THURSDAY, APRIL 13, 1882

THE COINS OF THE JEWS

The International Numismata Orientalia. Vol. ii. *Coins of the Jews.* By Frederic W. Madden, M.R.A.S. (London: Trübner and Co., 1881.)

THIS goodly quarto of nearly 350 pages, illustrated by 279 woodcuts, forms the second volume of the International Numismata Orientalia, which has been for some time in course of publication under, we believe, the chief editorship of Mr. Edward Thomas. The work now before us may be regarded as being virtually a second edition of Mr. Madden's "History of Jewish Coinage and of Money in the Old and New Testaments," which was published in 1864; but in many respects the book has been so much enlarged, and we venture to think improved, that it may almost take rank as a new work. Any summary of the strictly numismatic details of such a publication would be out of place in the pages of NATURE, but the public interest in all modern researches in the Holy Land, such as those carried on under the Palestine Exploration Fund, and the success that has attended the foundation of the Society of Biblical Archæology, prove the strong hold which, in this, and indeed in all Christian countries, the cradle of our religion retains.

Of contemporary witnesses of history, coins are among the best, but since the days of Bayer, the Archdeacon of Valentia, who wrote "De Nummis Hebræo-Samaritanis" just a century ago, there was a lull in the study of this branch of numismatics until within the last thirty years, when the labours of De Sauloy, Cavedoni, Levy, Von Werlhof, Reichardt, Madden, Garrucci, Merzbacher, and others began. The results of these labours, incorporated in Mr. Madden's present work, contrast strangely with Pinkerton's estimation of the Jewish coinage, as expressed in his Essay on Medals, which for many years was almost the only work of the kind accessible in English. The first edition appeared in 1784, but even in the third edition of 1808 we read:—

"The Hebrew shekels—which are of silver—and brass coins with Samaritan characters would have been put before, were not, most of them, later than the Christian æra, and generally the fabrication of modern Jews. At any rate the same impression of a sprig on one side and a vase on the other runs through all the coins of that barbarous nation; and the admission of but one of them is rightly esteemed to be almost a disgrace to a cabinet."

Certainly so far as art is concerned, the best and earliest of the Jewish coins compare unfavourably with those of the contemporary Seleucid rulers in Syria. For it must not be imagined that the Jewish shekel, notwithstanding its frequent mention in Scripture, was at any time an actual piece of coined money before the days of the Maccabees—or at the earliest, the time of Alexander the Great and the high priest Jaddua. If we accept the views of Dr. Merzbacher, who is probably the most competent judge in this matter, the earliest of the Jewish shekels were not struck until B.C. 141-140, when those dated ש״א, the year one, were coined. These pieces are of silver, about the size of our shillings, and fully twice as thick, and range in date from the year 1 to 5. Half shekels are known up to the year 4. The devices on the shekels are, on the one side, a cup or chalice, with the legend שקל ישראל, *Shekel Israel;* and on the other, what has been termed Aaron's rod, but what more resembles three lilies on one stem, and the legend *Jerusalem the Holy.* It is a curious circumstance, that on the coins of the first year, Jerusalem is spelt without a *yod,* and Holy is without the article and without the *vav,* ירשלם קדשה, *Jerushalem kedoshah;* while on the later coins the legend is always ירושלים הקדושה, *Jerushalaim ha-kedoshah.*

Besides the silver coins, there is a copper coinage inscribed with "the year four," but it seems somewhat doubtful whether it belongs to the same period as the shekels bearing the same date. Possibly future finds of coins with the shekels and other pieces either Jewish or foreign intermixed may settle the question not only of contemporaneity, but of actual date. The fact of the coins of the fourth year bearing upon them the legend, "The redemption of Zion," as well as the shape of some of the letters, points to these coins belonging to a later date than the shekels. At the same time the fabric looks as if they were of earlier date than the coins of the revolts, shortly to be mentioned.

Of John Hyrcanus, Judas Aristobulus, and Alexander Jannæus there are numerous copper coins of undoubted attribution. The Herods and Agrippas are also well represented; but among the most interesting, and at the same time perplexing coins of the series are those which were struck under the revolts against the Roman power, from A.D. 66 to 70, under Vespasian, and again under Hadrian, from A.D. 132 to 135. Without entering into any details with regard to these coins, it may be worth while to mention some of the devices upon them and to add a few words as to their palæographical bearing. Although portraits occur on coins of some of the Idumæan princes, the representation of any living creature is carefully avoided on all the more purely Jewish pieces. A favourite device is the palm tree, like which "the righteous shall flourish"; though this was also a common device on coins of Carthage. The *lulab,* or bunch of "branches of goodly trees," and the *ethrog,* or citron, such as were carried at the Feast of Tabernacles, also make their appearance on the coins. The vine leaf and the bunch of grapes, probably typical of "the vineyard of the Lord of hosts, being the house of Israel, and the men of Judah his pleasant plant," are often represented. The flagons and cups, and the lyres or "stringed instruments" and trumpets, are probably symbolical of the Temple worship; and on some of the shekels of the revolts we find a gateway which not improbably represents the Beautiful Gate of the Temple.

From a palæographical point of view the Jewish coinage is of great value as definitely fixing the ordinary forms of certain letters at given dates. This part of the subject is well illustrated by a folding plate comprising some thirty alphabets, from the ninth century B.C. to the tenth century after the Christian era. To these is prefixed an alphabet selected from Egyptian hieratic characters, from which M. François Lenormant and others have maintained that the early Phœnician alphabet was derived. Such a derivation appears to us at the best problematical; but it would be too much of a digression here to enter into the question. It is more to the purpose to note that while there is in the main a close correspondence between the letters on the early shekels and those on the Moabite stone, and on the inscription of Esmunazar, there is in the case of some letters on the copper coins of the Asmonæan family, which are regarded as being but a few years later in date, a marked divergence. This is notably the case with the letters ה, ו, and ש; and singularly enough these three letters revert to the forms employed on the silver shekels on some of the coins struck during the revolts, though the position of the letters is in some cases changed. Possibly the modification in the characters is due to their being so much smaller on the copper coins than on the silver. The persistence of the Phœnician or, as it may here be called, the Jewish or Samaritan character, is well exemplified by the legend on the shekel. It is of course retrograde, or to be read from right to left. The legend stands ∠F٩WN ∠PW, but when reversed, and the position of some of the characters slightly altered, it comes out as ΣPL ΊΣPΛL, in which SQL ISRAL can at once be seen, especially by eyes to which the Greek Σ and P are familiar.

Any notice of Mr. Madden's book would be incomplete without some reference to the Roman coins struck in commemoration of the Conquest of Judæa, of which excellent woodcuts are given. "Beneath her palm here sad Judæa weeps," while the captive warrior with his hands bound behind him, and his armour strewn upon the ground admirably typifies "How are the mighty fallen, and the weapons of war perished!" The sections devoted to money in the New Testament and to counterfeit Jewish coins will be read by many with interest, while the opening chapters on the early use of silver and gold, and on the invention of coined money, contain an excellent summary of our present knowledge. To the numismatist a work like the present is of special value, but we think that the ordinary student who neither knows nor cares in the smallest degree for coins as tangible objects for study or collection, will find much to reward him for a perusal of the non-numismatic parts of the volume, while to the theologian, and especially to the student of Jewish history, much of the information here contained is almost indispensable.

JOHN EVANS

THOMPSON'S LESSONS IN ELECTRICITY

Elementary Lessons in Electricity and Magnetism. By Silvanus P. Thompson, B.A., D.Sc., F.R.A.S., Professor of Experimental Physics in University College, Bristol. (London: Macmillan and Co., 1881.)

WE are glad to welcome a really admirable attempt to place before students the modern doctrines concerning electricity and magnetism in a popular but reasonably accurate form. The book begins with a rapid historical sketch of the long known facts on which it is the custom to dilate in every elementary text-book on electricity; but the historical statements indicate by little additional details that they have not been simply copied from the joint-stock property of text-book writers, but that some original authorities have been referred to. This portion of the book occupies the first 190 pages, and it does not call for special remark; the illustrations are, as a rule, familiar ones, but there is a very convenient magnetic map of England for 1888 as a frontispiece; and everything relating to the use of iron filings is well and clearly put, as would naturally be expected. The author's statements of the well-worn facts are moreover interspersed with notes and characteristic touches which redeem them from dulness.

The second half of the book commences in Chap. IV. with the principle of electrostatic measurement and the definition of potential, which the author proceeds to apply to various cases; and he succeeds in giving the theory of attracted disk electrometers and of the capacity of condensers in a way which it is very satisfactory to find in so small a book. It is in the possession of this more strictly scientific information that the book differs from its predecessors in the same line, and we think the author has shown much ingenuity in contriving to pack into so small a compass not only all the ordinary popularly known facts, but also a considerable amount of more advanced science, which will be most acceptable to teachers and to students, who have long been accustomed to a great gap between mere experimental treatises on the one hand, and advanced mathematics on the other.

After the chapter on Electrostatics comes one on Electrodynamics and Magnetic Measurements, which is very well done, though necessarily too concise to be in all parts readily intelligible to a beginner. It contains a reference to Rowland's convection experiment and to Hall's effect. The chapter which follows, on Ohm's law, is perhaps the least satisfactory in the book. We are not satisfied with the statement of Ohm's law, nor with what is said concerning the meaning and measurement of resistance. Towards the end of the book comes a brief account of the Siemens' and Gramme machines, of Planté cells, of telegraphs, telephones, and the electric light. There is also a chapter on "Electro-Optics," which refers to Dr. Kerr's discoveries and to Maxwell's theory of light.

If it is necessary to say anything by way of general criticism, it is that the author sometimes shows a disposition to theorise a little too baldly, and to state without qualification, and with an air of certainty and completeness, views concerning the nature of electricity, which, though undoubtedly they have some truth in them, *i.e.* which certainly are steps towards the truth, yet have no finality about them, and which require to be cautiously worded and expressed lest they should mislead. For instance, his statements in the preface that "electricity is not *two* but *one*"; that, "whatever it is, it is not *matter* and not *energy*"; that "it may be heaped up in some places and will do work in returning to its former level distribution," are all, considered strictly, unjustifiable dogmas of the kind we have mentioned. A student ought to be puzzled by the unqualified statement "that more electricity can be made to appear at one place and less at another" when he has learnt from Maxwell that it always behaves exactly like an incompressible fluid of which all space is completely full. Neither are we altogether disposed to approve of the phrase "Conservation of Electricity," by which the author seems to set much store.

However, all these doctrines are immense improvements on the old forms of the fluid theory, and, being steps towards truth, will probably do far more good than harm. We are fully impressed with the necessity in teaching of getting *some* ideas into the heads of the students to begin with, and of polishing them up as much as possible afterwards.

On the whole, then, while we have not been able to find any statement which is certainly and distinctly wrong, we find a very great deal which is not only certainly and distinctly right but which is also exactly that concerning which a real student desires, but has hitherto been unable to obtain, information; and the whole is well and clearly written. We cannot therefore too strongly recommend teachers to adopt it at once as their text-book. O. J. L.

OUR BOOK SHELF

The Tea Industry in India; a Review of Finance and Labour, and a Guide for Capitalists and Assistants. By Samuel Baildon, author of "Tea in Assam," &c. (London: W. H. Allen and Co., 1882.)

THE history of the discovery and introduction of what is generally known as Chinese tea, though often told, has a special interest to a very large proportion of the inhabitants of the civilised world. In every country, indeed, on the face of the globe, the people use some beverage which they know as tea, and which is prepared in a similar way to that in use amongst ourselves, namely, by infusion, and often, though made from the foliage of indigenous plants, having the same chemical properties as true tea. Considering the enormous money value the cultivation of the tea plant represents not only in this country, but in China and also in India, where it is continually extending, it follows that works on this special industry would meet with a wide circulation amongst planters, and managers and directors of tea companies, notwithstanding that books and papers on the subject are by no means scarce.

The work before us is one which, though containing a a good deal of information on the practical working and financial aspects of tea planting is, moreover, written in a style that will be generally acceptable, especially among young planters, who have their way to make in the planting world, and who want the dry details or drudgery of a planter's routine of toil stated in a clear and at the same time easy manner.

We will not follow Mr. Baildon through all his chapters. A glance at the introduction will prove that his reason for writing the book has been to show that India is *the* country from whence we get the finest teas, and that it is also the country where we may look in future years for the bulk of our supply, holding out inducements, as many districts do, for the investment of capital and the application of bodily health and talent. In Chapter II., on "India the Home of the Tea Plant," quotations are largely made from the published works of well-known botanical authorities, to show that though cultivated from such a remote period in China that the plant is truly indigenous to India. The legends connected with the origin or discovery of the tea plant in China are told, one of which refers its discovery to the year of grace 510. The author points out that these legends do not prove that tea was discovered in a wild state in China. "The earliest mention," he says, "tells of people using it, and it may be inferred therefrom that they cultivated it. Precise and accurate information is obtainable as to the actual discovery of tea in Assam, *away* from habitations and in dense jungles far from 'cultivated grounds.' But similar information is not obtainable in connection with the first days of tea amongst the Chinese."

Referring to the altered character of certain districts in India now under tea cultivation, Mr. Baildon says, "Where once jungle and its deadly miasma concealed the riches and importance of the province, hundreds of thousands of acres of open land are now to be seen planted with tea. Compared with past times Assam is no longer a howling wilderness, and the change from hundreds of miles of waste into cultivated land has altered almost everything."

In proof of the superiority of Indian over China teas, the author advances many arguments and anecdotes of a powerful nature, which, however, may be summed up in the simple statement "that it is systematically used to fortify tea from China," and that there is only one case on record of anything approaching adulteration of Indian tea. It is stated that "every pound offered for sale in England can be guaranteed as absolutely pure," and this is its reputation with the trade. Mr. Baildon's statements on this head are, we believe, an honest record of facts, for it is well known that Indian teas are largely used in this country for mixing with inferior China teas. This system is well known as "blending," and is stated to be resorted to because the public taste has not yet become educated to the flavour of Indian teas alone. The English tea drinker, however, is rapidly assuming a taste for the Indian produce, and the demand for Indian tea is already very great.

On the question as to the kind of men likely to succeed as tea planters in India, Mr. Baildon has a great deal to say, and is very outspoken in what he does say. His estimate of a successful planter is evidently drawn from a thoroughly practical experience, and will no doubt serve to encourage some, as it will to discourage others.

The book has been carefully revised, and is unusually free from blunders, the author wisely omitting to go into the botanical character of the tea plants any more than a reference to the names under which the forms have been described.

A Treatise on the Theory of Determinants; with Graduated Sets of Exercises for Use in Colleges and Schools. By T. Muir, M.A., F.R.S.E. (London: Macmillan, 1882.)

THERE has been a tendency of late among some of our mathematical writers to specialise their labours; thus, Dr. C. Taylor has confined his work chiefly, if not mainly, to the geometry of conics; and our present author, to the subject of determinants. This is, we think, a good practice. Mr. Muir is no novice, and has done good work in this field, much of which is original. We have long desiderated some such work as this. Mr. Scott's is very able, but we cannot but think it is hard for junior students. Mr. Muir, we are disposed to believe, has made the introduction to the subject easier for this class, at the same time that he brings before the reader all that could be expected in a text-book. The work before us consists of three chapters, the two first of which do not err on the side of brevity; but this fulness serves a purpose, viz. "that the reader may become thoroughly familiarised with the definition," which, by the way, is too long for us to reproduce here. Though the enunciation is long, the idea is easily grasped, and when taken in connection with the illustrations, is not likely to give much trouble to the student to master it. These chapters, as indeed the remaining one also, are copiously illustrated by graduated exercises. The third chapter is much more condensed in style, and treats of determinants of special form, viz. continuants, alternants, symmetric determinants, Skew determinants, and Pfaffians, compound determinants, and determinants whose elements are differential coefficients of a set of functions, to wit Jacobians, Hessians, and Wronskians.

In a final chapter is given an interesting historical and Bibliographical Survey, from which the reader learns that contributions have been made to the subject from the publication of the germinal idea (long unfruitful) by Leibnitz in 1693, down to this present work. We may refer for further information to the chronological "List of Writings on Determinants" (1693-1880), published by Mr. Muir in the *Quarterly Journal of Mathematics* for October, 1881. This, the completest list we have seen, was to have formed part of the present work. Though we have carefully read the book through, with the exception of the exercises, we have detected but three or four typographical errors. There are appended "Results of the Exercises." We take leave of Mr. Muir with the hope that he may be soon called upon to revise his book, with a view to the issue of a second and succeeding editions.

Experimental Chemistry for Junior Students W. Emerson Reynolds. Part II. *Non-Metals*. (London: Longmans, Green and Co., 1882.)

THIS is a most excellent little book on experimental chemistry, and should be especially useful to medical students, for whom it is chiefly designed.

There is a very large amount of useful information and descriptions of experiments in clear, but not too commonplace language, to make a beginner using the book feel at any loss when he shall come to use a larger work. The experiments are numbered for reference, and are also in most cases explained by an equation in symbols.

The student who works through this book will certainly know something practical of chemistry, as it can scarcely be used as a cram book.

We notice that in some of the formulæ and equations the symbols are adorned with dashes, which it is to be hoped have been explained in the first part, otherwise they would be somewhat misleading, or at least confusing to students at the stage at which they commence to use the book.

LETTERS TO THE EDITOR

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

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

Vivisection

IN NATURE (vol. xxv. p. 482) there is a letter signed "Anna Kingsford," to which I feel compelled to reply. Not that I contemplate convincing your correspondent of her error, for I have only *facts* to offer; I write only for the unprejudiced portion of the English public, to protest with indignation against the calumnies regarding physiology and so-called vivisection, especially as practised here by Prof. Schiff.

The theoretical arguments for and against vivisection have been discussed to satiety; I wish to keep strictly to a question of facts, and the only passages in Mrs. Kingsford's letter against which I protest, are the words, "the *horrible tortures* perpetrated by Professors Schiff, Mantegazza, and Paul Bert"; "the atrocities of vivisection"; "the prolonged and exquisite torments to which domestic animals are subjected"; and other similar passages. In the first place, Mrs. Kingsford shows how ignorant she is of the subject she undertakes to enlighten the public upon, by mentioning Mantegazza as "a fair type" of a Continental vivisector, when the truth is that Mantegazza did long ago make some experiments on living animals, but has not done so for very many years, is, in fact, not a vivisector.

As I have not been in Prof. Paul Bert's laboratory, and have therefore not been an eye-witness of his methods, I will say nothing of the attack against him.

