained by the assumption of the production of finely divided ice particles in the upper regions of the atmosphere; the sudden disappearance of the phenomenon was found to correspond with a sudden rise of temperature.—On the approximate representation of functions, by M. W. Stekloff.—On the structure of finite groups, by M. E. Cartan.—On bipolar electrodes, by MM. Andre Brochet and C. L.

Barillet.—On the time constant characteristic of the disappearance of the radio-activity induced by radium in a closed space, by M. P. Curie.—On atmospheric hydrogen, by M. A. Leduc. Confirmation of the view recently expressed by Lord Rayleigh that the actual amount of hydrogen free in the atmosphere is only about one-sixth to one-eighth that given by M. Gautier.—On the oxalomolybdites, by M. Bailhache.—Some remarks on musculamine, a base derived from muscles, by M. S. Posternak. The base recently described by MM Étard and Vila, and which they isolated from the products of hydrolysis of the muscle of veal, appears from its properties and analysis to be identical with cadaverine, pentamethylenediamine, and hence is not a triamine as supposed by MM. Étard and Vila. It would, however appear to be the first example of the direct formation of cadaverine by the hydrolysis of an albuminoid by means of acids.—On the variation in the reserve hydrocarbons in the stem and root of ligneous plants, by M. Leclerc du Sablon.—*Landolphia Pierrei* considered as a source of caoutchouc, by M. Henri Hua.—The influence of organic materials on the development and anatomical structure of some phanerogams, by M. Jules Laurent. The author has shown in previous publications that certain organic materials, such as glucose, saccharose and inert sugar, form excellent food substances for green plants. These results are now extended to glycerol and humic acid.—The analogy between the Carpathians and the Alps, by M. Maurice Lugeon.—The electrolysis of metallic salts in the tissues, by M. André Poëy.—An apparatus for determining the duration of luminous impressions on the retina, by M. Maurice Dupont. The apparatus described has been applied to the determination of the duration of the persistence of images on the retina, under normal conditions and in pathological cases.—The production of sleep and of general anæsthesia by electric currents, by M. S. Leduc. The production of sleep and of general anæsthesia in animals by means of electric currents has been described in a previous paper, but the method gave rise to some pain at the commencement; by introducing into the circuit a rheostat without self-induction, and taking from three to five minutes to attain the full intensity of the current, these inconveniences can be removed.—The reproduction of an unlimited number of phonograms in wax for phonographic museums, by M. L. Azoulay.—The production of fixed colours on all kinds of leather by the use of salts of molybdenum combined with tanning materials, by M. Emm. Pozzi-Escot.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 27.

ROYAL SOCIETY, at 4.30.—Experiments on the Effect of Mineral Starvation on the Parasitism of the Uredine Fungus *Puccinia dispersa* on Species of Bromus: Prof. H. M. Ward, F.R.S.—Note upon Descending Intrinsic Spinal Tracts in the Mammalian Cord: Prof. C. S. Sherrington, F.R.S., and Dr. E. E. Laslett.—The Inter-relationship of Variola and Vaccinia: Dr. S. Monckton Copeman.—The Colour-Physiology of Higher Crustacea: F. Keeble and Dr. F. W. Gamble.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—On Electrons: Sir Oliver Lodge, F.R.S.

FRIDAY, NOVEMBER 28.

PHYSICAL SOCIETY, at 5.—A Slide-Rule for Powers of Numbers: Prof. J. Perry, F.R.S.—A Lecture Experiment to determine the Value of the Mechanical Equivalent of Heat: Prof. Callendar, F.R.S.—A Portable Capillary Electrometer: S. W. J. Smith.

MONDAY, DECEMBER 1.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Influence of Impurities on the Specific Gravity of Sulphuric Acid: Arthur Marshall.—The Interaction of Sulphurous and Nitrous Acids as affecting various Absorbents employed in Testing the Gases escaping from Vitriol Chambers: R. Forbes Carpenter and J. E. Linder.—Note on the Determination of the Strength of Sulphuric Acid: Arthur Marshall.

VICTORIA INSTITUTE, at 4.30.—The Babylonian Story of the Creation: Dr. T. G. Pinches.

SOCIETY OF ARTS, at 8.—The Future of Coal Gas and Allied Illuminants: Prof. Vivian B. Lewes.

TUESDAY, DECEMBER 2.

INSTITUTION OF CIVIL ENGINEERS, at 8.—High-Speed Electrical Generating Plant: T. H. Minshall.

ZOOLOGICAL SOCIETY, at 8.30.—Features of Animal Life in Southern Mexico: Dr. Hans Gadow, F.R.S.—On the Variation of the Elk: Dr. Einar Lönnberg.—On the Crustacea collected during the "Skeat Expedition" to the Malay Peninsula. Part II.: W. F. Lanchester.

WEDNESDAY, DECEMBER 3.

SOCIETY OF ARTS, at 8.—Some Aspects of Photographic Development: Alfred Watkins.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.

GEOLOGICAL SOCIETY, at 8.—On some Suffolk Well-Sections: W. Whitaker, F.R.S.—The Cellular Magnesian Limestone of Durham: George Abbott.

THURSDAY, DECEMBER 4.

ROYAL SOCIETY, at 4.30.—*Probable papers*:—(1) On the "Blaze-Currents" of the Incubated Hen's Egg; On the "Blaze-Currents" of the Crystalline Lens: Dr. A. D. Waller, F.R.S.—A Contribution to the Question of "Blaze-Currents": Dr. A. Durig.—On the Similarity of the Short Period Variation over Large Areas: Sir Norman Lockyer, F.R.S., and Dr. W. J. S. Lockyer.—Isomeric Change in Benzene Derivatives. The Interchange of Halogen and Hydroxyl in Benzenediazonium Hydroxides: Dr. K. Orton.—On the Vibrations and Stability of a Gravitating Planet: J. H. Jeans.

LINNEAN SOCIETY, at 8.—New and rare Corals from Funafuti: G. C. Bourne.—On the Morphology of the Flowers and Fruits of the Xylosteum Section of Lonicera: E. A. Newell Arber.—Note on *Carex Tolomiei*, Boott: B. Clarke, F.R.S.—New and old Phalangidæ from the Indian Peninsula: C. With.

RÖNTGEN SOCIETY, at 8.30.—An Observation bearing upon the Therapeutic Action of the Focus Tube: Dr. D. Walsh.—X-Rays in Ophthalmic Work: Stephen Mayou.—Mr. Isenthal will show the Nodon Electric Valve for converting Alternating into Continuous Current.

CHEMICAL SOCIETY, at 8.—The Absorption Spectra of Metallic Nitrates. Part II.: W. N. Hartley.—The Specific Heats of Liquids: H. Crompton.—(1) Studies in the Camphane Series. Part X. The Constitution of Enolic Benzoylcamphor; (2) Note on the Isomeric Benzoyl Derivatives from Isonitrosocamphor: M. O. Forster.—The Constitution of the Products of Nitration of Meta-acetoluidide: J. B. Cohen and H. D. Dakin.

AËRONAUTICAL SOCIETY, at 8.—Presidential Address. Recent Aëronautical Progress: Major B. F. S. Baden-Powell.—The Contributions of Balloon Investigations to Meteorology: Dr. W. N. Shaw, F.R.S.—The Kite Equipment of the Scottish National Antarctic Expedition: John Anderson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Extra Meeting for the Inaugural Address by the President, Mr. J. Swinburne.

FRIDAY, DECEMBER 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Erection of Steel Bridges, Sheffield Extension of the London and North-Western Railway: A. Reynolds.

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