THURSDAY, FEBRUARY 21, 1884

THE MODERN LANGUAGES OF AFRICA

A Sketch of the Modern Languages of Africa, accompanied by a Language Map. By Robert Needham Cust. 2 vols. (London: Trübner, 1883.)

WHY this work has been restricted to the "modern" languages of Africa is not apparent, seeing that there are not half a dozen ancient or extinct African tongues altogether of which science has any knowledge. The limitation is the more remarkable that every one of these ancient tongues is duly recorded and dealt with in its place, partly lest it should "seem to have been overlooked," partly seemingly for no other reason than that the author has forgotten the restriction so needlessly imposed upon himself. Yet when we are told that Gíz, the most important of them next to Old Egyptian, "may be deemed the *Lingua Franca* of Abyssinia"! (p. 88), and when Rinn's remark on the possible reconstruction of an Archaic Berber "offering analogies to the languages of High Asia" (p. 105) is quoted without comment, one begins to feel that after all it might have been wise to have adhered to the restriction.

But Mr. Cust does not profess to be critical or even scientific, and although in one place science is declared to be his "sole object," it is elsewhere explained that his "chief motive" is to assist the missionaries, "the peculiar outcome, the most wondrous development, and the great glory of the nineteenth century" (p. 461). He hastens even to assure us that personally he knows "absolutely nothing" of the subject, and in one not very clear passage he seems to take the anticipated charge of "his entire absence of training in any school of comparative philology" as "a compliment" (p. 15). Most people, however, will probably feel that some knowledge of the principles of comparative philology would at all events have been an advantage, if not an absolute *sine quâ non*, in a writer undertaking to give us "a sketch of the modern languages of Africa." Anyhow, in the absence of such a qualification it is the less surprising to find the hand of the amateur betrayed in almost every page of the present work, which supplies abundant evidence that it is written by a person sure neither of himself nor of his subject. Great vagueness, inaccuracies, and incoherencies of all sorts, commonplace platitudes gravely put forward as important truths, the existence of well-known or historical people, such as the Funj (Fung) of Senaar, referred to as doubtful, such expressions as "parallels of longitude," "Hervas, the Father of Comparative Philology"! and the like, everywhere reveal an essentially unscientific habit of thought. This is strikingly manifested in the treatment of the Bantu prefixes, which are described as "an intolerable nuisance," as indeed they must needs have proved themselves to be to a writer ignorant of their very meaning. He refers (p. 12) to "languages of the Hamitic group, such as *Wa*-Galla," where the form should obviously be *Ki*-Galla, *Wa* indicating the people, *Ki* their speech. Hence the difficulty presented by these troublesome particles is perhaps not unnaturally met by the naïve plan of making a clean sweep of them. Thus we have everywhere Swahili, Suto, Chuana, Ng'anga (Nyanja), for Ki-Swahili, Se-Suto, Se-Chuana, Chi-Ng'anga, and so on; nor can it be denied that at least on the score of simplicity this plan may possibly recommend itself to the ordinary reader.

To a writer ignorant of comparative philology, the phonetics, structure, and general morphology of the languages must necessarily have proved equally "intolerable nuisances." Hence this difficulty is also met by the same simple expedient of elimination, and we are accordingly quietly warned (p. 15) that "it lies outside the purport of this sketch to dwell upon the grammatica peculiarities of languages, or families, and groups of languages," the object being "to give a sketch of the whole subject, not to write an account of each language." Certainly a zoologist might in the same way undertake to write a "sketch" of the animal kingdom without reference to the comparative anatomy, osteology, general morphology, or other structural "peculiarities" of his various orders and families. But by so doing he would perform a remarkable *tour de force*, if he thereby either added to his own reputation or conferred any substantial benefit on his readers.