I now come to Prof. Schiff, who, of all living physiologists, is the one who carries out the most numerous experiments, and who may therefore fairly be taken as a typical representative of physiological research on the Continent. Having been for the last two years constantly in the learned professor's laboratory (and, I may add, in a perfectly independent position), I am able to give authoritative testimony as to his methods of study, and this testimony is, that *never* during this time was vivisection practised on a *feeling* animal; and I have repeatedly heard Prof. Schiff (whose word no one will dare to doubt) declare that he never in his life had operated on an animal that could feel pain—a fact which any one who knows this pre-eminently humane and kind man, will readily understand. I do not say that no vivisections are carried out; on the contrary, often several operations included under this comprehensive denomination are performed in one day, but *never* so as to cause pain. Either the animal is instantaneously killed by a puncture in the "medulla oblongata," and artificial respiration set up, or it is completely anæsthetised, and Prof. Schiff's first care is always to see that this has been properly done. The trial with the eyeball is a sure criterion. The anæsthetised animals are eventually killed in the same manner as the others, while still completely unconscious; few other dogs have such a painless death. In those cases where animals which have been operated on are kept alive for ulterior observations, the best proof that they do not suffer pain is the excellent appetite and healthy appearance of the dogs in the school of medicine here, where they are, moreover, excellently well-housed and fed, for Prof. Schiff says: "I like my dogs to be well cared for in every way." So much for the "horrible tortures" perpetrated on the continent.

I may be allowed to repeat a few words fallen from Prof. Schiff's mouth as characteristic of the man. On one occasion I heard him say: "I cannot bear the least pain being inflicted on animals;" on another, seeing me petting a dog which was to be experimented upon, he said: "one must never caress a dog before an operation, for otherwise, although one knows it feels no pain, one's hand is not steady for cutting."

It is true that there do exist experiments in which the animal must retain consciousness in order that the effects may be watched; but just because the animal would suffer pain, *these experiments are never carried out by Prof. Schiff.*

Prof. Schiff has repeatedly invited his calumniators (both publicly and privately) to come to his laboratory, which is open at every hour of the day to all who wish to form an unbiased opinion on the methods of vivisection, and to see with their own eyes the real facts of the case; not one has ever accepted this invitation—which shows how deep the love of truth is in some hearts.

B.SC., STUDENT OF MEDICINE

Geneva, April 6

Precious Coral

I WAS very much interested in Prof. Moseley's note on "Precious Coral," which appeared in NATURE (vol. xxv. p. 510). During, or rather after our deep-sea explorations in the Mediterranean, last summer, the *Washington* passed a week exploring the coral-yielding banks between Sicily and Cape Bon (Africa); we were also therefore on the coral-banks of Sciacea. Most of the coral I saw—I mean, of course, precious coral—was dead and blackened, and I saw large quantities in the same state, and from the same locality at Naples. At the extreme edge of the Sciacea bank is the extinct volcano, now covered with a few fathoms of water, known as Ferdinandea or Graham's Island. I believe that the eruption of that volcano may explain the quantities of dead coral around. As to the black colour, I am of opinion that it may be due to the decomposition of organic matter, rather than to the presence of binoxide of manganese; some of the bottom samples which I collected at various depths, turned quite black after a few weeks. The disappearance of the black colour on prolonged exposure to the sun, would, I believe, confirm my view. It must also be borne in mind that precious coral, in the Mediterranean at least, never is found in mud or in muddy waters, but grows mostly on a regular coral-rock formed by Madrepora of different species.

I have often heard of Japanese coral, and saw some fine samples at the International Fishery Exhibition of Berlin, in 1880; they came from Okinava, or Kotshi, where, in 1877, a quantity of the value of 9000 dollars was collected. It is this species which has been called *Corallium secundum* by Prof. Dana, if I am not mistaken.

A third species or variety of precious coral is found near the Cape de Verd Islands, especially San Jago; it has been distinguished by Prof. Targioni as *C. lubrani*.

As a *finale*, I may add that very little precious coral is found off Torre del Greco, from which place most of the coral fishermen hail, and in which place much of the coral collected is worked.

HENRY HILLYER GIGLIOLI

R. Istituto di Studi Superiori in Firenze, April 6

Phenological Observations on Early Flowers and Winter Temperatures

THE relation of temperature to the earliness of the season is too obvious to be overlooked, but methods of representing it numerically are of considerable interest. Since 1878 this has been done for about thirty stations in the United Kingdom by observations on the first appearance of a selected series of thirty flowers. The results have been published in tabular form in the *Natural History Journal*. Thus the means for all the 900 observations (thirty plants at thirty stations) give an accurate comparison of the relative flowerings in different seasons. The values for the four years (1878-81), reckoning in days from January 1, are 93, 115, 103, and 111, respectively, giving a mean date of 105·3. It will be seen that, when such observations have been conducted over a sufficient period, important values can be deduced as to the relation between the mean temperature and the mean date of flowering; that is, between temperature and vegetable growth. The comparison ought, probably, to be made with the mean temperature of the six months from December to May, the flowers having been chosen so as to be all out by or near the close of the latter month.

That December (if not November) should be brought in will be apparent from the comparison of warmth and flowers in the following table:—Here the *total number of flowers found in bloom* is compared with the mean temperature for the *four, three,* and *two* preceding months. The flower observations were made in the Christmas holidays, at Street, Somerset, chiefly by myself; a few, however, were by friends at Bridgwater twelve miles to the west. The periods were, for the four weeks beginning about December 15; but began a week later, and lasted only three weeks, in 1879-80 and 1880-81. For these years, therefore, an addition has been made of about one-ninth of the number actually seen (31 and 82); as comparison with other years shows that to be the proportion added in the fourth week. Again, in the first season, 1876-7, only 20 flowers were seen at Street, for I then had no idea of the numbers to be found by a little searching. The correction is made by comparison with Sidcot, in the Mendips, eighteen miles N.E., where for the four seasons, 1877 to 1880, respectively, 59, 62, 16, and 13 wild flowers were noted in January. Possibly, more experience would have slightly enlarged the garden list.

The *temperatures* are supplied by Wm. S. Clark, whose observations go back over twenty-five years.

Season. Dec. to Jan.	Weeks.	Flowers.			Mean temperature.							
		Garden (kinds).	Wild species.	Total.	In the weeks of observation.	Sept.	Oct.	Nov.	Dec.	In the preceding 4 mos	3 mos	2 mos
1876-77	4	67	20	120	42·3	57·7	53·6	43·1	43·3	49·4	46·7	43·2
1877-78	4	80	55	135 [1]	39·8	52·2	48·8	45·4	40·3	46·7	44·8	42·8
1878-79	4	20	8	28	33·0	57·7	51·7	38·6	31·4	44·9	40·6	35·0
1879-80	3	21	10	34 [2]	45·6	56·4	50·4	39·3	31·0	44·4	40·2	35·2
1880-81	3	45	29	82 [2]	37·3	59·9	45·0	42·5	43·4	47·8	43·6	43·0
1881-82	4	101	88	183 [3]	41·0	55·5	46·1	49·0	40·2	47·7	45·1	44·6

Now, on comparing these numbers, we find that the plant totals do not vary precisely according to any of the eight temperature columns, though closely related to the last. That is, the amount of early and late flowering is most affected by the temperature of the last two months in the year. In 1880-1, the number of flowers was reduced by the severe frosts early in January, which practically cut off the last week of observation. The large number as compared to temperature in 1877-8, appears to be explained by the regular decrease of warmth, without any great cold to cut off autumn stragglers. The comparative fewness of these in the present season (40 out of 88) should be ascribed to the abundance of new-comers.

That the weather *during* the period is of less effect than that of the previous months, is evident by comparing this season with 1879-80, when the three weeks were the warmest of any season under consideration.

We have already seen that the Sidcot observations confirm those at Street, the totals, though different, not varying very greatly. The same is true of observations in Devon and Cornwall, where in 1876-7 Mr. W. B. Waterfall observed 103 wild flowers (N. H. J., vol. i. No. 1), whilst this year Mr. Wm. Waterfall has kindly sent me a list of 119. Twenty-five fresh ones have been observed, although eleven others were not again recorded, "but they would no doubt be in bloom if looked for in the same locality."

[1] Corrected by comparison with the Sidcot list.
[2] Corrected by allowance of ⅓ for an extra week.
[3] Six flowers being contained both in wild and garden list, deduction is made in the total accordingly.

He also makes the following comparisons of date for four common flowers, to which I append the same, so far as recorded, for Street, Somerset.

	Devon and Cornwall.			Street, Somerset.		
	1876-7	1880-1	1881-2	1876-7	1880-1	1881-2
Hazel	Jan. 15	Dec. 18	Dec. 26	Jan. 16	Jan. 1	Dec. 28
Celandine ...	Jan 16	Dec. 25	Dec. 25	Jan. 12	Dec. 25	Dec. 30
Ground Ivy...	Feb. 16	Dec. 25	Jan. 19	Jan.	Mar. 22	Jan. 31 (about)
Draba verna...	Jan. 4	Dec. 25	Dec. 12			Jan. 7
Average from Dec. 1	Jan. 18	Dec. 23	Dec. 28			Jan. 8

The comparative dates show even more clearly than the totals how remarkably forward the early part of the present season was compared with 1876-7, whilst the corresponding part of the foregoing season, previous to the severe weather, was still more advanced.

As regards classification, it is curious to notice that only three (wild flowers) were endogenous, the snowdrop and two grasses, *Poa annua* and *Triticum repens*. The following is a complete list under the various natural orders; S. stands for *Spring* blossom, R. for Remaniés (101 garden flowers were seen also).

EXOGENS.

Ranunculaceæ.
Anemone nemorosa, S.
Ranunculus acris, R.
,, repens, R.
,, bulbosus, R.
,, Ficaria, S.
Fumariaceæ.
Fumaria officinalis, R.
Cruciferæ.
Cheiranthus Cheiri, S.
Sinapis arvensis, R.
Arabis thaliana, S.
Barbarea vulgaris, R.
Nasturtium officinale, R.
Draba verna, S.
Capsella Bursa-pastoris, R. and S.
Senebiera Coronopus, R.
Lepidium campestre, R.
Violaceæ.
Viola odorata, S.
,, canina, S.
,, tricolor, R. and S.
Caryophyllaceæ.
Lychnis diurna, R. and S.
Cerastium triviale, R. and S.
Stellaria media, S.
,, Holostea, S.
Hypericaceæ.
Hypericum quadrangulum, R.
Malvaceæ.
Malva sylvestris, R.
Geraniaceæ.
Geranium molle, S.
,, Robertianum, R.
Leguminiferæ.
Ulex europæus, S.
Trifolium repens, R.
,, agrarium, R.
Rosaceæ.
Potentilla Fragariastrum, S.
Rubus fruticosus, R.
Prunus spinosa, S.
Fragaria vesca, S.
Geum urbanum, R.
Crassulaceæ.
Sedum acre, S.
Cotyledon acre, S.
Umbelliferæ.
Silaus pratensis, R.
Apium graveolens, R.
Heracleum Sphondylium, R.
Scandix Pecten-Veneris, S.
Conium maculatum, R. and S.
Araliaceæ.
Hedera Helix, R.
Rubiaceæ.
Galium Mollugo, R.
Dipsaceæ.
Dipsacus sylvestris, R.
Scabiosa arvensis, S.
Compositæ.
Silybum Marianum, R.
Chrysanthemum Leucanthemum, R.
Achillea Millefolium, R.
Senecio vulgaris, S.
,, Jacobæa, R.
Matricaria Chamomilla, R.
Bellis perennis, S.
Hypochœris glabra, R.
Leontodon autumnalis, R.
Crepis virens, R.
Hieracium umbellatum, R.
,, murorum, R.
Taraxacum Dens-Leonis, S.
Apocynaceæ.
Vinca major, S.
,, minor, S.
Scrophulariaceæ.
Linaria spuria, R.
,, Cymbalaria, S.
Veronica agrestis, S.
,, Buxbaumii, S.
,, arvensis, S.
,, serpyllifolia, S.
,, Chamædrys, S.
Labiatæ.
Stachys sylvatica, R.
Lamium purpureum, S.
,, album, S.
,, Galeobdolon, R.
Ajuga reptans, R.
Calamintha officinalis, R.
Boraginaceæ.
Myosotis arvensis, S.
Borago officinalis, S.
Primulaceæ.
Primula vulgaris, S.
Polygonaceæ.
Rumex obtusifolius, R.

Thymelaceæ.
Daphne Laureola, S.
Euphorbiaceæ.
Euphorbia Peplus, S.
,, Helioscopia, S.
Mercurialis perennis, S.
Urticaceæ.
Parietaria diffusa, R.
Urtica urens, S.
Amentiferæ.
Corylus Avellana, S.

ENDOGENS.

Liliaceæ.
Galanthus nivalis, S.
Gramineæ.
Poa annua, S.
Triticum repens, R.

In conclusion, my object in presenting these notes to your readers is threefold; first, to suggest an agreeable, easy, and yet useful occupation for winter walks; second, to indicate the value for phenological purposes if a great number of such series of observations could be made for a long series of years at various parts of our country; third, to show how great is the difference, even within the limits of the British Isles,[1] in the time of flowering of common plants, and yet how little we know upon the subject. Should any desire to assist in work of this kind, I would gladly forward free a copy of our printed form, containing lists and suggestions for observations, both of flora and fauna. The work is carried on in connection with the phenological branch of the Meteorological Society, of which the Rev. T. A. Preston, M.A., of Marlboro', is the efficient Secretary.

Bootham, York J. EDMUND CLARK

[1] At Wigton, Cumberland, for instance, although on the West coast, Mr. J. E. Walker noticed only *fourteen* wild flowers.

Colours of Low-growing Wood Flowers

NO one can enter our English woods just now without being struck with the lovely way in which they are starred with the yellow of the primrose, the white of the anemone and strawberry, and the light blue of the dog violet. It will be noticed that the tints of these flowers seem positively to shine in the low herbage and among the semi-shade of the trees and bushes. After twice going through the descriptions of flowers growing in similar situations, given in Hooker's "Student's Flora of the British Islands," I find that nearly all our dwarf wood flowers are white, light yellow, and light blue. None appear to be red. Three are purple—one form of the Sweet Violet and the Ground Ivy (*Nepeta Glechoma*), both of which are scented; and the Bugle (*Ajuga reptans*).

If the white and yellow tints of flowers fertilised by night-moths are of service in guiding the moths to them, may not the like tints in low plants in thickets and woods be similarly advantageous to the plants by tending to secure fertilisation? The more lordly foxglove, the ragged robin, and other higher growing flowers, erect above the low herbage, and enjoying more light, are conspicuous enough, but how would a small flower of the colour of a foxglove attract attention when hid among the grass? The purple of the bugle I cannot account for. The ground ivy has a pungent scent. The purple of the sweet violet is certainly inconspicuous, but here the scent may be the attraction, or the habit of the plant in forming cleistogamous flowers, may secure its multiplication. Hence it may be questioned whether the white form of the sweet violet does not mark a gradual transition towards that colour. If the white forms are more conspicuous, and ecure easier cross fertilisation, they may in time preponderate. Perhaps the existence of the sweet violet in the purple and in the white form may throw light on the origin of the general lightness of tint in dwarf wood subjects.

The low flowers in dark places which were lighter and made themselves best seen, would more readily secure fertilisation, and through natural selection would tend to have still paler tints. The change might be aided by the bleaching of flowers in shade, as described by Mr. J. C. Costerus (NATURE, vol. xxv. p. 482). In this connection it may be noted that the wood anemone has a rare purple form—perhaps a survival—and that *Anemone Apennina* is light blue. The Potentillas, close allies of the strawberry, but mainly growing in the open, have as a rule yellow flowers; sometimes red ones. The various mountain primroses of this and other countries, and those that grow in meadows (like our own Bird's Eye Primrose, *primula formosa*), have mostly reddish, lilac, or rosy flowers. The common primrose, when growing in exposed hedgebanks has often reddish, lilac, or purple flowers. Its sports in cultivation are often white, so it may be progressing towards that tint in woods. The cowslip, which grows in meadows, has a deeper tinge of yellow than the oxlip, which grows in copses. The cowslip is also far darker than the primrose, and sometimes has a scarlet or orange-brown corolla—perhaps the germ of the dark rich polyanthus of our gardens. The primrose family may have originated in woods, and have been originally light, gradually darkening as the flowers multiplied in the open; or, which is more probable, the tribe originated in exposed situations, creeping by slow degrees into the woods, and bleaching as it went.

Bexley, March 30 J. INNES ROGERS

Vignettes from Nature

MR. BUDDEN is perfectly right in querying the locality of the specimens of sharks' teeth which I mentioned as having seen from a South American digging. In consequence of a slight deafness, I misunderstood my friend's account of them; and knowing them to be American, assigned the word "South" to "America," instead of to "Carolina," in the coprolite pits of which they were found. WILLIAM B. CARPENTER

ECONOMIC GEOLOGY OF INDIA[1]

II.

IN a former notice of Prof. Valentine Ball's important work on the "Economic Geology of India," the subjects of the gold supply and of that form of carbon known as the diamond, were treated of. In the present notice it is proposed to give a brief account of that more important form of carbon known as coal, as well as to allude to the valuable information given in the chapters on Iron, Salt, and Building-stone. The rocks, which in Peninsular India probably correspond, as regards the time of their formation, to the true carboniferous rocks of Europe, are not coal-bearing, and the oldest coal-measures in the country belong to a period which is well included within the limits of the Upper Palæozoic or Permian, and the Lower Jurassic formations. All the useful coal of the peninsula may conveniently be described as being of Permio-Triassic age, and, with two exceptions, it may be added, these measures do not occur beyond the limits of the peninsula. In the extra-peninsular area, coal is found in various younger deposits, and there are numerous deposits in Afghanistan, the Punjab, at the foot of the Himalayas, in Assam and Burma, of undoubted Lower Tertiary, Nummulitic, or Eocene coals and lignites; but it is only quite exceptional that such deposits possess any great value (the chief noteworthy exceptions occur in Assam and Burma).

According to the somewhat liberal estimates of Mr. Hughes, the areas in India, in which coal-measures occur, including those unsurveyed, amount in all to 35,000 square miles, but the thickness of a vast number of the seams of coal in these basins is very varied. For over one century the coal-mining industry of India has been in operation, and there has been a steady increase in production and consumption, especially within the last ten years. Still the coal resources of the country cannot be regarded as yet developed. Out of over thirty distinct coal-fields in Peninsular India, only four or five are worked at all, and even of these, but two have arrived at an output of from 1 to 2000 tons a day, and this though in these two fields the coal-pits are numerous.

It is very important that the reasons for this state of things should be well understood, and they are not far to seek. Most of the coal-fields are very remote from the centres of manufacture and from the seaports, and at these places the native produce has to compete with a better quality of coal sea-borne from Europe. With the extension of railways in India, the home coal will have a better chance, as the facilities of carriage will enable the coal to be brought to the iron-mines, which are mostly too at long distances from the ports, and when used in the reduction of metallic ores, the demand for coal would increase.

[1] "A Manual of the Geology of India. Part III. Economic Geology." By V. Ball, M.A., F.G.S., Officiating Deputy Superintendent, Geological Survey of India. Published by order of the Government of India. (Calcutta, 1881.) Continued from p. 510.

As to the quality of the coal of Peninsular India, it is not easy to write in general terms. It may be described as a laminated bituminous coal, in which bright and dull layers alternate; much of it does not coke easily. No true anthracite has as yet been discovered. In the coal from the Raniganj field, the proportion of fixed carbon is under 55 per cent., which is about 10 per cent. under that from the Karharbari field. The amount of moisture varies a good deal in the coal from the different fields, being as high as 14 per cent. in the coal from the Godavari field, and not more than 5 per cent. in that from the Raniganj field. The quantity of sulphur and phosphorus present varies also considerably, but coal, sufficiently free from these impurities as to be available for the manufacture of steel, is to be found. In a table showing the amount of coal imported into, and raised in India, for the years from 1852 to 1880, we find, that of a probable total amount of mineral fuel consumed in India during 1880-81, of 1,500,000 tons, one million was raised in the country, and half a million was imported. While the price of European coal at Indian ports varies, the average value at present per ton is about 30*s.*, and English coal has been sold within the last ten years, in Calcutta, for as small a sum as 15*s.* a ton.

At the pit's mouth at the Raniganj field the value of the best coal is about 5*s.* a ton, but the same coal in Madras costs from 30*s.* to 32*s.* a ton, the difference being the cost of transit. On many of the railways in Upper India, wood is largely used as fuel, being much cheaper than coal.

The largest and most important of the areas in which coal is worked in India is that of the Raniganj field. It is situated on the rocky frontier of Western Bengal, at a distance of 120 miles from Calcutta. The available coal was calculated in round numbers by the late Dr. Oldham to be 14,000 millions of tons. Its proximity to the main line of railway, and also to the port of Calcutta, give it an advantage over all other coal areas in India. Coal was known to occur there in 1774, and so long since as 1777 was actually worked. There are now five European companies engaged in the extraction of the coal, besides many smaller firms, and one native company. At one time a good deal of the coal was obtained by open quarrying, now mining is adopted on the pillar and stall plan. None of the mines are of great depth; and there is a perfect freedom from fire and choke-damp. Some of the seams are nearly forty feet in thickness, but as a rule the very thick seams do not contain the best quality of coal. The Lieut.-Governor of Bengal reported for the year 1878-79, that "the year was a prosperous one for the coal companies of Raniganj. There was a large demand, and production was greatly stimulated. The output is estimated to have been 523,097 tons, against 467,924 tons, the average of the three previous years. The number of persons employed was 388,931 men, 194,647 women, and 27,277 children."

The coal-supply of India is a subject of vast interest, one full with a great future for India, and one which though slowly, is steadily coming to be properly understood.

Into the subject of "Peat in India" the space at our disposal does not allow us to enter; and that of "Petroleum" can only be glanced at. So far as is at present known, petroleum has not been met with within the limits of Peninsular India. In the extra-peninsular countries there are several regions where the strata yield more or less abundant supplies of petroleum. The most important of these are in Burma. In British Burma the working of the oil springs is but in its infancy. But in Upper Burma, the exportation of the rock oils is said to have been in progress during the last 2000 years. The oil of Upper Burma, commonly known as Rangoon oil, is a valuable article of export, taking its name from the port from which it is shipped to Europe and America.

In intimate connection with the Coal of India is the abundance in extent of the Iron ores of the same region. In the peninsular area, magnetite occurs in beds or in veins of greater or less extent in most of the regions where metamorphic rocks occur. In some places, as in the Salem district in the Madras Presidency, the development of this ore is on a scale of extraordinary and unparalleled magnitude, whole hills and ranges being formed of the purest forms of it; and in many cases these deposits are not lodes, but beds as truly such as those of gneissose and schistose rocks, with which they are accompanied. To the abundance and wide-spread distribution of these ores in the oldest rocks is no doubt to be attributed the fact of the frequent recurrence of considerable deposits of the general dissemination of ferruginous matter, which more or less characterise the sedimentary rocks of all subsequent periods. In some localities bedded magnetite is known to occur in sub-metamorphic or transition rocks. Thus the rich ores of Central India are principally found as hæmatites in the Bijawar or lower transition series of rocks.

The prevailing red and brown tints characterising the great Vindhyan formation are owing to the presence of iron ores in veins. The Talchir group of the Gondwana system—supposed to have been deposited from floating ice—is notable for the absence in it of iron matter. The next group Barakar is also almost free, but with some remarkable exceptions, as, for example, in the vicinity of the Aurunga coal-field at Palamow. The third group of the system is one of iron-stone shales; while in the succeeding members of the group iron is, though somewhat unequally distributed, always present.

The Laterite of India is peculiarly rich in iron ores, and these have been worked by the native smelters time out of mind. Practical men have sometimes spoken of the native furnaces and methods of working in a very contemptuous manner, or have regarded them as merely objects of curiosity, but ought this to be so? Does not such a work as the famous iron pillar at the Kutab, near Delhi, indicate an amount of skill in the manipulation of a large mass of wrought iron, which has ever been a marvel to all who have studied it. But a few years ago, what iron foundry in Europe could have produced the like, and even now how many are there that would turn out such a mass? Of a total length of 23 feet 8 inches, just 22 feet thereof stands exposed over the ground. Over 16 feet in diameter at the base it tapers to a little over a foot just below its capital, which is $3\frac{1}{2}$ feet high. Its total weight is over six tons. Mr. Ferguson, in his "History of India," believes from the letters on the inscription that it dates from A.D. 400; if so, then it has stood exposed to wind and weather for nearly 1500 years, showing no signs of rust; a most complete testimony to the skill and art of the Indian iron-workers of the period.

Even in quite recent days Indian steel was in considerable demand in England. Its production was the cause of much wonderment, and was accounted for by various theories. The famous Damascus blades had long attained a reputation for pliability, strength, and beauty, ere it was known that the material from which they were made was the product of an obscure Indian village, and it is probably not very generally known that a large quantity of the excellent iron used in the construction of the Menai Suspension and the Britannia Tubular Bridges, was from the Porto Nevo Works in South Arcot in Salem district. The competition with European iron has practically thrown the production of native ore into the deepest shade. Unless, indeed, the Indian iron factories should succeed in producing iron at so low a rate as to defy competition, the import of European iron must continue with the result of leaving no margin for profitable working. In England, too, it will be remembered that the demand for skilled labour has brought forth an abundant supply. In India the loss of a life, or a stoppage of machinery may be productive of serious and prolonged delay, causing numerous embarrassments.

It would seem almost too late for the Government of India itself to undertake the manufacture of iron. Perhaps had it done so, prior to the opening up of its fine system of railways it might have done good, keeping money in the country and employing labour, but there were many and serious objections to such government establishments. In the meanwhile, here and there throughout India iron is still manufactured.

The earthy varieties of the hæmatites, or red and yellow ochres, are abundant in India. They are used by the natives as mineral pigments under the collective term of *girn*, for the adornment of the walls of houses and huts, and sometimes to make the caste marks on the foreheads of the Hindus.

In the Gabalpur district a paint is manufactured by grinding the ore to an impalpable powder by means of grindstones worked by small water-wheels. The powder is packed in bags, and sells retail at a price so high as 13*l*. a ton. It has proved to be the cheapest paint in the Indian market. It lies smoothly on wood or iron, and has been successfully used against damp or porous tiles, bricks, and plaster. It has already stood a good practical test on the metal work of the principal bridges in India.

So far as the coal and iron products of this great dependency of ours are concerned, they would seem more than sufficient for all her needs, but at prices that were alone remunerative when the country remained isolated from the rest of the world. By competition the native production has been almost starved out, but the native consumers get as good an article, and at a far cheaper rate now than of old.

Salt is the mineral product of all others, the most important to the revenue of India, the gross annual receipts from the salt-tax being now about seven millions of pounds sterling. While the native supply is practically inexhaustible, there is still a steady import trade from foreign countries. Within the last ten or twelve years, a great deal has been done in the way of equalising the salt-tax in the different districts of India, and the Government monopoly is now fairly complete. In Madras the indigenous sources of supply have been the salt-pans on the coastal districts, where salt is obtained by the evaporation of sea water. It was also obtained at one time by the lixiviation of saline earth. The salt manufacture begins in January, as soon as the rains are over and the weather begins to get warm. Before the evaporation at the pans begins, there is a preliminary evaporation, lasting over some twenty-five days, in pits, by which the brine is reduced 50 or 75 per cent. in bulk. The manufacture in the pans continues for about twenty-nine days, when the salt is taken out and stored on the banks to dry. The brine is not evaporated to dryness in the pans, in order that the magnesium sulphate may, as much as possible, remain in solution. In Rajputana, there are four sources of salt. The most extensive are the salt lakes, such as Sambhar and Didwana; next come the brine-pits, then some salt is obtained from saline efflorescence from earthwork, and some from deposits in old river-pits. A brine-pit in Bhartpur, examined in 1865, contained 20 to 30 feet of brine at a depth of 20 feet from the surface, and was reported to have shown no diminution of supply during the preceding twenty-eight years.

The Punjab is distinguished from all the other districts of India, in possessing enormous deposits of rock-salt, and it is very remarkable that these deposits do not all belong to the one geological age, but are referable to very distinct periods which are widely separated in time. During the year ending March 31, 1880, inland customs duty was paid on 55,000 tons of salt from the rock-salt mines of the Punjab. The rock-salt of the Kohet district would seem to be of Eocene age; it is overlaid conformably by gypsum, which is again overlaid by rocks of Nummulitic age. Here the salt is obtained by open quarrying. The quarries at Malgin have been worked from time immemorial; those at Bhadur Khel were opened some twelve centuries ago. The total available quantity of salt in these quarries has been estimated to afford a supply, which, allowing a liberal margin for waste, would, at the rate of the present demand, last for 4000 years.

The Salt-range deposit is the oldest-known deposit in the world. It underlies beds containing Silurian deposits, and is therefore of a period at least not younger than the Silurian age. The rock-salt in this range is worked underground. The largest mines of the range are the Mayo mines at Khewra, on the eastern side of the Indus. These and the neighbouring mines had been worked most of all, and generally on a most dangerous system. Thus, in one of the Mayo mines the old Sikh workmen having worked out the salt in one vast chamber, the roof of which which was supported by two immense pillars, commenced and worked out a second chamber under the first one, and beneath the pillar supporting its roof, with the result that on a Sunday, in June, 1870, one of these pillars broke through, carrying with it a large part of the roof, and forming a crater on the hill where the mine is situated. Since then, these mines have been worked in accordance with modern principles, and the appearance of their tunnels, drifts, and tramways is most imposing. There is even a wire-rope tramway to the nearest village from the mouth of the mines. The annual average receipts from the Salt-range Mines is 388,144*l*.

In connection with salt, the subject of Reh is a highly important one. *Reh* is the native term applied to efflorescent salts which have accumulated in the soil or in the subsoil waters of large tracts in India, and this, in some places, to such an extent that cultivation has become impossible, and fertile fields have become barren spaces. The origin of this Reh is now fully understood; the rivers carry in solution saline particles washed out of the rocks over which they flow; as well as a fine silt or alluvium, which also, on its decomposition, yields further salts; in a region of intense evaporation, and where the surface of the ground is constantly irrigated, if there be no free drainage outlet for the waters, the salts contained in them are accumulated in the soil, or still further surcharge the subsoil waters; while over and above all this, during the rainy reason the rain-water, charged with carbonic acid, falling on the porous soil, has the effect of decomposing its mineral constituents and of carrying down to the subsoil the salts then formed. This being the state of things, when the surface of the ground becomes dried, the water, charged with salts, rises up and evaporates, leaving a salt efflorescence, the *reh*, which at length so permeates the superficial layer of soil as to leave it little better than a salt marsh. Contrary to what might on first sight be expected, irrigation by even pure canal water seems to increase the evil; for, as Mr. Medlicott has so well pointed out, the table of salt subsoil water is, by the addition of the canal water, raised to a height that brings it within the reach of evaporation; and so the efflorescence is increased. The only remedies for this state of things would seem to be good, deep subsoil drainage, with thorough washing of the surface soil, and protecting the latter as much as possible from evaporation.

India at one time enjoyed almost a monopoly of the saltpetre trade, and even still, from the port of Calcutta, in the year 1879-80, the export of this commodity was nearly 432,000*l*. The peculiar habits of the people and the fact that in the saltpetre- roducing districts there is a long period of drought after a long period of rain, accounts for the soil in the vicinity of the Indian villages being impregnated with this salt. More than two-thirds of the total quantity of the saltpetre which is exported from Calcutta at present comes from the districts of Tirhut, Saran, and Champaran in Behar.

The Building Stones of India form a wonderfully interesting subject. Among the most abiding records of any nation must always be included the buildings they have raised, and the duration of these will depend on the material chosen for the erection. Is it a necessity of modern civilisation that our great edifices should be constructed of materials that are quick to perish? and why should it be said of Anglo-Indian architecture, that if the English left India, in a century after their departure no sign of their occupation would remain? and in India, as Prof. Ball remarks, unlike new countries such as Australia and most parts of America, where knowledge had to be obtained by experience, the native temples and buildings should have at once furnished the needed information as to the durability of the material used in them, the only one quality in building material that nothing save time is a test for. Most of the buildings erected by the British in India are built of brick; it need scarcely be added that all the native temples are of stone, and that many exhibit a wonderful mastery over sometimes difficult material. Very strange is it, too, to learn that the resources of India in this respect are so little known or appreciated, that at this day advertisements daily meet the eye in the Indian papers of Aberdeen granites and Italian marbles; and yet how many temples are there to be found in India, constructed of native granites? and what can surpass the white marble filigree screens called jalee, made out of the native marble?

One splendid screen is thus described by Mr. Keene: "But all the marble work of Northern India is surpassed by the monument which Akbar erected over the remains of his friend and spiritual counsellor, Shekh Sulim Chisti, at Fatipur Sikri (1581 A.D.). In the north-western angle of a vast courtyard, 433 feet by 366 feet, is a pavilion externally of white marble, surrounded by a deep, projecting dripstone, also of white marble, supported by marble shafts, crowned by most fantastic brackets, shaped like the letter S. The outer screens are so minutely pierced, that at a little distance they look like lace, and illuminate the mortuary chapel within with a solemn half-light which resembles nothing else that I have seen."

The varieties of metamorphic rocks suited to building purposes in India are very numerous; besides the granites, sandstones and porphyritic gneiss abound. In Mysore, a building-stone occurs in the crystalline rock of the district, which can be split into posts twenty feet long, which have been used for the support of the telegraph wires; and the peculiar adaptability of gneiss to fine carving is often to be seen in the rings appended to the drooping corners of some of the pagodas, where the rings, the links within which are movable, and the projecting corners, are carved out of a single block. Among all the formations, the Great Vindhyan sandstones stand prominent; these were used in the manufacture of stone implements; the great memorial monoliths or lats, many of which bear the edicts of Asoka, the protector of the early Buddhists who reigned about 250 B.C., are made of this stone; some of these are of great size, and on the exposed surfaces are polished; their carved capitals were surmounted with figures of lions or elephants.

There are many quarries of stone throughout India, opened in these Vindhyan rocks. At Dehri, on Son, the stone is a compact white sandstone, strong and durable, and susceptible of artistic treatment. Other fine quarries are at Chunar, from which has come for ages the supply to Benares and Calcutta. But perhaps the most important quarries in India are those in the Upper Bhanrers, which have furnished building material since before the Christian era, to the cities of the adjoining plains. Portions of the Taj at Agra, Akbar's Palace at Fatipur Sikri, the Jamma Masjid at Delhi, have been built from the stone of these quarries. The palace of the Rajah of Bhartpur, at Deeg, one of the most beautiful edifices in India, is constructed of the stone from the same district. In it, cupolas rest on slender shafts of two or three inches in diameter. Arches are supported on strong, yet graceful pillars, and windows are formed of single slabs of stone, perforated with the most elaborate tracery.

Among the sandstones of the Damuda series, there are several varieties which are suited for building purposes. Throughout the Damuda valley, where these rocks occur, they have been used from considerable antiquity for the construction of temples. Among the finest examples known, some Jain temples at Barakar may be mentioned, as they exhibit specimens of wonderful carving which has stood well, though the old Pâli inscriptions on stone of this material in the caves of Sirguja and Chang Bakhar even better testify to the endurance of this rock.

Laterite has also been used as a building material, but it is not ornamental, and does not weather well. Good roofing slate does not appear to exist in India, though in the transition rocks of the Kharakpur Hills, slate occurs; it is a partially altered earthy rock, which is readily fissile, and with pains and care can be reduced to a thickness of one-eighth of an inch; it would answer well for flagging.

Extended though this notice of Prof. Ball's book has been, we have been unable therein to glance at more than its more prominent features. We doubt not, however, that the reader will perceive that it is one of the most important contributions yet made to our knowledge of the economic geology of this vast kingdom, the prosperity of which so nearly and so intimately concerns ourselves.

THE SCIENCE AND ART DEPARTMENT

WE have received the following communication from a correspondent:—

There are few Blue Books that better repay careful study than the admirable reports of the Science and Art Department. The Twenty-eighth Report has recently been issued, and is of exceptional interest. Its bulky appendices contain, as usual, a mass of valuable statistics relating to the diffusion of scientific and artistic instruction among the masses; and in the body of the report we find indications of a general scheme of reorganisation, both in the details and the scope of the higher scientific education given in the Science Schools at South Kensington. This scheme has now taken definite shape, and came into operation with the session which has recently opened. It is therefore a fitting opportunity briefly to review the work done by the Science and Art Department in the scientific instruction of the people, and then examine the nature and object of the changes that are being made at South Kensington.

The Great Exhibition of 1851 revealed the fact, that in order to compete with the industries of foreign nations, it was imperative to have artistic and scientific instruction more widely diffused among the middle and lower classes of this country. To accomplish this the Science and Art Department was formed, and to the soundness of the principles laid down by the Prince Consort and the genius and labour of Sir Henry Cole the success of this Department is largely due. This success is not merely to be found in the large numbers attending the classes in connection with the Department; it is to be seen in the growth of artistic and scientific knowledge among the people, and the application of that knowledge to industrial pursuits. A striking testimony of the change, mainly wrought by the Department, is to be found in the report of the French jurors in the last general Exhibition at Paris. This report states:

"English industry in particular, which, from an artistic point of view, seemed greatly in arrear at the Exhibition of 1851, has during the last ten years made amazing progress; and should it continue to advance at the same rate we might soon be left behind. This state of things appears to us to merit the most serious attention of the French Government and manufacturers."

The Department had nevertheless to encounter a bitter and unscrupulous opposition in various quarters, and being less anxious to answer its detractors than to do the work intrusted to it, sneers about South Kensington became easy, and a clap-trap denunciation of the Brompton clique went the round of society, and is even now to be found among its dregs. Though for many years the object of persistent and venomous attacks, Sir H. Cole, never swerved from the great work committed to his care, and England is now beginning to recognise the debt of gratitude she owes to this truly remarkable man.

And now let us look at the method of encouraging elementary scientific instruction adopted by the Department, and at some of the results of its methods.

The system of certificated science and art teachers was introduced, with payments to both teachers and pupils dependent on the results of an annual examination in May. By this means pupils were attracted from the artizan class, and teachers were glad to have pupils at almost a nominal fee. Through evening instruction alone a moderate income could thus be made by any active and painstaking teacher who complied with the rules laid down by the Department. In this way, irrespective of fees, the teachers of the Science School at Keighley received last year in payments on results nearly 350*l.*; the teachers at the Bristol Trade and Mining School, in the same way, made upwards of 450*l.*; the teachers at St. Thomas, Charterhouse, nearly 600*l.*; and the teachers at some of the Science classes in Liverpool nearly 700*l.* Similar results are to be found among the certificated art teachers. It is not surprising that the number of schools in connection with the Department rapidly and steadily increased, till in 1870 there was only one short of 800 science schools, with the large number of 34,283 students under instruction, chiefly during the evenings of the week. Ten years later, in 1880, these numbers had increased nearly 60 per cent., there being now 1391 elementary science schools under the Science and Art Department, with 60,871 individuals under instruction: 34,678 of these students entered for the annual examination in May, several taking two or more subjects, so that there were over 69,000 papers worked; of these upwards of 45,000 were passed, or more than 65 per cent.; and 12,000 gained a first-class, or say 27 per cent. of the successful papers. Every successful paper entitles the candidate, if in the first division, to a prize, and the certificated teacher to a money payment.