Nevertheless, it cannot be denied that, heavily handicapped as he was, Mr. Cust has contrived to produce a work of value to linguistic students. This he has done by wisely restricting himself to what may be called the topography and bibliography of the subject. Abundance of time and means, industrious habits, and the opportunities of procuring information afforded by his connection with a number of learned bodies in England and abroad, have enabled him to deal with these useful branches almost exhaustively. Apparently following somewhat on the lines suggested by the linguistic and ethnological appendixes to Stanford's Compendium, he has collected from all quarters copious materials bearing on the history, habitat, literature, bibliography, and classification of almost every known language and dialect still current amongst the African aborigines. The bibliographical references, perhaps the most valuable feature of the work, are reserved for a very full appendix, containing "a bibliographical table of languages, dialects, localities, and authorities." The other materials, generally brought well up to date, are distributed over the various chapters devoted to the "prolegomena" of the subject, and to the several linguistic families of the African continent. Here the author unfortunately still follows Fr. Müller's classification, apparently unaware that on some material points this writer's views have lately been completely exploded. Thus the Tibbu of the Eastern Sahara, although clearly shown by Nachtigal (*Sahărâ und Sudan*) to be essentially distinct both in speech and physical type from the Negro, are still grouped with that division. The consequence is that in the accompanying coloured language-map by Mr. E. G. Ravenstein, the Negro domain is extended beyond the Sudan northwards to Fezzan and Tripoli, at least 7° of latitude beyond its proper limits. The nomenclature is here also both confused and, as frequently elsewhere, at variance with the text. Thus we have "Teda or Tibbu" instead of Teda or Northern Tibbu, and below it "Dâza or Gora'an" for "Dâza or Southern Tibbu." And in quoting Nachtigal's work why does Mr. Cust go out of his way to give us a false prosody (*Sahâra*), where the author was so careful to write correctly *Sahărâ?*

A more serious blunder is his retention of the unfortunate "Nuba-Fulah" family, which has no objective existence, and which he has rashly taken upon himself even to enlarge. On this subject he writes in the true style of the amateur:—"This arrangement [an arrangement absolutely unscientific] commends itself to my judgment from its convenience, as enabling me to pass on from the confines of the Hamitic language-field, and sweep into this new group all that is not strictly Bántu, or which cannot be conveniently treated as Negro" (p. 142). So in their reports on Egyptian Sudan our officials "sweep" into the Arab group all that is not strictly Negro, and *vice versâ*. And so nearer home our popular ethnographists "sweep" into the "Turanian" group all that is not strictly Aryan, and so on. The scope that this sort of thing gives to discursive writing is about as boundless as is the mischief it does to the cause of scientific progress. In future editions Mr. Cust ought relentlessly to exscind this "convenient" Nuba-Fulah group, and relegate to one of his numerous appendixes "all that cannot be conveniently treated" under any recognised divisions.

These remarks will apply with equal force to the "Hottentot-Bushman Group," of which Mr. Cust again writes: "Following F. Müller and T. Hahn, I constitute a separate group, and take the opportunity of enlarging its dimensions, so as to sweep in certain tribes speaking apparently languages which differ entirely from any above described" (p. 434). It will be seen that Mr. Cust has constituted himself a sort of African "Spazzacammino," sweeping up and down the continent with an airy recklessness which may astonish the groundlings but "cannot but make the judicious grieve." The result in this instance is to scatter over the southern half of Africa a number of tiny little enclaves, all coloured alike and reaching as far north as Abyssinia, which make Mr. Ravenstein's otherwise excellent map look like nothing so much as one of those coloured maps of Scotland with fragments of Cromarty, Elgin, and the other northern shires strewn promiscuously over the face of the land. Now in Scotland these fragments have literally a *tribal* connection, but the connection between the African enclaves—Tua, Sarwa, Nena, Sania, Akka, Twa, Doko, &c.—is of a purely negative character. None of them speak Negro, Fulah, or Bantu idioms; therefore let us sweep them together. It is the old joke about elephant and tea-cup, which are said to resemble one another because neither can climb up a tree.

Besides the general classification, the whole text will need careful revision before the book can be accepted as a standard work of reference on the points with which it professes to deal. Almost on every other page we read such statements as these:—There is "nothing savage" in the Somali nature. There is little doubt that Kandáke was Queen of Napata on the Middle Nile, and a Hamite. The very existence of the Niger was unknown before the present century. The Siwah language is of no importance whatever, &c. The account given (p. 110) of the word *Tamashek* is hopelessly muddled. It is stated to have been applied to the people "by the Arabs, and not by the tribes themselves, who scarcely recognise it, and call themselves Imoshagh, or Amazirg," the fact being that Imoshagh and Tamashek are the same word, the former masculine, indicating the people, the latter feminine, indicating their language. About the closely related Kabail dialect again, Mr. Cust writes: 'I was unable to satisfy myself on the subject of this language until I had personally visited Algeria, Tunisia, and the Sahara, conferred with men on the spot, and seen with my eyes the conformation of the country" (p. 106). Here there seems to be some mystification. It is not obvious at first sight what the conformation of the country has to do with the language; and it is still less obvious how a visit to the Sahara, of which we now hear for the first time, could throw any light on a language scarcely current within the frontier of that region.