As might be expected, the inhabitants of the manufacturing districts avail themselves most largely of the May examinations; and it is instructive to note the relative number of individuals receiving elementary science instruction in the different sections of the United Kingdom. Last year there were in *England* 42,711 students, who paid in fees 8963*l.*, or a little over 4*s.* each; and gained 7281 prizes and medals, or about one prize to every six students. In *Wales* there were 1344 students, who paid in fees 146*l.*, or a little over 2*s.* each, and gained 184 prizes and medals, or one prize to every seven students.

In *Scotland* there were 7376 students, who paid in fees 2088*l.*, or 5*s.* 9*d.* each, and gained 1423 prizes or medals, or one to every five students; in *Ireland* there were 5369 students, who paid 665*l.* in fees, or 2*s.* 5*d.* each, and gained 1267 prizes and medals, or one to every four students. The payment on results to the teachers amounted to 29,900*l.* for *England and Wales*, or say 14*s.* per pupil, to 5250*l.* for *Scotland*, or 14*s.* 2*d.* per pupil, and to 5079 for *Ireland*, or 18*s.* 9*d.* per pupil. The foregoing analysis which we have made of the figures in this report shows that Ireland has the highest proportion of prize-winners, indicating a higher grade of ability on the part of both teachers and pupils; at the same time its students are poorest, or at any rate least inclined to pay for instruction. The smallness of the fees received by the teachers doubtless also acts as a stimulus to the teacher, for it makes his payment almost wholly dependent on the successes of his pupils.

The report unfortunately does not supply any data as to the relative number of boys and girls among the students, an omission that we hope may be supplied in some future reports; for the Department had the honour of recognising the claims of women to educational prizes and distinctions long before any University opened its door to women.

The nature of the subjects selected by the students differs considerably. The following table, which we have summarised from the report, shows a singular and suggestive difference in national traits; the figures indicate the number of individuals under instruction in 1880:—

	Geometrical drawing.	Mathematics.	Mechanics.	Physics.	Chemistry.
England and Wales	17,494	11,081	4,293	15,401	7,732
Scotland	2,229	3,050	1,226	1,477	1,475
Ireland	292	2,738	982	3,212	439

	Geology.	Biology.	Steam.	Physiography.	Agriculture.
England and Wales	2,092	9,336	1,539	4,435	2,772
Scotland	416	935	539	709	548
Ireland	406	821	105	1,521	3,104

It will be seen from this that in England the majority select geometrical drawing, next to that physics, and then mathematics. In Scotland the majority choose mathematics, and next to that geometrical drawing; very few selecting agriculture. In Ireland the majority select physics, and almost as many agriculture; next to that being mathematics, and very few geometrical drawing.

In connection with these statistics we notice that Ireland stands far below England and Scotland in point of the number of its art schools and art students; and this notwithstanding that the Irish are essentially an artistic race, the fame of many Irish artists being well known. In fact, though the number of art students in Ireland is small, the quality of their work is more than twice as good as English or Scotch art students; that is, judged by payments on results, the payment to pupils in English art schools under the Department average in the annual competition about 2*s.* 3*d.* a head, in the Scotch 2*s.* 4*d.*, in the Irish 5*s.* In round numbers, there are in England about 5000 art schools, with some 650,000 pupils; in Scotland there are more than 500 art schools, with some 75 000 pupils; whilst in Ireland there are only 50 to 60 art schools, with 6000 to 7000 pupils. In fact few things are more needed in Ireland than the encouragement of art-teaching by local art, by museums, and otherwise; and now that the difficulties and interminable correspondence between the Royal Dublin Society and the Department are at an end, we have no doubt that the able and energetic director of the national collection in Ireland will make this question an object of care.

If we now turn to examine the percentage of failures in the different subjects taught by certificated science-teachers, we find some surprising results. Not only is there a wide difference in the number of failures in the different subjects, but in the same subject the percentage varies extravagantly in different years. We cannot think this is wholly, or even chiefly, due to the candidates, the variations seem far more likely to be due to differences in stringency on the part of the examiners. Uniformity is of course impossible, but a greater unity of action on the part of the Board of Examiners seems necessary. Take, for example, geometrical drawing: there were 39 per cent. of failures in the elementary stage in 1879, and 50 per cent. in 1880. In botany there were 43 per cent. of failures in 1879, and 20 per cent. in 1880. In biology there were upwards of 40 per cent. of failures in 1879, and only 17 per cent. in 1880. In sound, light, and heat 51 per cent. of failures in 1879, and 35 per cent. in 1880. Magnetism and electricity on the other hand, is extremely uniform, having 29 per cent. of failures one year and 30 per cent. the next. But if we look at the advanced stage for 1879 the failures vary from 25 per cent. in magnetism and electricity to 60 per cent. in botany, and 82 per cent in biology. These fluctuations, if due to idiosyncrasies on the part of the examiners, are very serious for the teachers who are dependent for their livelihood on the payment by results. The natural result is the teacher selects that subject wherein he thinks there is least chance of failure, and thus we find the number of papers worked in the different subjects follows very closely the ease with which a candidate is likely to pass.

Then, as to the method of examination. Would it not be possible to introduce a *practical examination* in physics as well as chemistry? The additional expense might in part be met by imposing a small fee for examination, and only those students should be eligible for the practical examination who have passed in the "advanced" stage. A certificate for practical knowledge in special branches of science would be most valuable to its holders, and no teacher should be allowed to obtain payment on results until he has one of these certificates. At present any one with very elementary knowledge indeed can set up as a teacher, and the value of the title "Certificated Teacher under the Science and Art Department" is not what it should be. Moreover, a preliminary examination in writing and spelling, and perhaps elementary drawing, ought, we think, to be passed by every certificated teacher. Again and again has the present writer had the most atrocious spelling and writing, to say nothing of English grammar, come under his notice in the May Examination Papers; and yet if the student answered the questions before him he was bound to obtain a certificate, and would doubtless be a full-blown certificated teacher, with a class of pupils, before the year was out.

To meet the need of practical teaching, the Department has lately taken a most admirable step in advance. An arrangement has been made whereby a certain number of carefully-selected teachers have the opportunity of coming to London during the summer vacations, and spending a month to six weeks in the practical study of certain branches of science under the direct personal guidance of the eminent professors at the South Kensington Science Schools. In this way, year by year, from twenty to fifty teachers avail themselves of invaluable instruction in chemistry, physics, mechanics, geology, botany, and agriculture. A number of teachers (some 65 out of 200 applicants) are admitted free to the regular courses of instruction at South Kensington. Furthermore to meet, what to many certificated teachers would be the prohibitive expense of coming to London from the provinces, Government pay their railway fare to and fro, and give them an allowance for board whilst under instruction at South Kensington.

And just in passing we may perhaps ask how it is the Treasury have sanctioned the expense of paying the yearly contingent of Irish teachers going the long distance to and from London, when in Dublin there is a School of Science under the Department equipped with an even larger staff than at South Kensington, and furnished with quite as extensive and as admirable educational appliances? This is just one of those points which are calculated to wound the susceptibilities of Irishmen and to foster the cry for local self-government. Moreover, the claims of the College of Science to take part in the training of assisted teachers become still more evident when we find that there are in England thirty-three training colleges receiving grants from the Department, whilst in Ireland there is not one. We feel, however, that attention has only to be called to this point to lead to some change, if there are no insuperable obstacles in the way.

To return—the need for, and the success of, the scheme for training teachers has led to an important alteration in the scope of the Science Schools at South Kensington. This session it begins its work under the title of the "Normal School of Science," added to that of the Royal School of Mines. As before, Diplomas of Associate are given to those students who successfully pass through the prescribed curriculum, but considerable changes have been made in the curriculum. A student can now gain the title of Associate of the Normal School of Science if he passes successfully in one or more of the following divisions:—(*a*) Mechanics, (*b*) Physics, (*c*) Chemistry, (*d*) Biology, (*e*) Geology, (*f*) Agriculture, and he can gain the Associateship of the Royal School of Mines in (*g*) Metallurgy and (*h*) Mining. The course of instruction is the same for all divisions during the first two years, after which it is specialised in accordance with a carefully-prepared scheme. At least a three-years' course is therefore necessary for all candidates for Associateship, the fees amounting for the first two years to 75*l.*, and for the remainder of the time vary from 30*l.* to 40*l.* There are, however, several scholarships and free studentships open yearly to competition.

And now we must close this lengthy review. To those who have followed the work already done by the Department of Science and Art, and even to those who, ignorant of it, have troubled themselves to read this article, it must be evident that the anonymous croakers at South Kensington are merely enjoying the English privilege of grumbling, and are doubtless secretly proud of this important Government Department.

AN ELECTRIC BAROMETER

NOTICING an account of a new electric barometer, brought before the Royal Scottish Society of Arts, which requires some fifty communicating wires, and reads but to the one-tenth of an inch, I venture to send the following. It aims at solving the problem—that of reading a barometer, placed at a distance from an observatory—in a more simple manner.

FIG. 1.

The barometer, the height of which is to be ascertained, has two platinum wires fused through the glass, at the vacuum end of the tube. One of these is continued by a stout iron wire, the other by a fine carbon thread, both of which are joined at a point in the tube below the level of lowest fall. The iron wire keeps the carbon filament vertical and central in the tube. From the platinum ends outside, wires communicate with the observatory; and a current passed through them, traverses both iron and carbon in its passage.

Now, the carbon being a substance of high resistance, a very small change in its length will tell on the potential of the returning current: its effective length, however, varies with the level of the mercury, and the object in view is to measure the movement in the barometer by the potential of the returning current. And, in the first place, what is the theoretic sensitiveness to be expected?

Taking the conductivity of copper as 100, that of carbon is about 0·07; and supposing eight miles of copper wire in circuit (barometer being four miles from observatory), and that a wire of one-eighth inch diameter be used; supposing, also, that the carbon filament be of one-fiftieth inch diameter; then the following is the result arrived at:—For a rise of the mercury of one-fiftieth of an inch, the resistance is lowered 1-455th. Closer readings would probably be questionable, owing to capillarity. I would observe, also, that the 0·07 applies to graphite in general; I do not know what exactly may be the resistance of the carbon thread lately come into use.

In order to measure these changes of potential in terms of the barometric height, the whole circuit is treated at the observatory as one resistance in a Wheatstone's Bridge. Thus, in Fig. 1 let A be the distant barometer, B and C battery and galvanometer in the observatory, D—also in the observatory—a means of altering *ad lib.* the resistance in the second circuit of the bridge. The instrument used at D indicates the barometric height at A when the galvanoscope is brought to zero.

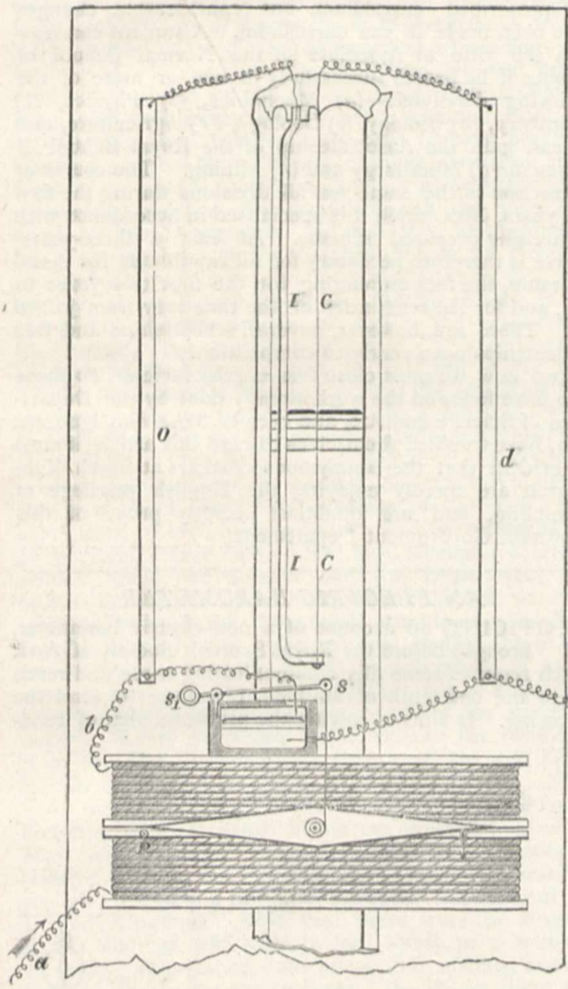

Fig. 2.

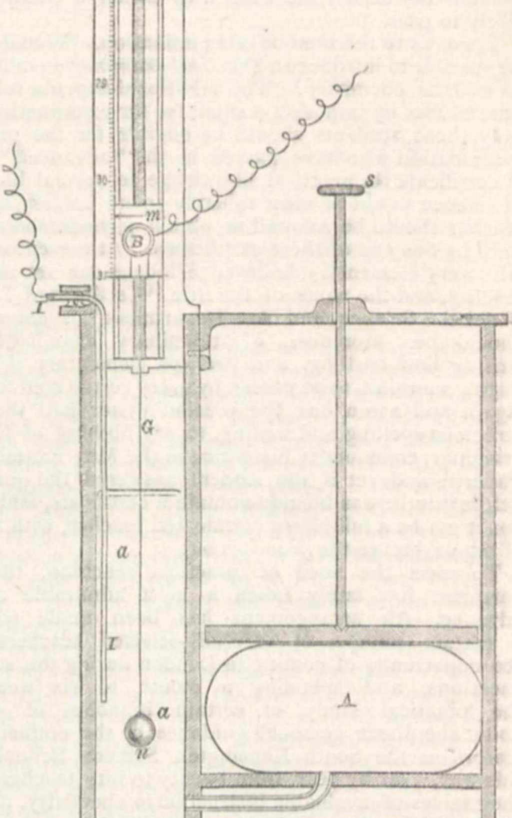

Fig. 3.

Before describing the apparatus used at D, it is necessary to explain how the question of temperature is dealt with. Copper has its resistance increased by about 0·4 per cent. for each rise of 1° C. above 20° C.; and as the temperature along the four miles traversed by the wires is wholly unknown, some means must evidently be found for allowing for errors from this source. The problem is to do this without necessitating extra wires to barometer A.

It is obvious that if the barometer could be thrown out of circuit before each observation, and the resistance of the eight miles of circuit independently balanced in the bridge at D, then, restoring the barometer, a second determination made at D would yield results which might be dealt with quite independently of the resistance of the wires.

This can be effected by sending a reverse current through the circuit immediately before each observation. The apparatus shown in Fig. 2 explains this. The figure is an elevation showing the upper part of the barometer. The iron wire I and the carbon C are shown in position. The galvanometer placed immediately in front of the tube is contrived to deflect the current from the barometer when the current traverses it in one particular direction. It will be best understood, if the action of the current be considered in detail throughout the operation of reading.

We desire, in the first place, to find the resistance of the circuit independently of the barometer.

A current is sent along the wire *a* (Fig. 2) from the observatory. It traverses the coils, issuing by wire *b*, and, during the first instant of time, takes its course along the conductor *o*, passing through iron wire and carbon, and by *d*, *f*, back to the battery. The needle, however, is immediately deflected (in the direction shown by the arrow) pulling down the little lever *s s*, which, oscillating on the edge of a small vessel of mercury, and bearing a branch from the wire *b*, completes a circuit of low resistance with the return wire *f*, a branch from which communicates with the mercury in the vessel. A current is now flowing free of the carbon. It may be balanced at D (Fig. 1), and the second operation commenced. This consists in switching the current by a commutator, so that it arrives by wire *f*, and returns by wire *a*. The current on arrival tends to restore the needle to the horizontal, pressing it against the stop P. This, also (being the best position for deflection), is designed to be its position of equilibrium; the counterpoise *s*, being utilised to this end. The needle being horizontal, the low-resistance circuit is open, and the current must pass through the carbon to return to the battery. It is then again balanced at D, and the resistance of the carbon accurately determined.

Turning to Fig. 3 we find that the instrument used at D (Fig. 1) consists of a deep vessel of mercury *a a*, communicating with a flexible reservoir A, which is under the control of the screw *s*. A scale is mounted on the vessel carrying a marker, *m*, which is movable on the screw attached to knob *k*; to the marker a thread of carbon, similar to that in the distant barometer, is attached, it is kept vertical and rigid by a small varnished platinum weight *n*, beneath the surface of the mercury. The marker is of ivory, and a binding screw, B, keeps the carbon in circuit, the circuit being completed through the mercury and iron wire I.

For equalising the resistances in the bridge, when the barometer is out of circuit, the screw S is turned, and the mercury thus raised or lowered on the carbon, till the galvanoscope returns to zero. This being effected, and the barometer restored to circuit, the galvanoscope is once more brought to zero by turning the knob K. The marker M now reads the height of the distant barometer.

The scale, in Fig. 3, may not really be one of inches and fractions of inches; it may have to be divided by experimentally comparing the two carbons. Probably it would be hopeless to expect them to be exactly similar in section throughout their entire lengths.

There are many ways of rendering this method of determining the height of a barometer by resistance more sensitive. It was suggested to me, for example, to double the effect on the resistance of any movement, by replacing the iron wire in the barometer by a second carbon. With this arrangement, moreover, if we still retain but the one carbon for equalisation (Fig. 3), the range is doubled, and the chances of errors correspondingly diminished.

Other meteorological instruments may also be read by this method. J. JOLY

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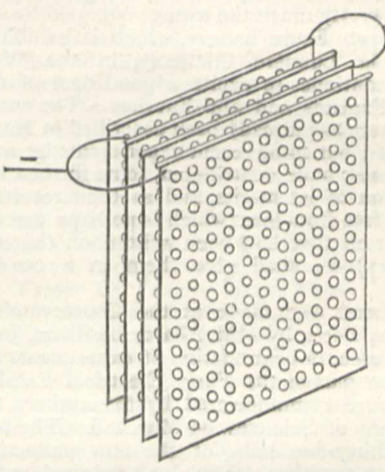
ELECTRICITY AT THE CRYSTAL PALACE

IV.—*Electrical Accumulators.*

THE new accumulator of Messrs. E. Volckmann and J. S. Sellon, exhibited at the Crystal Palace Electrical Exhibition, in connection with the Lane-Fox system of electric lighting in the Alhambra Courts, has already been announced, but its construction has hitherto been kept a secret for reasons of patent right. The storing-power of this new secondary battery may be gathered from the fact that 33 cells feed 201 Lane-Fox incandescent lamps, nominally of 20-candle power for 7 hours at a time, if the battery is fully charged to start with. The actual light of each lamp, however, is nearer 30 candles; and it is found that these lamps, which are designed to bear a 20-candle current from the generator, will stand a 30-candle current from the accumulator owing to its more uniform flow.

Each cell is stated to contain 5 horse-power of energy acting for an hour, or 1 horse-power for 5 hours, and so on. It consists of a series of metal plates of some alloy, each plate being $\frac{5}{16}''$ thick, and perforated with round $\frac{1}{2}$ inch holes, as close as they can be punched or cast. These plates are connected alternately in series like the plates of a condenser, as in the figure, and joined to two



stout terminals, which are the poles of the cell. The holes are filled with a metallic paste, the composition of which is not yet divulged, but may readily be guessed, from the fact that metallic lead is reduced on the negative plates, and peroxide of lead on the positive plates. The spaces between the plates, which are placed nearly an inch apart, are filled up with water mixed with one-tenth part of sulphuric acid, to give good conduction. The whole is contained in a wooden trough about 30 inches square and 8 inches in thickness. The weight of each cell is about 375 lbs., including 295 lbs. of the metallic composition which is the storing agent. The sparks given off on connecting several cells of the charged battery by a stout copper wire are remarkably violent, the deflagrated wire flying off in a perfect shower of red-hot sparks of copper accompanied by loud cracks. On examining the wire afterwards, it is found to be literally torn asunder in small pieces by the force of the discharge. A considerable quantity of hydrogen is evolved from the cells.

The exhibition of Lane-Fox lamps fed from this battery is without doubt the most beautiful display of incandescent lighting which has yet been made in this or any other country. This, however, is chiefly due to the designs of the ornamental lamps employed to show off the rich architecture of the Moorish courts. The arches of the courts are picked out with rows of lamps having bulb or opal glass, which give a very pleasing light, not in the least dazzling to the eye, but at the expense of 25 or 30 per cent. of the light. A crystal chandelier of the same kind of bulbs hangs in the Lion Court, and it is a moot point whether these opal globes, or globes of clouded glass are not best adapted for incandescent lamps in dwelling-rooms and studies. It is certain that the naked lights, though absolutely steady, have a dazzling effect on the eyes if looked at, which cannot but be injurious to the sight. The gems of the display are, however, three Mauresque electroliers designed by Mr. E. R. Johnson for Messrs. Verity Brothers, Regent Street. These large pagoda-like lanterns are hung in the inner courts, and the lights contained inside are only visible through the stained glass of the sides and bottom. The power of the lamps is ingeniously graduated by simply switching on or off more cells of the battery.

Rumours of at least two other secondary batteries of great promise are in the air; but it is not yet known what these are, and they have not been exhibited in action yet before the public. They are doubtless modifications of some or other of the ordinary voltaic batteries by which their action can be conveniently reversed, and the alteration patented. For it is obvious that the old combination pure and simple cannot be patented for a new purpose. It must be changed in some way or other, though the essential action may be pretty much the same.

The well-known Faure battery, which is exhibited by La Force et la Lumière Company, in the Western Corridor, still continues to excite a good deal of debate amongst the Faurites and anti-Faurites. The construction of the battery has already been described in NATURE, vol. xxv. p. 461; but some recent experiments by a group of French *savants* have contributed some further matter to the discussion of its merits, and as their results must be considered free from bias (which is perhaps more than can be said for all that has been written on the subject in this country) we shall give them in a condensed form.

The experiments were made at the Conservatoire des Arts et Métiers, Paris, by MM. Allard, Le Blanc, Joubert, Potier, and Tresca, in continuation of experiments begun during the latter part of the Paris Electrical Exhibition. The results were communicated by the authors to the French Academy of Sciences, on March 6. The battery consisted of thirty-five cells, of the new pattern, with plates rolled up together. Each cell weighed 43·7 kilograms, including the liquid. The lead plates were covered with minium to the amount of 10 kilograms per square metre. The solution was formed of distilled water, mixed with one-tenth of its weight of pure sulphuric acid. It will be seen that the cells were in the most favourable condition for experiment.

They were charged by a Siemens' machine, of which the armature resistance was 0·27 ohms, and the resistance of the inducing magnets was 19·45 ohms. The latter were excited by the current in a derived circuit from the main current in the armature. A species of voltameter was used to regulate this exerting current, so as to keep it between 2 and 3 ampères.

The object of the experiments was to measure—

1. The mechanical work expended in charging the battery.
2. The quantity of electricity "stored" during the charge.
3. The quantity of electricity yielded up during the discharge.
4. The electrical work actually done during the discharge.

It was also necessary to know, at each instant of the experiments, the electromotive force and the resistance of the battery; and further, as the discharge should make itself through a series of Maxim incandescent lamps, to study the variation of the resistance, and the luminous power of these lamps, according to the intensity of the current.

The mechanical work was measured by a totalising dynamometer, constructed for the French Society of Agriculture by Messrs. Easton and Anderson, after the model belonging to the English Royal Society of Agriculture. The luminous intensity was measured by a Foucault photometer, such as was employed in the Exhibition experiments. As to the electric measures they were made by means of a Marcel Deprez galvanometer which measured the total current generated, and sometimes the exciting current on the magnet; a Siemens' electrodynamometer which measured only the charging current; and a dial electrometer arranged according to a plan of M. Joubert, which gave the difference of potentials between the two poles of the battery. The indications of all the instruments were read off every quarter of an hour, sometimes at closer intervals.

The following table gives the principal results:—

TABLE I.—*Charge of the Battery*

Date.	Duration of experiments. h. m.	Speed of the dynamo.	Indicated work in kilogrametres.	Mean E.M.F. of the battery in volts.
January 4	5 30	1079	2,414,907	82·21
,, 5	7 0	1072	2,772,292	91·08
,, 6	7 30	1083	3,246,871	92·91
,, 7	2 45	1085	1,135,728	92·06
	22 45		9,569,798	
		Deduct	808,750	
			8,761,048	

(The work deducted was lost in the transmission of the indicated power to the dynamo.)

Date.	Duration of experiments. h. m.	Mean intensity of charging current in ampères.	Mean intensity of exciting current in ampères.	Quantity of electricity furnished by the battery in coulombs.
January 4	5 30	10·93	2·46	216,400
,, 5	7 0	7·97	2·81	200,800
,, 6	7 30	7·94	2·33	214,300
,, 7	2 45	6·36	2·18	63,000
	22 45			694,500

Date.	Duration of experiments. h. m.	Electric work of the charge in kilogrammetres.	Electric work of excitation in kilogrammetres.	Electric work of the ring in kilogrammetres.
January 4	5 30	1,814,600	408,400	94,400
,, 5	7 0	1,947,100	676,300	79,100
,, 6	7 30	2,028,800	596,100	76,800
,, 7	2 45	591,600	202,800	19,500
	22 45	6,382,100	1,883,600	269,800

The same determinations have been made during the discharge, observing at the same time the power of 12 Maxim lamps in a derived circuit. The light of a Carcel lamp was obtained from this experiment with an expenditure of 5·8 kilograms of electric work per second.

The following table gives the results for the discharge of the battery:—

TABLE II.—*Discharge of the Battery*

Date.	Duration of the experiment. h. m.	Mean E.M.F. of the battery in volts.	Mean resistance of the current in ampères.	Quantity of electricity in coulombs.	External electric work in kilogrammetres.
Jan. 7	7 19	61 39	16·128	424,800	2,608,000
,, 9	2 20	61 68	16·235	194,800	1,201,000
	10 39			619,600	3,809,000

The conclusion from these results is that between the quantity of electricity put into the battery (694,500 coulombs) and that got out (6,196,000 coulombs) there is a difference of only 74,900 coulombs, corresponding to a proportional loss of 10 per cent. (0·108). This refers, however, to the *quantity* of electricity, not, be it remembered, to the power stored. The electric work during the entire discharge was 3,809,000 kilograms. The mechanical work expended was 9,570,000 kilograms, but only 6,382,000 kilograms was really stored by the battery. It follows that the work recuperated or given back by the discharge of the battery is to that stored up, as 3,809,000 is to 6,382,000: that is to say, about 60 per cent. of the energy of the current was rendered up by the battery. If we compare the work recuperated with that indicated by the dynamometer, the percentage given back is still less, namely, 40 per cent.

This considerable loss of power, whilst the quantity of electricity is nearly the same in the charge and discharge, is due to the fact that there is a marked loss of electromotive force in the battery. Thus the charging current had 91 volts, while the discharging current had only 61·5 volts. It follows, from a consideration of the theory of the battery and the formula—

$$a = \frac{I'(E'-R'I')t'}{I(E-RI)t}$$

that the efficiency must always be less than unity, but may be greater as the intensities and resistances are less. In the formula, E is the E.M.F. of the battery, R its internal resistance, I and t the intensity of the current and its duration during charge, while the same letters marked serve for the corresponding quantities during discharge. It is therefore advantageous to charge the battery with a feeble current flowing for a long time. It was observed also, that the resistance of the battery was lower during discharge than charge.

To sum up, the charge of the battery requires a total mechanical work of 1·558 horse-power during 22h. 45m., which is equivalent to a horse-power during 35h. 26m. The battery only received 66 per cent. of the total work expended, the rest being lost in overcoming passive resistances, and exciting the field magnets. Only 60 per cent. of this power stored was yielded back by the battery, and there is reason to believe that the same result will be forthcoming in all applications similar to lighting by Maxim lamps.

THE WILD SILKS OF INDIA [1]

THE laudable efforts of the Indian Government to utilise the various products of which these wild silks form a class will tend, by the immediate production of wealth, and yet more by the spirit of intercommunication and enterprise thus created, to overcome the great difficulty of poverty and still greater difficulty of isolation, which so tasked its efforts in the last famine. And this work is the more desirable because, as the last census shows, the peaceful, firm rule of the British in India has removed that natural check to population which was found of old in the mutual internecine wars of its peoples; and numbers have increased to such an extent that the failure of a crop over any wide district is invariably followed now by a famine.

The principal varieties of wild silks found in India are the Tusser, or Tasar, the Eria, and the Muga, or Moonga, silks, besides several others, at present of little commercial importance.

Silk differs from all other materials used in textile fabrics in the nature of the thread as originally produced. Hemp, flax, cotton, wool, and many other threads are produced by the twisting tightly together of the short but very fine fibres of the raw material, the untwisting of which reduces the thread again to short loose fragments. The long fibre of the best Sea-Island cotton does not much exceed 1½ inches in length. Silk, on the other hand, is spun by the silkworm (except that it is not a worm, and does not spin it!) in one long thread: three-quarters of a mile is quoted by Mr. Wardle as the length of the thread of a Tusser worm. There is no "spinning" in the process at all, but two fine threads come from the spinnarets of the grub as from the spinnarets of a spider in such a glutinous semi-liquid condition that they coalesce into one thread, which, in the best kind of silkworms, can be wound without a break from the outside of the suspended cocoon to where the grub left off spinning and turned into a chrysalis. The silk-reeler does not, even in the coarse Tusser variety, reel off a cocoon of this singly, but from four to six together, whose gummy surfaces make them combine into a single thread still fine.

[1] "Handbook of the Collection Illustrative of the Wild Silks of India in he Indian Section of the South Kensington Museum," by Thomas Wardle. (Eyre and Spottiswoode, 1881.)

The Eria cocoon is not found practically so available for this treatment, but, in addition to the beautiful continuous thread of the Bombyx or Tusser silkworm, the waste part of their cocoons can be treated like the vegetable fibres (cotton, &c.) of which we spoke with equally good results as a textile material, and with nearly all the beauty of the perfect silk thread. For this purpose the whole of the cocoon of the Eria is specially available, and, instead of being carefully reeled off, it is cut up or torn into shreds by the carding machine, and then treated as a long staple cotton. This is known as spun silk, or by the more recent name of Schappe. If, however, the surface of such a thread is examined, even with small magnifying power, it will show the loose ends of the fibres sticking out in every direction; and although they are individually too fine to attract the attention of the naked eye, in combination they are quite patent to the finger and to the ear, a soft deadness resulting instead of the sharp whistle of the natural silk, on which are no fibres except the ends left by careless throwsters.

Another inferiority of spun silk, though not a great one in the ever-changing fashionable world of England, is that it has not the durability which distinguishes the continuous silk thread. Yet in India garments made from the former are handed down from mother to daughter!

The Tusser or Tusseh larva, whose coarse, strong thread is available for thrown silk, is a monster compared with the larva of the *Bombyx mori*, or common silk-worm, It measures 7 inches in length and 1 inch in diameter; the wings of the moth—a very handsome one—are 7 inches across, and the thread also is three times as coarse, and three times as strong as that of the China silkworm. Here, however, comes an objection to it in the eye of the manufacturer. While the thread of the Bombyx is almost round, the extra coarseness of the Tusser thread all consists in its extra width: it is, in fact, three times as broad as it is thick. Like any thread of this shape compared with a round one, it has a great tendency to split, and consequently become rough in working. Another difficulty to both reelers and dyers is caused by the substantial way in which the Tusser grub forms its cocoons. Major Coussmaker observes that—

"As the chrysalis remains in the cocoon as long as eight months, exposed to the hottest sun and occasional thunderstorms, the cocoon had need to be made a hard impenetrable material; so indestructible is it, that Bheels and other tribes which live in the jungles, use the cocoon as an extinguisher to the bamboo tube in which they keep the 'falita' or cotton tinder used by them for lighting their tobacco and the slow matches of their matchlocks. The cocoon is also cut into a long spiral band, and used for binding the barrel of matchlocks to the stocks, being, as the natives say, unaffected either by fire or water. . . . . After the caterpillar has spun a layer of silk thick enough to conceal itself, it discharges some kind of gum or cement, thick like plaster of Paris, and with its muscular action it causes this secretion to thoroughly permeate the whole cocoon and solidify the wall. In this manner it goes on spinning layer after layer of loops, and cementing them altogether until the whole of its silk is exhausted, and the wall of the cocoon becomes so hard that it requires a sharp penknife to cut through it" (pp. 18, 19).

Again, in a later report (February 21, 1880), Major Coussmaker writes:—

"One of the most interesting, and I think important, facts that I have this year been able to prove, is with regard to the composition of the cement with which the caterpillar hardens its cocoon. Former analyses of this agent made for me, in England by Dr. Taylor, and in Bombay by Dr. Lyon, had shown that it contained the acid urate of ammonia, that it was in fact excrementitious; and this year, by opening the cocoons at various intervals, I was able to convince myself of the fact that when the caterpillar has left off feeding and begins to spin, it voids the food remaining in the alimentary canal, first of all in a more or less solid form and of a dark colour, but after it has become fully enveloped in the cocoon the excrement comes away as a light-coloured liquid, the hue and consistency of which depend upon the amount of vegetable matter not previously evacuated and the amount of lime, carbon, and ammonia present. The respective proportions of these ingredients vary, I presume, with the food upon which the caterpillar has fed, and with the state of the atmosphere at the time of spinning; also the longer they remain coating the fibre the harsher and more discoloured it will be. It is therefore very necessary, I think, to remove this cement at a very early date; and this chemistry has shown the manufacturers how to do. Judicious feeding too may alter its nature. Before long, fresh cocoons will be at an early stage thoroughly cleansed from all discolouring matter, and Tasar silk will be available for manufacturing purposes as colourless as it is when first put forth by the caterpillar" (p. 21).

At any rate here is a fine field for both economic and philosophical results for both the chemist and the naturalist.

There are two crops of Tusser silk in the year, *i.e.* two generations of grubs pass from the egg to the imago, whereas the Bombyx of commerce so passes only once. The moth is considered a sacred insect, and it is interesting to read of the long series of ascetic ordinances connected with the attendance upon it, the failure to observe which will bring down the anger of the gods and destruction upon the cultivators. Yet the grubs are said to flourish better out-of-doors than under the roof and care of men, and are found feeding upon seventeen different species of trees growing wild over various parts of Hindostan. It is much more practicable and hopeful to engage the unenterprising natives in its collection under these conditions than if the elaborate art with which the Chinese cultivate the Bombyx were required.

The silk of the Eria and Moonga or Muga cocoons is softer and of a clearer colour than the Tusser silk, but lacks the strength of that very coarse variety. It dyes well, but is difficult to wind. In all respects therefore it is easier to work it up into spun silk.

The favourite food of the Eria is the *Palma Christi* or castor oil plant, *Ricinis communis*. So productive is this worm that it sometimes gives twelve broods, *i.e.* generations, in a year.

The Muga worm breeds five times; the colour of the silk varies with the food, some of it retaining its drabby colour till the last. The moths of all these genera are large and handsome. The magnificent *Attacus atlas* moth, called in France Le Géant des Papillons, measures upwards of ten inches in expanse of wing. It is a common idea that moths *eat* their way out of their cocoons, and that all permitted to do so spoil their silk; but even in the case of the solid cocoon of the Tusser moth it is observed that "after eight or nine months in the pupa state a moist spot is observed at one end of the cocoon. The moth is now about to emerge both from its pupa shell and from the cocoon. It secretes an acid fluid which softens the cement of the cocoon, and enables it to separate the fibres sufficiently to allow of its creeping out" (p. 19). Capt. Brooke also says that "in Seonee the pierced cocoons are wound, and that no koshtee rejects a cocoon simply because the moth has eaten its way through it. . . . It does not eat its way out but separates the fibres with its legs and wing-spine, and so creeps out. It has neither teeth nor mouth proper" (p. 26). More remarkable still is the provision made by the larva of this *Attacus atlas*, "the upper extremity of whose cocoon forms a natural orifice for the exit of the moth, made by the conveyance of a great number of silk fibres which are left ungummed, and are thus soft and flossy; thus the exit of the imago leaves no disturbance behind" (p. 63).

The most interesting question, of course, is, how far care and industry can improve this imperfect natural wealth. The strongest proof of the value of such education is to be found in the fact that the beautiful Italian and French silks, whose fineness and regularity insure for them a price 50 per cent. higher than the best China silks, are the lineal descendants of the eggs brought from China in the reign of Justinian. The destruction caused among them by the dreadful disease, pebrine, has necessitated the import into Europe of Japanese eggs, the drabby colour of the silk of which marred all the efforts of the dyer to obtain clear delicate tints, especially in different shades of white; but careful attention and artificial selection are bringing them near to equality with the pure European silk; and Major Coussmaker in Pooneh has succeeded in obtaining perfectly white Tusser silk by causing the caterpillar to void all its excrement before spinning.

The special fitness of Tusser silk for the dark dull colours now fashionable is most optimistically expressed by Mr. Wardle in the phrase that "Tusser silk properly dyed inherently takes shades of *artistic merit*." Is dirt then beauty? and purity and brilliancy essentially vulgar?

There can be little doubt that European skill and machinery would more than balance the cheapness of Indian labour, which could be trusted to produce only the commonest qualities of thrown silk. It is also far safer and less likely to end in failure or discouragement to make spun silk the object of Indian produce than to attempt to rival the beautiful productions of Italy and China.

One cannot help noticing with satisfaction in this concise history the working together for good of such widely separated parties as, in India, the high Government official, the investigating naturalist, the active military officer in charge of a district; then the organising British manufacturer, who brings into willing co-operation the Italian throwster, the Leek dyer, the Halifax weaver, the London artist, not to mention the taste and skill of the lady-bountiful of her neighbourhood.