At the same time it is but fair to state that, with all its inevitable shortcomings, it often betrays evidence of extreme labour profitably bestowed on obscure languages. A good idea of the general treatment of the subject is afforded by the subjoined account of the little-known Komóro group:—"There is no doubt that these languages are African, and not Malayan, like the Malagási. Several names are recorded, and it is presumed that they are dialects:—(1) Hinzua, (2) Angazidya, (3) Antilote, (4) Mohilla. Elliot left in manuscript a vocabulary of Hinzua, the dialect of the Island of Johanna, compiled by himself. Hildebrandt supplies a considerable one of Ki-Nzuáni compiled on the spot. Casalis in his Suto [Se-Suto] grammar gives a dozen words picked up by chance. Bleek in the 'Languages of the Mozambík' gives words picked up by Peters during a week's residence in the island. Hildebrandt remarks that this dialect is only spoken in the Johanna Island, but that the dialects of the other islands only differ a little. It is never committed to writing. For purposes of business the people use the Swahíli language in the Arabic character. Steere printed in 1869 a short vocabulary of the language of Great Komóro, called Angazidya, supplied by the sons of one of the kings of the islands. Van der Decken remarks that it is only a dialect of Swahíli, greatly altered in pronunciation and affected by the contact of Malagási. Gevrez, a French *employé* in Mayotte, one of the islands, and a French colony, published an account of the group from personal knowledge in 1870. He divides the population into fractions: one-tenth are Arabs, one-tenth are Malagási, four-tenths are Antilote—a mixture of Arabs and Africans, and four-tenths are of the Bántu family, though not entirely pure. The Antilote speak a mixture of Malagási and Swahíli. Very few in the island speak or write pure Arabic, but Swahíli, which is the language of the schools, the towns, and good society. The character used for writing is a corrupted form of Arabic." A. H. KEANE

RECENT TEXT-BOOKS OF DETERMINANTS

Die Anfangsgründe der Determinanten. Von Dr. H. Kaiser. (Wiesbaden, 1882.)

Die ersten Elemente der Determinanten Theorie. Von Prof. Wilh. Bunkofer. (Tauberbischofsheim, 1883.)

Éléments de la Théorie des Déterminants. Par P. Mansion. (Paris, 1883.)

Teoría elemental de las Determinantes. Por D. Darío Bacas y D. Ramón Escandón. (Madrid, 1883.)

THE literary activity of Germany seems to make it necessary that a new Introduction to Determinants shall appear at least once a year. What amount of good results from this is not quite apparent to an outsider: it is even probable that there is none, unless the unintended reflex benefit, in the form of experience in book-making, which the authors thereby obtain.

Here we have two elementary booklets, one of 40 pp., the other of 28 pp.; and a very short examination of them suffices to show that the writers could have spent their time and energy to much better purpose, if it was the public that they intended to benefit. What they have written is probably not worse than what has been in use for years; but certainly it is not any better. Indeed Germany has always had more really good elementary expositions of the theory of determinants than any other country, and two or three of these have passed through several editions. Dr. Kaiser and "Professor" Bunkofer are quite capable men for the work they have undertaken: on this score little fault can be found. The latter sketches his "Notes of Lessons," as young English teachers would call them, with pedagogic ability and skill; the former is more wooden, and more unwisely ambitious, and we cannot, unsupplicated, pardon him for saying that Gauss in coining the word "determinant" thereby introduced a definite new idea into analysis, but he goes about his work in a sufficiently workmanlike manner, and is on the whole sure of the ground he treads. We only wish both authors "more power," and next time a happier selection of subject.