W. ODELL

NOTES

ON Tuesday evening, April 11, the public thoroughfare stretching between Hatton Garden and the Old Bailey was lighted for the first time by the electric light. The novelty of the installation was the fact that the incandescent system had been adopted in preference to the arc system. Mr. E. H. Johnson, the agent of the Edison Electric Light Company, has in fact made a public demonstration of the Edison system by lighting up a district of London in the same way as by gas. In addition to the street lights, the different premises lining the street are also lighted; for example, the City Temple Church, Messrs. Negretti and Zambra's, Messrs. Spiers and Pond's. In all there are 936 incandescent lamps, and these are fed by one of the large dynamos stationed at No. 57, Holborn, the distributing centre of the company. These large generators are made upon the same plan as the smaller ones recently described by us, and are driven by Porter engines. They yield a current of 1025 ampères. The resistance of each lamp white-hot is 140 ohms, and as this is much greater than the hot resistance of other incandescent lamps, the resistance of a long circuit is not so relatively high as in other systems, and hence there is less need of large leads. The cost of copper for conductors is an important item in electric lighting, but should copper conductors become too expensive to use, Mr. Edison intends to employ iron, say old iron rails. Mr. E. H. Johnson states that the company intend to manufacture and supply electricity for all kinds of purposes, and judging from experience gathered in New York, where a district is lighted by this system, the profits from the sale of electricity for power purposes alone will pay the company's dividends, so that they can afford to give the light for nothing. This remark is a rejoinder to those who argue that the gas companies will successfully compete with the electric light, because the profits from their waste products will pay their dividends. The Holborn street lamps each contain two of Edison's bulbs suspended from a cross bar running through the top of the lantern. The light is of a golden tinge like gas, but much purer, brighter, and steadier. The lamps were switched on and off with the greatest ease, and altogether the experiment was a complete success.

THE Commission of the French Academy of Sciences for the Transit of Venus expeditions have completed their work. All the astronomers selected are practising daily at the observatory, taking readings with the artificial transit apparatus, invented by M. Wolf on the occasion of the last transit. In spite of some objections, which have been disregarded, three kinds of observations will be taken: (1) by direct contact; (2) by refracting prisms and micrometrical distances; (3) by photography. The stations are the following: French Antilles (Guadeloupe or Martinique), directed by M. Tisserand; Spanish Antilles (Cuba), M. d'Abadie; Florida (United States), Col. Perrier; Coast of Mexico, M. Bouquet de la Grye; Patagonia (on the Rio Negro), M Perrotin, director of the Nice Observatory; (M. Bischoffsheim will be at the expense of the partial fitting out of this expedition); Santa Cruz, Capt. Fleuriais. It is to be remarked that very few of the heads of the missions sent out in 1874 have been appointed again by the French Institute. Four of these eight stations are located in the northern hemisphere, and four in the southern. At all of them will be observed the entrance and the exit.

THE use of Jablochkoff lights in the Avenue de l'Opera has been discontinued, the Municipal Council of Paris having refused to grant a concession of ten years, which was asked for by the Company. It is said that other electric light companies will make proposals for the illumination of that fashionable part of Paris. In the meantime M. Cances, the inventor of a new regulator, is illuminating experimentally the rue de Crassant, a long and narrow lane of Central Paris, where newsagents have congregated for the last half century.

ON March 20 last, William Edward Gaine, C.E., the inventor of parchment paper, died at the residence of his son, at Blackburn, at the age of sixty-five.

THE usual Congress of Astronomers and Meteorologists will take place this week in Paris, as well as the Congress of the Sociétés Savantes, the annual meeting of the Société de Physique, and the Association Scientifique de France. But the Congress of Instituteurs and Institutrices has been postponed for a future period. M. Ferry will deliver as usual the official speech as Minister of Public Instruction, on Saturday, on the occasion of the distribution of prizes to the delegates of learned societies.

MM. MIGNAN AND RANARD have constructed an integrating hygrometer for precipitating the vapour of the atmosphere, and analysing the products if required. It is composed of an iron tube filled with liquor ammoniæ; by gently opening a taper the ammonia is absorbed by water and the hygrometer is covered with moisture which is collected in a cup arranged for the purpose. During the recent dry weather the amount of precipitation was 3 grammes of water in twenty minutes. The weight of liquor ammoniæ was 34 grammes. A peculiarity is that a number of floating particles are precipitated with the humidity of the air. It has been suggested by M. W. de Fonvielle that the hygrometer might be used for analysing the matter of clouds where the precipitation of a few grammes will be a question of a very few minutes.

EXPERIMENTING with electro-magnets on various minerals, Prof. Doelter has made the interesting observation that the absolute amount of iron present does not determine the degree to which the minerals are attracted, for sulphides and sulphates containing much iron are very little attracted, while the attraction of oxides, carbonates, and silicates is strong. This varying amount of attraction (it is pointed out) may be of service in mechanical separation of natural mixtures of ores, purifying ores, isolation of rock matter, and approximate estimation of quantitative mineralogical composition.

THE project started by Admiral Mouchez of building a captive balloon for observing the conditions of the air at several hundred metres from the earth will be abandoned; but a captive balloon will be established at Montsouris Meteorological Observatory.

THE deaths are announced of Prince Wladislaus Lubomirski, an eminent conchologist, who recently died at Warsaw, aged fifty-eight; and of Prof. Vincenz Kletzinsky, Professor of Chemistry at the Wieden Communal School, who died at Vienna on March 18 last, aged fifty-six.

THE Ethnographical Congress which was to meet this week at Geneva has been indefinitely postponed. The number of participators who intended to be present from England, Germany, Austria, and Italy was not considered sufficient by the Committee.

MOUNT ETNA has again been in an active condition. An eruption and a rain of ashes (rampilli) has quite recently alarmed the neighbouring inhabitants.

THE first number is published of Dr. M. C. Cooke's "British Freshwater Algæ" (exclusive of Desmidieæ and Diatomaceæ). As no systematic work on the subject has been published since Hassall's in 1845, a good account of British Freshwater Algæ is much wanted. In the present number, which includes the Palmellaceæ only, Dr. Cooke has perhaps already reached the most difficult part of his work, the history of development of some of these lower organisms being still very obscure. We could have wished to see, at the outset, a greater effort to give the student something approaching a natural classification of Algæ, instead of the very rough and artificial one which Dr. Cooke has adopted. The exclusion of the desmids and diatoms is wise, these forming a separate literature of their own.

PROF. E. MORREN issues the ninth annual edition of the "Correspondance Botanique" (Liste des Jardins, des Chaires, des Musées, des Révues, et des Sociétés de Botanique du Monde), well posted up to the close of the year 1881.

IN addition to the above catalogue, the *Bulletin de la fédération des Sociétés d'Horticulture de Belgique* (1881), published under the authority of the Belgian Government, contains the official report of the National Exhibition of Horticulture and Pomology, held at Brussels in 1880, in honour of the fiftieth anniversary of the independence of Belgium; much other horticultural information, and a paper on the Bromeliaceæ of Brazil.

SINCE March 1 a new Spanish periodical, *Revista Germanica de Literatura, Artes y Ciencias*, is published at Leipzig twice a month. Its editors are Señores S. Gimenez and J. O. Monasterio; Herr L. Seidel is the publisher. The object of the serial is to facilitate intellectual intercourse between Germany and the Spanish races.

AT the last meeting of the American Association a lecture was delivered by Capt. C. E. Dutton, of the United States Geological Survey, upon the "Excavation of the Grand Cañon of the Colorado River." The lecture was illustrated by a large number of lantern views. A picture of the chasm, at a point about the middle of its length, was exhibited as a type, showing that it consists of an inner and an outer gorge, or an upper and a lower chasm. The outer one is about five miles in width, with palisades on either side, very nearly 2000 feet high, facing each other across a comparatively smooth plain or valley floor.

Within this floor is sunken the great inner gorge, 3000 feet deep, with nearly vertical walls. The width of the inner gorge is about the same as the depth, or 3000 to 3500 feet. The strata exposed in this section are 4500 feet of Carboniferous (the entire local series), and 500 or 600 feet of Lower Silurian or Primordial. The speaker then indicated the salient features of the topography and stratigraphy of the country in the vicinity of the chasm. It is for the most part a desert plain, surfaced by the summit beds of the Carboniferous, with low mounds or flats consisting of remnants of the Permian, and occasionally a small remnant of the Lower Trias. Forty miles north of the chasm is found the main Permian mass lying as a higher bench or terrace terminated southwardly by a cliff. Proceeding northward, the Trias, the Jurassic, the Cretaceous, and the Lower Eocene systems are successively encountered, each at intervals of five to ten miles. Each of these formations is likewise terminated southwardly by a great cliff, and the whole series, from the Permian to the Eocene inclusive, constitute a stairway leading up to the high plateaux of Utah. Capt. Dutton stated that conclusive evidence has been found that these terraced formations, thus abruptly terminated, once extended southward across the Grand Cañon and far into Central Arizona, but have been denuded down to the summit of the Carboniferous. The total thickness of beds removed was a little over 10,000 feet, and the eroded area was from 13,000 to 15,000 square miles. This area is called by him the Grand Cañon district. The erosion began about the middle of Eocene time, and has continued uninterruptedly to the present. The cutting of the Grand Cañon is merely the closing episode of a much greater work. The excavation of the present cañon is a comparatively recent geological event, and Capt. Dutton is of the opinion that its origin does not antedate the Pliocene period. He then explained some of the more important considerations and conditions upon which the cutting of cañons depends, and showed the natural mechanical process of creating and maintaining the singularly beautiful and architectural profiles of the cliffs, and how their wonderfully constant outlines are preserved. He then entertained his audience by a graphic and enthusiastic description of the phenomenal scenery revealed in the wider and deeper portions of the chasm.

THE geology of Spain being yet very imperfectly known, we are glad to find in a recent number of the *Boletin* of the Geographical Society of Madrid the continuation of Don Juan Vilanova's paper on the geological survey of the province of Valencia, being a description of the Tertiary formation of the province. This formation consists of conglomerates and clays covered with marls, sandstones, grits, and gypsum, with beds of lignite and peat. The surface is undulated, forming low hills with gentle slopes, but intersected with deep ravines, or barrancos, or terrace-like, with deep ravines, along which streams flow in cascades during the rainy season. Wide lacustrian basins at Bicorp, which were considered by Verneuil as Cretaceous, belong also to this formation.

THE Jubilee Meeting of the British Medical Association will be held at Worcester, on August 8–11. The president-elect is Dr. William Strange, senior physician to the General Infirmary, Worcester.

PROF. HAECKEL is giving some account of his recent visit to Ceylon and India in the *Deutsche Rundschau*.

WE read in the "Diario de Manila" that a German ethnologist, Dr. Schadenberg, of Breslau, has now resided for some time amid the savage tribes in Sibotam, at the foot of the Volcano of Apo, for the purpose of studying the ethnography of the tribes of Atas, Bagobos, Manobos, Mandayas, Tagacaolos, Vilanes, Samales, Sanguiles, Moros, and Guiangas. All these races differ materially in language, religious customs, attire, and habits, so that Dr. Schadenberg has certainly selected a rich field of study.

IN a *brochure* published by Messrs. Sampson Low and Co., Col. Burnaby has given an interesting narrative of his recent balloon trip across the Channel.

THE additions to the Zoological Society's Gardens during the past week include a Black-eared Marmoset (*Hapale penicillata*) from South-East Brazil, presented by Mrs. Davidson; a Ring-tailed Lemur (*Lemur catta* ♂) from Madagascar, presented by Dr. J. Lea, M.R.C.S.; two Grey-backed White-eyes (*Zosterops dorsalis*) from Australia, presented by Mr. J. Abrahams; a Jardine's Parrot (*Pæocephalus gulielmi*) from West Africa, presented by Capt. H. Hope Keighley, 2nd W.I. Regt.; three Zebra Waxbills (*Estrelda subflava*), a Shining Weaver Bird (*Hypochera nitens*) from Africa, two Amaduvade Finches (*Estrelda amandava*) from India, a Crimson-eared Waxbill (*Estrelda phœnicotis*) from West Africa, presented by Mrs. Beauclerk; a Common Buzzard (*Buteo vulgaris*), British, presented by Mr. J. C. S. Rocke; a Common Partridge (*Perdix cinerea* ♂), British, presented by Mr. H. T. Bowes; a Long-tailed Copsychus (*Copsychus saularis*) from India, deposited; a Mantchurian Crossoptilon (*Crossoptilon mantchuricum* ♂) from North China, two Japanese Pheasants (*Phasianus versicolor* ♂ ♀) from Japan, an Amherst Pheasant (*Thaumalea amherstiæ* ♀), a Gold Pheasant (*Thaumalea picta* ♀) from China, a Lineated Pheasant (*Euplocamus lineatus* ♂) from Tenasserim, two Black-backed Kaleeges (*Euplocamus melanotus* ♂ ♀) from Sikkim, two White-crested Kaleeges (*Euplocamus albo-cristatus* ♂ ♀) from North-West Himalayas, two Hasting's Horned Tragopans (*Ceriornis hastingii* ♂ ♀) from North India, purchased; a Rifle Bird (*Ptilorhis paradisea* ♂) from Australia, received on approval; a Sambur Deer (*Cervus aristoteles* ♀), a Gaimard's Rat Kangaroo (*Hypsiprymnus gaimardi*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

A SYSTEMATIC SEARCH FOR COMETS.—The necessity of a more rigorous and systematic examination of the heavens with the view to the early discovery of telescopic comets has been somewhat forcibly exemplified of late years, and it is satisfactory to learn that American observers are taking the initiative vigorously in this direction. A partial arrangement for regular sweeping has been made, and is detailed in a circular issued from the office of the *Science Observer*, in which also further cooperation is invited, and it is to be hoped that amateurs here with the necessary instruments, and time at command, will actively second the efforts that are being made in the United States, to further our knowledge of these, as yet, in a cosmical sense at least, problematical bodies. Mr. W. F. Denning, of Bristol, after proving his extraordinary patience and perseverance in the observation of meteors, and who has done excellent work in that class of observation, has for some months instituted a search for comets in such quarters of the sky as his position best commanded, and has made, as we know, a most notable beginning by the detection of the comet of short period, which astronomers will recognise in future as "Denning's comet." He has kindly afforded us an opportunity of perusing a letter addressed to him by Mr. J. Ritchie, jun., of Boston, U.S., from which we may be pardoned for making the following extract:—"We wish it understood that although from the circumstances of the organisation, the majority of observers are here in this country, still we do not wish to make anything exclusive or national about it, and are simply after the most scientific ways of doing certain things, and are ready to receive that advice which the experience of others renders them competent to give." Mr. Denning has found a coadjutor to divide with him the examination of the eastern sky in the morning hours, and there should be little difficulty in arranging for other amateurs here to take part in an evening search. Two or more observers in the other hemisphere will be needed to complete the regular scrutiny of the whole sky, and we do not anticipate that the scheme will be rendered imperfect for want of them.

It would be an easy matter to cite a number of cases where the earlier detection of comets would have materially aided our knowledge of their motions in space, and probably of their gradual development in approaching the sun. We may refer to two cases of recent occurrence. The fifth comet of 1877 was detected by Tempel on October 2, when its south declination was already 10°, and its motion towards the south did not permit of its being followed after October 14, when the last observations were made at Leipsic and Milan. On the orbit being calculated, it was found that the comet had passed the perihelion as early as the end of June, and, further, that it had escaped observation before perihelion, when in a much more favourable position than at the time of its discovery by Tempel. Thus, on April 5, as the moon was drawing away from the evening sky, it was in R.A. 161°, Decl. +57°, consequently a circumpolar object in these latitudes, its distance from the sun was 1·69, and from the earth 1·05, and the intensity of light, expressed in the usual manner, was 0·32. At its actual discovery, on October 2, the distance from the sun was 1·86, and from the earth 0·88, consequently the intensity of light was 0·36, or virtually the same as on April 5. But the orbital arc available for the final calculation of the elements was less than 4½°, whereas if the comet had been detected in its more favourable position towards the end of the first week in April, there would have been available for this purpose an orbital arc of upwards of 160°.

As a second case in point, we may mention the circumstances attending the discovery of the comet by Mr. Denning last October, and its previous track. Mr. Denning found it on October 3, the perihelion passage having taken place on September 13, so that it was already at a considerable angular distance from perihelion at the first accurate observation. But prior to arriving at its least distance it had made the following tour of the southern heavens. In the column headed "Intensity of Light," the brightness at discovery on October 3 is taken as unity.

12h. G.M.T.	R.A.	Decl. °	Distance from Earth.	Intensity of Light.
June 26	296·1	−33·8	0·481	0·8
July 25	280·3	66·9	0·159	11·9
30	228·5	80·5	0·128	20·4
Aug. 2	158·9	74·9	0·118	25·6
4	143·2	65·6	0·116	27·6
6	136·0	55·6	0·119	27·9
8	131·8	−45·8	0·125	26·5
Sept. 13	129·2	+11·1	0·503	2·9

With anything approaching to a regular examination of the southern sky such an object could not have escaped notice.

CHEMICAL NOTES

WHETHER the atomic weight of uranium is represented by the number 120 or 240, is still a disputed question. Experiments recently conducted by Herr Zimmermann (*Berichte*) are strongly in favour of the latter number. Herr Zimmermann has determined the densities of the vapours of uranium tetrabromide and tetrachloride, by Victor Meyer's method, at the temperature of a Perrot's furnace; his results are as follows:—

	Sp. gr. of vapour.	Calculated. U=120.	Calculated. U=240.
Uranium tetrabromide	19·46 (mean of 6)	9·68	19·36
Uranium tetrachloride	13·33 (mean of 4)	6·60	13·21

SEVERAL important papers on general considerations regarding processes of chemical change, by MM. Potilitzin, Beketow, and Kajander, have appeared in the *Journal* of the Russian Chemical Society (good abstracts in *Berliner Berichte*, xiv. 2044–2058). As a deduction from experimental results, M. Potilitzin concludes that in every reaction, whether in presence or absence of water, a division of the elements of the reacting bodies occurs, and this is conditioned by the atomic weights of the elements, and the mass of the reacting substances. Berthelot's principle of maximum work is only applicable when but a single product is formed in a reaction, and when the energy, liberated in the reaction, all appears as heat. But in actually-occurring processes of chemical change there is a conversion of potential into kinetic energy, and subsequent employment of this kinetic energy in the work of fusion, evaporation, affinity, &c. Sometimes a portion of this energy may be used in the formation of compounds wherein heat is absorbed. This change of potential into kinetic energy is counterbalanced by the conversion of energy of motion into heat: a condition of equilibrium for the entire chemical system is thus attained, conditioned chiefly by the atomic weights of the reacting elements, the masses of the chemical substances in the system, and the relative amounts of potential and kinetic energy. The heat evolved in a chemical change measures the initial velocity of that change; but the final result of the change is dependent on the attainment of a general equilibrium, the conditions of which have been stated. Any change in one or more of these conditions causes a change in the direction of the chemical reaction.

IN the paper of M. Kajander the action of acids on plates of magnesium is considered: it is shown that the velocity of the action is inversely proportional to the internal friction of the liquid: raising the temperature of the liquid acts by diminishing the internal friction.

PROF. MENSCHUTKIN continues to publish, in the *Journal* of the Russian Chemical and Physical Society his researches on the influence of isomerism on the formation of compound ethers, and deals with the etherification of polybasic acids. The researches are rendered difficult by the circumstance that we know but few polybasic acids, the structure of which is well determined. Altogether the etherification of polybasic acids is very like the etherification of monobasic acids; the limits of etherification are always high, if a primary alcohol is taken for the formation of the ether; the rate of etherification varies with the isomerism of the acid, and the variations of the rate are as in monobasic acids. This likeness is the more remarkable, as the reactions are far more complicated in this case than in the preceding one.

PROF. MENSCHUTKIN also discusses the influence of the molecular weight of homologues on the course followed by incomplete and reversed reactions. He has succeeded in establishing that the law of homology, extends as well to the chemical as to the physical properties of homologues, and as well to their complete reactions, as to the incomplete ones.

THE phenomenon noticed by Mills, and called by him "chemical repulsion"—referred to some time ago in these "Notes"—has been recently studied by Herr Lecher (*Wien. Akad. Ber.*), who thinks that there is no need for the new hypothesis of chemical action at a distance introduced by Mills. A few drops of barium chloride solution are placed on the surface of a glass plate, a second plate containing two circular holes is pressed on the first, and a drop of sulphuric acid is introduced at each hole: the formation of barium sulphate proceeds in circles which gradually extend their circumference, but cease to do so before they come into contact. The author's explanation, which is based on several experiments, assumes that the barium chloride molecules originally move equally in all directions through the liquid; the presence of sulphuric acid, however, fixes many of these molecules and prevents their moving out of the sphere of action of the acid: the space between the advancing circles of barium sulphate thus becomes gradually poorer in barium chloride, until finally the whole of this salt is removed: there is a space of no action, because the compounds which react are absent.

HERR SCHULZE (*Journ. für pract. Chem.*) describes an interesting case of so-called "catalytic action." Sulphuryl chloride (SO_2Cl_2) is not formed by the action of chlorine on gaseous or liquid sulphur dioxide, but if these gases be passed over camphor, large quantities of sulphuryl chloride are produced; five grams of camphor sufficed to induce the formation of 470 grams of sulphuryl chloride. Acetic or formic acid likewise induces the combination of chlorine and sulphur dioxide, but these compounds are themselves more or less attacked, whilst camphor remains unchanged at the close of the reaction. Acetic and formic acids dissolve considerable quantities of sulphur dioxide, but other good solvents of this compound, *e.g.* acetone, fail to induce the formation of sulphuryl chloride.

MALLET (*Amer. Chem. Journ.*) finds the number 1·759 as representing the sp. gr. of hydrofluoric acid gas at 25°, hence molecular weight = 39·32. If this determination is confirmed, the formula of the compound in question must be written H_2F_2, and not, as at present, HF. But if Mallet's formula is correct, the atom of fluorine must be divalent; it has hitherto been regarded as markedly monovalent.

M. L. DE BOISBAUDRAN (*Compt. rend.*) has prepared gallic chloride, Ga_2Cl_6. The specific gravity of the vapour of this chloride, at 273°, was found to be 11·9, which confirms the formula Ga_2Cl_6.

AN iron wire embedded in lampblack and heated to redness in the reducing flame of the blowpipe loses weight; a portion of the iron, according to Colson, diffuses into the carbon. This chemist states that solids diffuse into each other when a chemical action can take place between the solids in contact (*Compt. rend.* xciii. 1074).

IN the *Berichte* (xv. 109) Brauner describes some new compounds of the cerium metals, especially *Cerium tetrafluoride*, CeF_4, and didymium pentoxide, Di_2O_5; he also gives data whence he deduces the value 146·5 for the atomic weight of didymium. Brauner likewise discusses the grouping of these metals in accordance with the "periodic law," and shows that didymium may fairly be placed as the eighth member of group V., the members of which group form pentoxides, M_2O_5 (see also *Chem. Soc. Journal*, Trans. 1882, p. 68).

VARIOUS new salts analogous to the ferrocyanides and ferricyanides are described by Descamps (*Ann. Chim. Phys.* [5] xxiv. 178), chiefly *mangano-* and *mangani-cyanides*, *cobalto-cyanides*, and *chromo-cyanides.*

FROM experiments on the action of sulphur dioxide on nitric oxide, Lunge concludes that, when water is present, sulphur dioxide partially reduces the higher oxides of nitrogen to nitrous oxide, even in presence of free oxygen (*Berichte*, xiv. 2196). These results of Lunge's have a direct bearing on the changes which proceed in the chambers of the sulphuric acid manufacturer.

THE synthetical production of urea, by passing air charged with ammonia and benzene over hot spirals of platinum wire, is described by E. F. Herroun in *Chem. Soc. Journ.* Heated spongy platinum, or platinised asbestos, caused a large production of ammonium carbonate with little urea; platinised charcoal caused the production of much urea, but the action proceeded more slowly than when spirals of platinum wire were employed.

FROM results of series of measurements, the following general statement regarding fractional distillation is made by F. D. Brown (*Chem. Soc. Journ.*). "In distillations with a still-head maintained at a constant temperature, the composition of the distillate is constant, and is identical with that of the vapour evolved by a mixture whose boiling-point equals the temperature of the still-head." Brown thinks that the reciprocity between a liquid mixture and the gaseous mixture evolved by it on ebullition has been too much neglected in reasonings about fractional distillation.

THE explosion of fulminate of mercury has been studied by Berthelot and Vieille (*Ann. Chim. Phys.*). The chemical change which occurs when this salt is exploded is a simple one, thus: $C_2HgN_2O_2 = 2CO + N_2 + Hg$; the heat produced, at constant pressure, per gram-molecule, is sufficient to raise the temperature of the products of explosion (supposing these already gaseous) to about 4200°. The local action exerted when the fulminate is exploded in a closed vessel is more violent than with other explosives, but the total pressure is only about three-fourths of that produced by dynamite or nitro-glycerine. The instantaneous nature of the explosion of fulminate, the almost complete absence of dissociation of the products, and the high specific gravity of the material, conspire to render the explosion of this substance very effective.

ACCORDING to M. Amagat (*Compt. rend.*) pure dry oxygen exerts no action on mercury even under pressure: this is opposed to the results obtained by Regnault.

FURTHER observations bearing on the relations existing between molecular structure and the absorption spectra of carbon compounds are described by Hartley (*Chem. Soc. Journ.*, Trans., p. 45), who concludes that "the simple union of carbon to nitrogen does not cause selective absorption of the ultra-violet rays." This conclusion is aplied to a discussion of the structural formulæ of several compounds, more especially of *cyanuric acid*, the molecule of which appears to possess "a nucleus with a compactness of structure intermediate between that of benzene hexchloride and that of benzene."

EXPERIMENTS by Remsen and Hall (*Amer. Chem. Journ.* ii. 50) on the oxidation of *sulphamine-para-toluic acid* confirm the general statement that when, in a derivative of an aromatic hydrocarbon, one of the substituting groups is electronegative, this negative group exerts a *protective influence* on the other group during oxidation.

VARIOUS papers on the cinchona alkaloids have recently been published: two new alkaloids are described, one by Arnaud, under the name of *cinchonamine* (*Compt. rend.* xciii. 593), the other—*homoquinine*—by Howard and Hodgkin (*Chem. Soc. Journ.*, Trans., 1882, p. 66). Both alkaloids are found in bark from Santander, Columbia, described by Flückiger as *China cuprea.* The structural formulæ of *quinoline*, *quinic*, and *quinuric acids*, are discussed at length by Skraup (*Monatshefte für Chemie*, ii. 587). Various sulphuric derivatives of cinchonine are described by Weidel (same journal, p. 565), and papers of importance, although too technical for detailed notice here, on cinchonine and the so-called homocinchonine, by Koenigs, Hesse, and Claus, appear in the *Berichte* (xiv. 1852, 1888, 1890, and 1921).

REINCKE states (*Berichte*, xiv. 2144) that he has obtained aldehydic substances from the juices of chlorophyll containing plants. The formation of these substances appears to depend on the action of sunlight. Reincke thinks that formic aldehyde is present as the most active among these reducing substances, but he does not support this supposition by experimental evidence.

HERREN GOLDSCHMIDT and V. Meyer describe a modification of the well-known apparatus of the latter chemist for determining the specific gravities of gases. The apparatus is filled with dry air, and heated to the temperature at which the determination is to be made; the air is then driven out by a stream of hydrochloric acid, received in a graduated tube standing over water, and measured: the gas under examination is passed into the apparatus, heated, and driven out by dry air into weighed potash-bulbs containing a liquid which will absorb the gas. In this way the weight of the gas is obtained; the volume of air gives the volume of this weight of gas at the observed temperature. The apparatus may also be used as an air-thermometer (*Berichte*, xv. 137).

NOTES FROM THE OTAGO UNIVERSITY MUSEUM

II.—*On the Skeleton of Notornis Mantelli*[1]

HITHERTO the rare flightless rail, *Notornis Mantelli*—the Takahe of the Maoris—has been known only by the two skins now in the British Museum, and by a few fossil bones, found associated with remains of *Dinornis*, *Aptornis*, &c.

Quite recently a third specimen was killed on the eastern shores of Lake Te Anau, and the finder, Mr. J. Connor, not only removed and preserved the skin, but, most fortunately, retained as well the roughly-cleaned skeleton of the trunk. With Mr. Connor's permission, I have prepared a description and drawings of the more important parts of this unique specimen, which is now, with the skin, on its way to England for sale.[2]

The skeleton, consisting as it does, of the parts saved after skinning, is *minus* the skull and anterior cervical vertebræ, the wing-bones, the bones of the legs with the exception of the femora, and the posterior caudal vertebræ. It is in very good preservation, with the exception of the ribs and the femur on the right side, which are shattered, probably by shot, and the right side of the middle xiphoid process of the sternum, which is slightly cut, apparently during skinning.

The more important measurements are as follows:—

	cm.
Length of trunk, measured from the anterior (dorsal) ends of the coracoids to the posterior end of the pelvis	18·5
Length of scapula	8·0
,, coracoid	4·2
,, sternum	6·8
Width of sternum, measured just posterior to the coracoid grooves	4·3
Depth of carina sterni	0·9
Length of ilium	10·4
Width of pelvis at posterior border of acetabula	5·6
Length of femur	10·3

In the vertebral column the nine posterior cervical vertebræ are

[1] Abstract of a paper read before the Otago Institute on September 21, and to be published in the next (13th) volume of the *Transactions* of the New Zealand Institute.

[2] It was much to be regretted that the funds of this Museum did not allow of the purchase of these specimens and their retention in New Zealand. But by the kindness of two ladies, Miss F. M. Wimperis and Miss Maud McLaren, the Museum now possesses the next best thing to the actual specimen, namely, two life-sized oil paintings, executed with a fidelity and artistic skill which leave nothing to be desired. I was the more glad to obtain these pictures, as the Te Anau specimen differs in many details of colouring from the British Museum examples, notably in the absence of the broad black band on the neck and of the crescentic markings on the wing-coverts.

left; there are seven pre-sacral thoracic vertebræ, free save for a union of their several spines by ossified ligaments; the com-

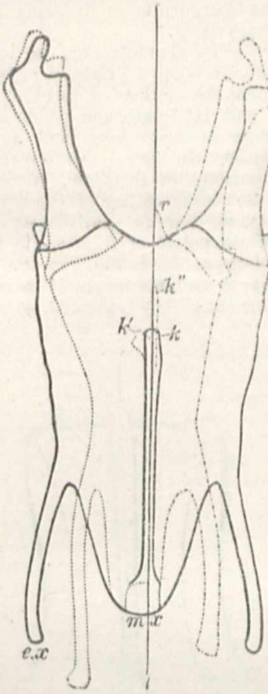


FIG. 1.—Ventral aspect of the sternum and coracoids of *Notornis*, three-fourths natural size (continuous outline); on the left are shown the corresponding bones of *Ocydromus* (dotted outline), on the right those of *Porphyrio* (broken outline), both reduced to the same absolute length of sternum as *Notornis*. *m.x.*, middle xiphoid process; *e.x.*, external xiphoid process; *r*, rostrum of sternum (*Porphyrio*); *k*, point of keel of sternum of *Notornis*, *k'*, of *Ocydromus*, *k''*, of *Porphyrio*.

pound "sacrum" contains one thoracic, five lumbar, four sacral, and six caudal vertebræ. I give no detailed description of the

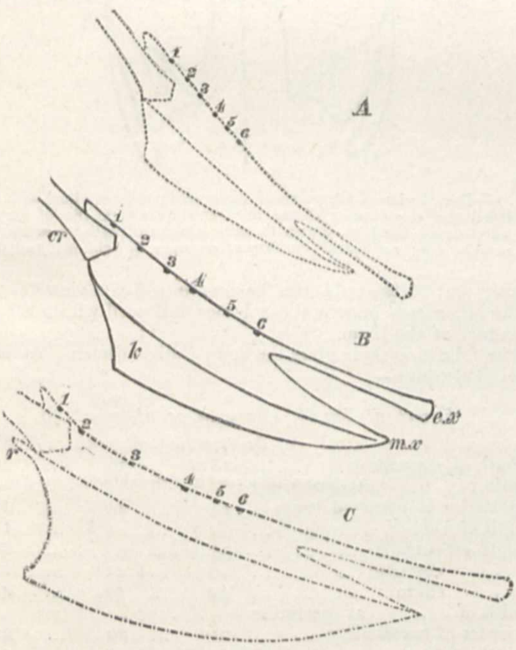


FIG. 2.—The sternum of *Ocydromus* (A), *Notornis* (B), and *Porphyrio* (C), viewed from the left side, and all reduced to the same absolute length of trunk. *cr*, coracoid; *m.x.*, middle, and *e.x.*, external xiphoid process; *r*, rostrum; *k*, keel; 1–6, places of articulation of sternal ribs.

vertebral column, as I could not have it disarticulated; it was, however, quite evident that there was no difference of any importance between the vertebræ ot *Notornis* and those of its nearest New Zealand allies, *Porphyrio* and *Ocydromus*.

Of the eight thoracic ribs six are united to the sternum; four of these—the second to the fifth—have uncinate processes, which have a similar position to those of *Ocydromus*, being situated nearer the sternal ends of the ribs than in *Porphyrio*. The penultimate cervical rib is short and stout, quite like that of *Ocydromus*.

The sternum and shoulder girdle and the pelvis are best described by comparing them, point for point, with those of the two allied genera; I am unfortunately not able to include *Tribonyx* in the comparison, as I have not yet succeeded in ob-

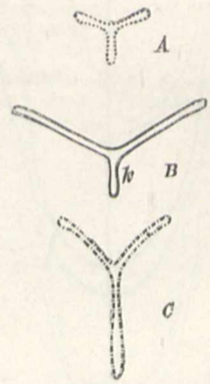


FIG. 3.—Transverse section of sternum of *Ocydromus* (A), *Notornis* (B), and *Porphyrio* (C), showing transverse sternal angle and depth of keel (*k*); three-fourths nat. size.

taining a skeleton of it. It is convenient to study the relative sizes and proportions of the bones by reducing the three skeletons to the same absolute length of trunk, as measured from a point midway between the anterior or dorsal extremities of the coracoids to one midway between the posterior extremities of the pubes. The proportions of the individual bones, considered separately or without reference to the rest of the skeleton may be studied by reducing the corresponding bones in the three genera to the same absolute length.

In all the figures the bones of *Notornis* are drawn with a continuous outline, those of *Ocydromus* with a dotted, and those of *Porphyrio* with a broken outline. In each case also the bones of

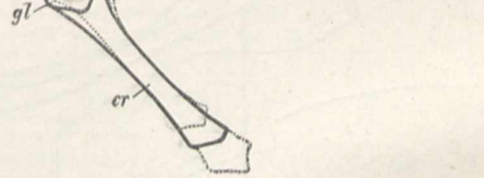


FIG. 4.—Scapula and coracoid of *Notornis* (continuous outline), *Ocydromus* (dotted outline), and *Porphyrio* broken (outline), all drawn to same absolute length of trunk. *cr*, coracoid; *sc*, scapula; *gl*, glenoid cavity.

Notornis are three-fourths the natural size, those of *Ocydromus* and *Porphyrio* being reduced either to a common length with those of *Notornis* (Figs. 1 and 7), or so as to correspond with a common length of trunk (Figs. 2, 4, 5, and 6).

The sternum of *Notornis* (Fig. 1) is broad and flat, at its anterior end it closely resembles that of *Ocydromus*, having a precisely similar emargination and being devoid of the rostrum (*r*) present in *Porphyrio*; on the other hand, it diminishes very gradually in width from the anterior to the posterior end, and has very divergent external xiphoid processus (*e.x.*); the middle xiphoid (*m.x.*) is blunt and unossified. Relatively to the trunk the sternum is about intermediate in size between those of *Ocydromus* and *Porphyrio* (Fig. 2). The keel is shallow, like that of *Ocydromus*, having very nearly the same depth proportionally to length of trunk (see table of comparative measurements below); its anterior edge has nothing of the strong forward curvature seen in *Porphyrio*. The lateral curvature of the

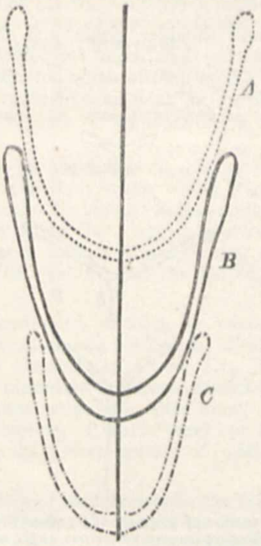


FIG. 5.—Furcula of *Ocydromus* (A), *Notornis* (B), and *Porphyrio* (C), drawn to same absolute length of trunk.

sternum is very slight, its two sides inclosing a dihedral angle—the *transverse sternal angle*, as it may be called—which is very nearly as open as open as that of *Ocydromus*, and many degrees greater than that of *Porphyrio* (Fig. 3).

In the shoulder-girdle both coracoid and scapula are about intermediate in proportional size between those of the two allied

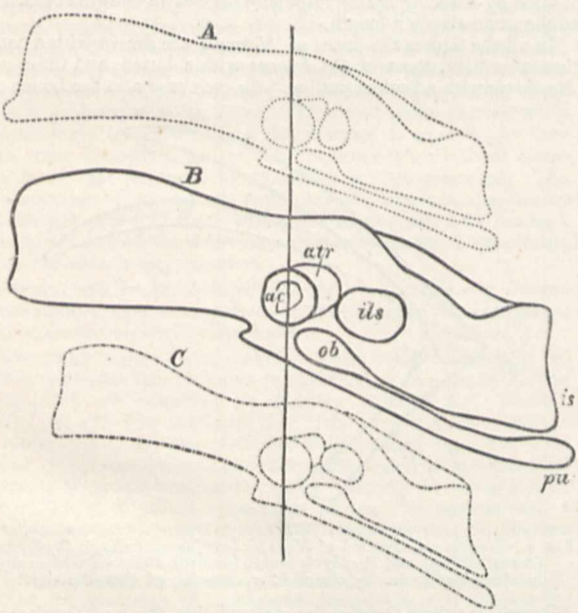


FIG. 6.—Side views of pelvis of *Ocydromus* (A), *Notornis* (B), and *Porphyrio* (C), drawn to same absolute length of trunk. *ac*, acetabulum; *atr*, anti trochanter; *ils*, ilio-sciatic foramen; *ob*, obturator notch; *is*, ischium *pu*, pubis.

genera (Fig. 4). The same is the case with regard to the curvature of the scapula, and the angle inclosed between it and the coracoid—the *coraco-scapular angle*—which in *Nortornis*, as in *Ocydromus*, is greater than a right angle. In this, as in other characters of the shoulder-girdle, *Notornis*, although intermediate between its two allies, approaches most nearly to *Ocydromus*.