Prof. Mansion's "Elements" is a book of a higher type. The present edition, however, is the fourth; and therefore no detailed examination can be looked for. Suffice it to say that there is really no better introductory book published; the exposition and arrangement are admirable, and it has, what so many Continental text-books want, small collections of suitably graduated exercises for the learner. There is only one point which it seems desirable that Prof. Mansion should reconsider, viz. the nomenclature of the special forms of determinants. He employs, for example, both Sylvester's term "persymmetric" and Hankel's "orthosymmetric." Should not one of these immediately receive decent burial, and should not the latter be that one? It is not shorter, it is not more descriptive, it is not more accurate in its description than its rival, and its rival was by several years first in the field. As for "doppelt-orthosymmetrisch," its author is simply unconscionable; it is one of those words which, as Mark Twain puts it, are alphabetical processions and have a perspective: we should have been glad if Prof. Mansion had dealt more summarily with it. In another instance, that of "skew" determinants, we have confusion worse confounded. Cayley's first paper regarding them appeared in *Crelle* (1846), and was written in French, the title being "Sur quelques propriétés des déterminants *gauches.*" The term *gauche* (Eng. *skew*, Germ. *schief*, Italian *gobbo*) was at once accepted and employed, as well it might, by all the standard writers. Of late years, however, there have been busy times with the mathematical coiners on the Continent, and in consequence we have as substitutes for "skew"—

"symmetrale,"
"congruente" (not in Mansion),
"pseudosymétrique."

Surely it is too tiresome and quite unnecessary to wait until by a process of artificial selection the fittest or unfittest of these shall survive. Prof. Mansion's "Elements" and the German translation of it have deservedly a large circulation on the Continent, and thus have much power to propagate good or evil. We would therefore earnestly ask him to consider whether it would not be better to recognise throughout his work only *one* name for each special form, and to relegate all synonyms to the index.

The last text-book on our list is Spanish. Although it is the largest (200 pp.) and most pretentious of the four, we regret that it is impossible to say a good word regarding it. The authors have most manifestly no grasp of the subject, and advance with a gay step and light heart through inaccuracy after inaccuracy. Their model unfortunately is Dostor, and equally unfortunately they are more than faithful to him. At the very outset they show their hands. The so-called "notation of Cauchy" is not Cauchy's; what is really Cauchy's is not attributed to him; and the "notation of Leibnitz" is more Cauchy's than Leibnitz's, but belongs to neither. Nor is this wild start of Book I. redeemed by a good end. On pp. 96-98 five examples of skew determinants are calculated at length with a complacent unconsciousness of the simple property which makes all the calculation unnecessary; and pp. 99-101 are taken up with the rather epoch-making definition—

$$\left\| \begin{matrix} a & b & c \\ a' & b' & c' \end{matrix} \right\| \equiv \left| \begin{matrix} 1 & 1 & 1 \\ a & b & c \\ a' & b' & c' \end{matrix} \right|,$$

and some perfectly legitimate deductions from it. Book II. deals with the so-called applications of determinants, and closely follows Dostor. The most amusing part of it, as is the case also with Dostor, is the chapter devoted to "Applications to Trigonometry." Dostor, however, is outdone on his own ground. For example, after it has been proved that $\cos A = (b^2 + c^2 - a^2)/2bc$, one whole octavo page is occupied in showing, *by means of determinants*, that $\sin \frac{1}{2} A = \sqrt{(s-b)(s-c)/bc}$. This *tour de force* is like that of Hudibras, *telling the clock by algebra;* and the moral in both cases is the same.

LETTERS TO THE EDITOR

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

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

Mr. Lloyd Morgan on Instinct

I HAVE read with much interest Mr. Lloyd Morgan's very able paper on "Instinct" in the current issue of NATURE, and I feel it is desirable, without following him over all the ground which he has traversed, briefly to consider those parts of his communication which have special reference to my own work.

The broad question with which he begins—viz.: "Is there a science of comparative psychology?"—is not a question which I feel specially called upon to answer, inasmuch as almost every one who has hitherto written upon psychology has taken it for granted that there is such a science. Nevertheless I may state the justification which I am myself prepared to give of this universal assumption.

When we say that a dog is a more intelligent animal than a sheep, we do not doubt that we are making as real a proposition as when we say that the President of the Royal Society is a more intelligent man than Dick, Tom, or Harry. Now in all cases where there is a general consensus of feeling of this kind, there is an antecedent presumption that the common sense of which it is the expression is in the right, and that any ingeniously-constructed argument of scepticism is in the wrong. We may therefore approach Mr. Lloyd Morgan's argument with the antecedent presumption that there must be something wrong about it somewhere; and I do not think that it requires much reflection to see where the error lies.