The same is true of the furcula (Fig. 5), which is less markedly U-shaped than that of *Ocydromus*, more so than that of *Porphyrio*. It is a very slender bone; the apparent thickness of its median portion in the figure is due to its being flattened in that region from before backwards.

In the pelvis intermediate characters are no longer found, the heavy cursorial *Notornis* having a pelvis of considerably greater proportional dimensions than either of its allies (Fig. 6). Both in vertical height, and in length the pelvis is proportionally markedly larger than in *Ocydromus*, and very considerably larger than in *Porphyrio*. In the relative proportions of the pre- and post-acetabular portions of the ilium, *Notornis* most nearly approaches *Porphyrio*: in the outline of the ilium, as seen from the dorsal side (Fig. 7), it more nearly resembles *Ocydromus*. The excess in size of the pelvis of *Notornis* is most marked in its transverse dimensions, as seen in Fig. 7, where the three pelves are drawn to the same absolute length of sacrum. The ischia and pubes of *Notornis* are widely separated, so much so that the

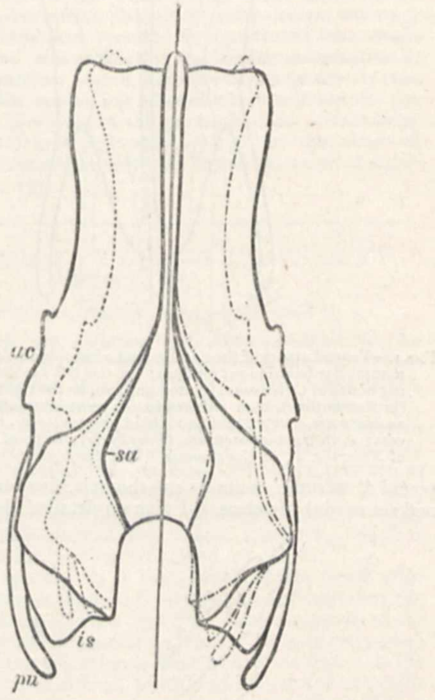


FIG. 7.—Dorsal view of the pelvis of *Notornis* (continuous line) with on the left that of *Ocydromus* (dotted line), and on the right that of *Porphyrio* (interrupted line), all drawn to same absolute length of sacrum. *ac*, acetabulum; *sa*, lateral boundary of sacrum; *is*, ischium; *pu*, pubis.

greater part of the pubis can be seen in a dorsal view (Fig. 7); in the other two genera these bones fall well within the outer boundary of the ilium.

The following table gives the comparative dimensions of the three skeletons:—

Length of Trunk, measured as above = 100

	Ocydromus.	*Notornis.*	*Porphyrio.*
Length of sternum	28	36	40
Width of ,, measured just posterior to coracoid grooves	14	24	17
Depth of keel of sternum ...	4·7	4·8	13
Length of scapula	35	43	49
,, coracoid	20	22	28
,, ilium	49	56	43
Width of ,, at posterior border of acetabulum	21	29	21
Length of femur	51	57	51
Coraco-scapular angle	100°	97°	86°
Transverse sternal angle	141°	132°	96°

T. JEFFERY PARKER

Dunedin, New Zealand, November 9, 1881

SCIENTIFIC SERIALS

THE most recent numbers of Trimen's *Journal of Botany* (224-232) run rather strongly on phanerogamic, descriptive and geographical botany. The diligence of English observers seldom fails to add two or three species to the British flora every year, either by absolute discovery, or by the separation of well-marked varieties. Three of these are described and figured in the numbers before us, viz. *Spartina Townsendi*, Groves, *Agrostis nigra*, With., and *Senecio spathulæfolius*, DC. There are various other descriptions of critical forms, and papers on the flora of English districts or of foreign countries; also on British Characeæ, and on marine Algæ new to Devon and Cornwall. Among the more interesting illustrations are two coloured plates of *Cinchona Ledgeriana*, a new species described by Dr. Trimen.—The number for April, 1882, contains an interesting paper by C. P. Hobkirk, on the development of *Osmunda regalis* from the prothallium, and several contributions to the extended controversy on the principles of botanical nomenclature.

THE *Bulletin of the Torrey Botanical Club* continues to be well supported by such writers as Mr. G. Farlow, W. Trelease, T. Meehan, H. W. Ravenel, D. C. Eaton, G. E. Davenport, C. E. Bessey, and others; and indicates the careful manner in which botanical science is cultivated on the other side of the Atlantic. The papers have chiefly a local value, though there are several on morphological points of more general interest.

Bulletin de la Société Impériale des Naturalistes de Moscou, No. 2, 1882.—Studies on the fauna of terrestrial and fluviatile molluscs of Moscow, by C. Milachevitch.—The Amphibiæ and Reptiles of Greece, by Dr. Jacques von Bedriaga.—List of phanerogams and vascular cryptogams observed in the Government of Tula, by B. J. Zinger (with 2 plates).—Materialia ad zoographiam Ponticam comparatam, by V. Czerniavsky (with a plate).—On the phanerogamous flora of the Government of Moscow, by A. A. Fischer von Waldheim.—On Devonian fossils at the Shelon River, by H. Trautschold (with a plate showing the new species, *Tentaculites ghaber*, *Aulopora arborescens*, *Chætetes intricatus*, and *Stromatopora Porchovensis*).—Annual report of the Society, and minutes of proceedings.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 30.—"Description of Portions of a Tusk of an Australian Proboscidian Mammal (*Notelephas australis*, Ow.)." By Prof. Owen, C.B., F.R.S.

The author premised a quotation from the work by Count Strzelecki, entitled "Physical Description of New South Wales, and Van Diemen's Land"; 8vo, 1845, p. 312; in which the Count states that he had bought of a "native," employed at Boree, the station of Capt. Ryan, New South Wales, a molar of a *Mastodon*, of which the vendor stated that "similar ones, and larger still, might be got further in the interior." This tooth was submitted by the Count to Prof. Owen, and was by him provisionally named *Mastodon Australis*. In subsequent extensive correspondence leading to the acquisition of the fossils from a wide range of Australian localities, described in successive volumes of the *Philosophical Transactions*, stress had been laid on the possibility of additional and more decisive evidence of a true proboscidian mammal having left its remains in the formations or caverns whence the marsupial fossils had been derived; but, as more than thirty years elapsed without the acquisition of such evidence, the author could add nothing to Count Strzelecki's original announcement.

Early in the present year he received portions of a tusk discovered or obtained by the late Mr. F. N. Isaac, in a "drift deposit" of a ravine in a district of Darling Downs, about sixty miles to the eastward of Moreton Bay, Queensland, Australia. Prof. Owen had previously received fossils from that gentleman, and the present, apparently Mr. Isaac's latest acquisition, was kindly placed in the Professor's hands by Mr. E. Thurston Holland, nephew of Mr. Isaac.

In his paper the author points out the several characters of true ivory presented by the portions of tusk, including those displayed in microscopic sections. Drawings of these sections, as seen under requisite magnifying powers, and others of the tusk, of the natural size, accompany the descriptions.

The tusk is one from the upper jaw, including a portion of the base and pulp-cavity; and, on the supposition that it has come from a mature animal, it indicates an elephant or mastodon of somewhat smaller size than the existing species of India and Africa.

The wide distribution of elephantine quadrupeds in Africa, throughout an extensive latitudinal range in Asia and Europe, also in both North and South Americas, indicates that at the periods when forest-growths were undisturbed by mankind, the huge quadrupeds deriving sustenance from the leaves, fruit, and tender branches of trees were coextensive therewith. Australia seemed to offer an exception, but the subject of the present paper justifies the belief in the further extension of the hugest land mammals over the tree-bearing surfaces of the earth.

Further quest in the localities indicated by Count Strzelecki, and more definitely made known by Mr. Isaac's discovery, may, it is hoped, be rewarded by the much-desired materials for extending our knowledge of the characters of *Notelephas*.

Mathematical Society, April 6.—S. Roberts, F.R.S., president, in the chair.—Messrs. Buchheim, Muir, and C. Smith were admitted into the Society.—The following communications were made:—The Algebraic solution of the modular equation for the septic transformation, G. S. Ely.—Note on the condensation of skew determinants which are partially zero-axial; and on a symmetric determinant connected with Lagrange's interpolation problem, T. Muir.—On the analogue to the addition-equation for Theta functions, Rev. M. M. U. Wilkinson.—On the general equation of the second degree referred to tetrahedral coordinates, Rev. A. J. C. Allen.—On certain loci and envelopes belonging to triangles of given form inscribed and circumscribed to a given triangle, Prof. Wolstenholme.—On binomial biordinals, Sir J. Cockle, F.R.S.—On the coordinates of a plane curve in space, H. W. Lloyd Tanner.—On Polygons circumscribed about a cuspidal cubic, R. A. Roberts.

Physical Society, March 25.—Prof. Clifton, president, in the chair.—New Members. Mr. M. J. Jackson, B.A., Mr. Nazarus Fletcher, British Museum.—Mr. Shellford Bidwell read a paper on the electric resistance of a mixture of sulphur and carbon. These experiments were begun in December, 1880, to ascertain if the mixture in question was sensitive to light like selenium. Sulphur was melted and mixed with powdered plumbago (the best proportions being 20 parts by weight of the sulphur to 9 parts of the plumbago. The mixture was poured into moulds, and quickly cooled, yielding plates and sticks. When exposed to the light of a gas-flame, an increase in resistance was noticed, and was proved to be due to the heat of the flame, not the light, by experimenting with different sources of light and coloured screens of glass. As both carbon and sulphur decrease in resistance under heating, the opposite effect of the mixture is anomalous, and Mr. Bidwell explains it by supposing that the mixture is mechanical, and that heat expanding the size of the insulating sulphur crystals, separates the conducting carbon particles further apart, and increases the resistance of the mass. Cells of this compound were made like selenium cells by spreading it between the parallel turns of two fine platinum wires wound round a mica plate and the rise of resistance for temperature carefully measured. At 14° C. the resistance was 9100 ohms; at 55° C. it was 5700 ohms, and the rise was in greater ratio than the rise of temperature. Mr. Bidwell also found that these cells would transmit speech when connected in the circuit of a battery and a Bell telephone. They also acted as a thermoscope, when employed after the manner of a thermopile. Mixtures of shellac and graphite, of paraffin and graphite, &c., were also tried with like results. In reply to Prof. Macleod, Mr. Bidwell said the resistance of the cells decreased soon after being made. Mr. Bidwell also stated, that acting on a suggestion of Dr. Hopkinson, he had found that the resistance diminished under a more powerful current force.—Mr. C. V. Boys read a paper on a new method of finding the index of refraction of lenses, based on the general principle employed by Foucault, of causing the ray of light to return on the same path. Prof. Clifton stated that a similar method was now employed by him at Oxford, and was useful for small lenses.—Prof. Fitzgerald, of Dublin, showed mathematically that it was impossible for a small charge of static electricity, carried along by the earth, to move a magnet in its neighbourhood. Prof. Ayrton questioned this conclusion, and exhibited an apparatus intended to test the point experimentally.—The meeting was then adjourned till April 22.

Anthropological Institute, March 21.—Major-General Pitt-Rivers, F.R.S., president, in the chair.—The following new Members were announced:—Messrs. Francis Archer, William A. L. Fox Pitt, W. E. Maxwell.—Mr. Worthington G. Smith exhibited a measured transverse section through 300 feet of the Palæolithic floor of the Hackney Brook, near Stoke Newington Common. He also showed a collection of ovato-acuminate implements, scrapers, flakes and nuclei from the same spot, all the objects being lustrous and as sharp as on the day they were made. General Pitt-Rivers exhibited and described a large collection of padlocks, showing that the same type had been used in civilised countries from the earliest ages.—Mr. A. L. Lewis read a paper on the relation of stone circles to outlying stones or tumuli or neighbouring hills. The author, from an examination of eighteen stone circles in southern Britain, showed that their builders had in various ways made special references to different points of the compass, but most particularly to the north-east. He then showed from a number of independent sources, ranging from the Prophet Ezekiel down to a foreign correspondent of the *Daily News*, that other ancient structures had similar references, known to have arisen in connection with times and seasons, and various forms of nature worship; that practices connected with such worships, and especially with sun and fire worship, have come down, even in this country, to the present time; and that circular buildings and open circles have been, and are used for worship of this kind; and inferred from these facts that the British stone circles were used for sun worship, probably in the Druidic period. He then dwelt on the references to the North and East in the orientation of English churches, which he thought to be derived from the references to those quarters in the circles, as the Papal churches, whether in Rome or London, are not so placed; and he gave some curious details on this point, and concluded by drawing attention to the firm root taken by Christianity in the Druidic countries of Gaul and Britain, and the great influence exercised by those countries in the later Roman empire, and especially in the establishment of Christianity as the State religion.—A paper was read by Mr. J. E. Price, on excavations of tumuli on the Brading Downs, Isle of Wight, by himself and Mr. F. Hilton Price.

Royal Horticultural Society, March 14.—Dr. M. T. Masters in the chair.——*Australian Fungi:* Mr. W. G. Smith exhibited dried specimens and drawings of grasses attacked by a fungus, from Sussex, and especially Kent, probably new to Britain. It was only known a little more than two years ago. It appears to attack species of *Festuca* chiefly, and is most abundant on sandy soils, not uncommon on chalk, bnt not on clay. The Rev. M. J. Berkeley described and figured it amongst Australian fungi in the *Journal* of the Linnean Society, 1873, xiii. p. 175, and named it *Isaria fuciformis:* Dr. Cooke now regards it as British. It is said to cause the death of animals browsing upon the grass infected with it.—*Disease of Thujas:* Mr. Smith also exhibited specimens of *T. compacta*, attacked by the Australian fungus, *Capnodium australe*, of Dr. Montague.—*Rhododendrons:* Mr. Mangles exhibited several true species from Sikkim.—*Fritillaria obliqua*, &c.: Several plants were exhibited by Mr. Elwes.—*Leucojgum æstivum*, var., from South France, which flowers two months earlier than the commonform; *Chionodoxa*, var., from self-sown seeds which blossom in two years; Mr. Elwes remarked that its habit has changed, inasmuch as it comes up rapidly and blossoms as soon as the snow is off in Asia Minor, whereas here its progress is delayed to a much longer period, and it is getting longer in this respect every year; *Korolkowia Sewerzovii*, sport., a remarkable *green* flowered branch from what is normally a purple flowering plant. *Tulipa Greggii*, Mr. Elwes remarked how the colour appears to be fading under cultivation.—Dr. Masters exhibited specimens of cones, &c., from trees grown by Mr. Veitch:—*Abies* (*Picea*) *grandis*, *Pinus tuberculata*, the scales being unequally developed on opposite sides of the cone; the seeds of which are believed only to escape after forest fires have taken place. They hang on the trees in many generations even for thirty years.—*Welwitschia seedling.* He also exhibited a dried specimen of a germinating *W. mirabilis*, showing the two cotyledons (deciduous), and the two next pair of (persistent) leaves.—A botanical certificate was awarded to Mr. Veitch for *Pleurothallis glossopogon*, remarkable among its genus for its large flowers, the segments of which are 3 inches in length, broad at the base, and prolonged into a very long slender tail, as in some of the Masdevallias. The lip is small, oblong, chocolate-coloured, with a fringe of hairs at the tip. A similar award was made to him for the beautiful orchid, *Spathoglottis lobbi*, a plant with a very slender wiry flower-stalk, with a single flower, 1½ inch in diameter, clear canary yellow, with broad ovate segments, and a lip with a narrow stalk, and a spoon-shape blade.

EDINBURGH

Royal Socety, March 20.—Prof. Douglas Maclagan, vice-president, in the chair.—Prof. Geikie read a paper on the remarkable series of Carboniferous rocks which are developed in Eskdale and Liddesdale, in the south of Scotland. They form a continuous succession from the volcanic band of porphyrite which overlies the Upper Old Red Sandstone to the Scar limestone of Northumberland. Eleven distinct zones were particularised, of which the fourth and sixth were volcanic (tuff, porphyrite, &c.) These two zones were separated by a bed of fine grey shale, rich in specimens of such marine organisms as Orthoceras, Lingula, Discina, &c., mingled with the remains of fishes, crustaceans, scorpions, and, especially in the upper part, algæ, ferns, lycopods, and other carboniferous plants. Above the latest volcanic platform comes the Gilnockie marine limestone group, which is very similar in appearance and in its fossil contents to the ordinary Carboniferous limestone. This zone dies out to the north-east in Liddesdale, where the cement stone group of Tarras (zone No. 2 of the series) passes into the upper cement stone group (No. 9). The Canobie coal group forms the eighth zone, and, notwithstanding its low position in the Carboniferous series, contains plants of true coal-measure type. Above the upper cement stone group come the Plashetts and Lawsburn coals, which are succeeded on the southern margin of Liddesdale by a conspicuous group of sandstones—the "Fell sandstones." The central part of the thick cement stone groups of Upper Liddesdale must be referred to the same horizon as the Gilnockie limestone; so that the Scottish cement stone group differs from the lower Carboniferous limestones of England in being less marine.—This paper was succeeded by more special papers descriptive of the fossils which have recently been discovered in these Eskdale and Liddesdale rocks: Dr. Traquair treating of the fossil fishes, Mr. B. N. Peach of the Crustacea and Arachnida, and Mr. R. Kidston of the fossil Plants. Several beautiful specimens of scorpions were exhibited.—Dr. J. J. Dobbie and Mr. G. G. Henderson, B.Sc., communicated a paper on the formation of serpentine from dolomite. That such a transformation is probable, had been recognised by many geologists and chemists; but no attempt had been made to point out the precise reactions involved. The explanation given by the authors was as follows: Carbonate of magnesia decomposes at a much lower temperature than carbonate of lime; and hence, in a rock containing these together with silica, and heated to a sufficiently high temperature, the carbonate of magnesia decomposes, silicate of magnesia is formed, the carbonic acid is taken up by water, and so acts as a solvent on the carbonate of lime. Where no water is present, of course the last is not removed.

VIENNA

Imperial Institute of Geology, March 21.—The following papers were read:—C. I. Griesbach, geological sketches from India.—E. Doell, on a fall of meteorites in Europe, and on the shape of the meteorites that fell near Mocs on February 7.—H. v. Foullon, on the eruptive rocks of Montenegro.—R. Zuber, geological notes on the Carpathian mountains of Eastern Gallicia.

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