According to the argument as stated by my critic, there is a true science of human psychology, because, although my knowledge of another human mind is no less ejective than is my knowledge of a dog's mind, yet "by means of language human beings can communicate to each other the results which each has obtained, and each human being is able *to submit these results to the test of subjective verification.*" But how, let us ask, in its last analysis is this verification obtained? By language, no doubt; but what in its last analysis is language? As spoken by my neighbour, it is for me nothing more than my own interpretation of a meaning presented by the observable activities of an organism. Therefore, if on such a basis I am entitled to affirm that such interpretations as I make are of the nature of "subjective verifications" of conclusions drawn from the introspective observation of my own mind, why am I not entitled to a similar view when the eject of my contemplation is the mind of a dog? The dog cannot speak, but he can display other activities which, so far as they go, are quite as valid as a basis on which to construct my "subjective verification" as are the activities manifested in language. Of course language is able to convey immeasurably more information touching the ejective mind than can be conveyed by any other kind of activity; but this fact is merely due to the further fact that language is a system of activities expressly designed for this very purpose. The higher value of language in this respect is therefore nothing more than an expression of the higher development of intelligence, which enables the mind to perceive the desirability of devising a system of bodily activities expressly designed to serve as the vehicle of communication between subject and eject,—as is proved by the fact that any system of bodily activities which may be agreed upon (such as gesture, lip-reading, writing, &c.) are alike available for this purpose. Language, then, of any kind is merely a conventional system of bodily activities which, because *intended* to convey information from mind to mind, we call signs. But now, the element of *intention* on the part of my neighbour is in no wise essential to my ejective interpretation of his bodily activities, or to what Mr. Morgan calls my subjective verification of them. The involuntary groan of pain, the pallor of fear, and a thousand other unintended "expressions of the emotions," as well as a thousand other unintended expressions of thought (*e.g.* the act of pocket-picking under the eye of an unseen detective), are, as it is proverbially said, "more eloquent than words."

I submit, therefore, that, although a dog cannot give us any large measure of ejective information intentionally, or by purposive signs (he does, however, give us some even of this), we have still abundant material furnished by his other bodily activities for constructing our ejective inferences. For example, the dog gives very much the same indications of pain under the whip that a boy gives under the cane; therefore the gamekeeper has no more doubt that he is hurting the dog than the schoolmaster has that he is hurting the boy—nor would the schoolmaster be more satisfied on this point by asking the boy whether the cane did hurt.

If I have been followed thus far, I should be inclined to go still further, and to say that in my opinion the "unpremeditated art" of natural movements (whether in men or animals) is a surer basis on which to build ejective conclusions than is the more indirect information supplied by intentional gesture or language, *so far as the low or simple intelligence to which animals attain is concerned.* Poets and moralists are fond of insisting upon this point as regards young children, where the level of intelligence may be even considerably above that of the most intelligent animal. The immense service of language in ejective analysis is rendered in those higher and more complex regions of intellectual life to which man alone attains. Still, I doubt not that if animals could speak, so that we could interrogate them as to their mental operations, we should obtain a great deal of supplementary information; only of course this supposition is an impossible one, seeing that, if an animal could speak, its intelligence would no longer be "animal intelligence."

On the whole, then, as concerns the question whether there is a science of comparative psychology, I should say that there certainly is such a science, in the same sense as there is a science of human psychology. For it seems to me, in view of the above considerations, that the argument adduced by Mr. Lloyd Morgan against the former is quite as applicable against the latter. In both cases alike our ejective inferences can only be founded on the observable activities of organisms, and if it is true that of these observable activities language affords an exceptionally meaning class, it is also true that where language is absent the mental processes which stand to be ejectively analysed are of a comparatively simple nature. I therefore see no reason to recede from the position which I have taken up in the works to which Mr. Lloyd Morgan refers, where I observe with reference to the peculiar standing of psychology (both human and comparative) among the sciences in the matter which we have been considering—"although the evidence derived from ejects is practically regarded as good in the case of mental organisations inferred to be closely analogous to our own, this evidence clearly ceases to be trustworthy in the ratio in which the analogy fails; so that when we come to the case of very low animals—where the analogy is least—we feel uncertain whether or not to ascribe to them any ejective existence" ("Mental Evolution in Animals," p. 22). And again, with reference to such objections as that of Mr. Morgan—"Scepticism of this kind is logically bound to deny evidence of mind, not only in the case of the lower animals, but also in that of the higher, and even in that of men other than the sceptic himself. . . . This is evident because, as I have already observed, the only evidence we can have of ejective mind is that which is furnished by objective activities; and, as the subjective mind can never become assimilated with the ejective, so as to learn by direct feeling the mental processes which there accompany the objective activities, it is clearly impossible to satisfy any one who chooses to doubt the validity of inference, that in any case, other than his own, mental processes ever do accompany objective activities" ("Animal Intelligence," p. 16). And, by parity of reasoning, the same argument may be used against Mr. Morgan's sceptical objection to comparative psychology as a science. In whatever measure he is *on principle* a sceptic touching the inferences which this science is able to draw as to the existence and nature of animal psychology, in that measure I think he ought in consistency also to be a sceptic with reference to the same points in the science of human psychology.

Coming now to Mr. Morgan's strictures on my psychological definition of instinct, I understand that they are made, not with reference to any defect in my definition as a psychological definition, but with reference to the possibility of any such definition whatever. In his view there can, from the nature of the case, be no psychological definition of instinct; there can only be a physiological definition of the cerebral processes which are concerned in actions termed instinctive. Here, then, is a broad issue, although it only constitutes a part of the still broader one which we have just been considering.

I may say first of all that, if we want a physiological definition of instinct, I do not think that the one which is furnished by Mr. Lloyd Morgan is valid. This definition is that reflex actions are due to a general type of nervous organisation, instinctive actions to a specific type, and intelligent actions to an individual nervous organisation. Now, this threefold definition presents none of that "definiteness of application" which Mr. Morgan implies, nor does it tend, as he supposes, to add any "clearness to our ideas concerning the things of which we speak." For it is open to the fatal objection of arbitrarily classifying as instinctive many actions which are now universally regarded as reflex; while, conversely, a still greater number of actions now universally regarded as instinctive would, under this definition, become classified as reflex. That is to say, there are, on the one hand, many reflex actions which we should all feel it absurd to call instinctive, and which are nevertheless manifested by only one species (in our own organisations, for example, we may mention the "patellar reflex," and the convulsions produced by tickling the soles of the feet); and, on the other hand, there is a very much greater number of instinctive actions which we should all feel it absurd to call reflex, but which are nevertheless manifested by many species of a genus, others by many genera of an order, and so on, until in such cases as those of nidification, incubation, &c., we arrive at instincts general to a whole class. The truth, therefore, is that a zoological classification, being made with reference to the whole organisations of animals, has no such special application to the refined structure of their nervous systems (which, indeed, we can only appreciate by its effects on conduct) as would be required for the groundwork of

Mr. Morgan's physiological definitions of reflex action, instinct, and intelligence. If we want such a definition it must be made independently of any zoological classification, *and with exclusive reference to the point whether the adaptive action requires for its performance the operation of the higher nerve-centres*—a point which can only be determined by vivisectional experiment. In other words, on the side of objective psychology the only distinction that can be drawn between a reflex and an instinctive action, is as to whether the action can be performed by the lower nerve-centres alone, or requires likewise the cooperation of the higher nerve-centres. And this is just what we should expect to find to be the case on the objective side if, as I have endeavoured to show, the one peculiarity which distinguishes actions classed as reflex from actions classed as instinctive, consists in the latter exhibiting in their performance a mental or conscious element which is not exhibited in the former.

Now, if the *raison d'être* of the term "instinct" is thus to denominate a class of adaptive actions in which there is a subjective, or rather let us say an ejective element, I cannot see that anything but confusion is to be gained by forcing this term into objective implications. Were any term needed to designate the neurosis of instinctive action, it would be far better to coin a new one than thus to abuse an old one. I am fully sensible of the difficulty which often arises in deciding whether a particular action should be assigned to the instinctive or to the reflex class; but, as I observe in "Mental Evolution in Animals," "this difficulty does not affect the validity of the classification any more, for instance, than the difficulty of deciding whether Limulus should be classified with the crabs or with the scorpions affects the validity of the classification which marks off the group Crustacea from the group Arachnida."

For the rest, Mr. Morgan's criticism on my psychological definition of instinct hangs entirely upon his previous criticism as to the possibility of a science of comparative psychology, and as I have already endeavoured to answer the latter, I need not go over the same ground again by answering the former. There are only two points raised by his paper to which this general answer does not apply, and with these, therefore, I shall conclude.

The first of these two points is a charge of inconsistency. My critic observes that, after having said "it is enough to point to the variable or incalculable character of mental adjustments as distinguished from the constant and foreseeable character of reflex adjustments," I go on to define instinctive actions as mental adjustments which are nevertheless of a constant and foreseeable character. Now I think, if any one will read my chapter on "The Criterion of Mind," he will see that this apparent inconsistency is not a real one. It would be a real one if the passage above quoted referred only to this and that particular action of an animal, apart from all the other actions of the same animal, which, according to my criterion of mind, are competent to inform us whether or not the animal in question is a *choosing* and *perceiving* animal. But the passage quoted refers to the whole constitution of an animal so far as we can know it by observation of activities, and therefore the question whether this or that particular activity is to be regarded as mental or non-mental (instinctive or reflex) requires to be answered by all that we learn concerning the other activities of that animal. If none of its activities are other than those of a constant and foreseeable character, we have no reason to suppose that it is a choosing or perceiving animal; but if some of its other activities are indicative of choice and perception, our knowledge of this fact must be allowed due weight in any attempt that we may make at classifying this or that particular action as reflex or instinctive. The case, in short, is just the converse of that which I thus state in the chapter referred to:—"Many adjustive actions which we recognise as mental are, nevertheless, seen beforehand to be, under the given circumstances, inevitable; but analysis would show that this is only the case when we have in view agents whom we already, or from independent evidence, regard as mental."

The second point to which I have referred as the only one that now remains for me to consider, is to the effect that I have mistaken "Mr. Spencer's position with regard to the 'very subordinate importance of natural selection as an evolving source of instinct,' and with regard to the question of 'lapsed intelligence.'" Here I can afford to be brief, inasmuch as any one who cares to do so can compare my interpretation of Mr. Spencer's writings with the passages in those writings to which I refer. It seems to me perfectly clear that, although both the principles in question are alluded to by Mr. Spencer, neither of them holds the same prominence in his theory of the development of instincts from reflex action as they hold in the theory of Mr. Darwin.

In conclusion, I trust Mr. Morgan may feel that, in writing this somewhat elaborate reply to his criticism, I am marking as emphatically as I can my sense of its ability. And if the general effect of this discussion is to show that the phenomena of instinct present peculiar difficulties to any attempt at a fundamental analysis, I should like no less emphatically to express my conviction that such an analysis is not to be facilitated by closing our eyes upon the entire class of phenomena to which alone the word is applicable. We may, of course, abstain from any attempt at such analysis, and devote our attention exclusively to the physical as distinguished from the mental side of the subject. Only in this case we may not speak of *instinct*.

GEORGE J. ROMANES

"Mental Evolution in Animals"

MR. ROMANES' comment on my communication in NATURE of February 7 (p. 335) is not quite satisfactory. I do not suppose that he has any spite against my skate; but as he does not know me, and did not see the incident in the Manchester Aquarium, I think it is very possible that he may have been naturally predisposed to underrate the significance of the story. I do not admit that I can be reasonably blamed for saying that a repetition of the conditions would have been useful, if possible, while at the same time pointing out that the result would not necessarily have settled the question. Test experiments are always useful, even if they do not settle the main question. Mr. Romanes' terrier story was not necessary to make clear what he means by "accident," and there is no analogy between it and my skate story. In one case a trained, or at least tamed, dog did as he was told, and the conditions of success were prearranged; in the other, a fish spontaneously did something for his own advantage. As for the fish smelling the food, this does not harmonise with the circumstances as I described them, and had Mr. Romanes seen the incident I do not think this explanation would have occurred to him; the whole series of actions was too rapid, and had too much the appearance of co-ordination. The propulsion of the food into the ready mouth was the work of an instant. Had the mouth not been ready, as the cricketer's bat is the instant the ball leaves the bowler's hand, the morsel would have been missed. Finally, Mr. Romanes tells us ("Animal Intelligence," p. 351) that the bear observed by Mr. Hutchinson was a Polar bear. Now this species is "almost marine in its habits." It lives upon seal-flesh and also upon dead meat which it finds floating in the water. It is not infrequently cast adrift on an ice-floe or an iceberg. It is therefore not at at all improbable that the method of fishing described may be an instinct developed hereditarily. The fact that two bears behaved in precisely the same manner strengthens this supposition. Mr. Darwin does not say whether the bear observed by Mr. Westropp in Vienna was a Polar bear or not, but he observes that the action in question "can hardly be attributed to instinct or inherited habit," as it would be "of little use to such an animal in a state of nature." It seems to me that such action would be very useful to Polar bears in a state of nature.

Manchester, February 11 F. J. FARADAY

The Remarkable Sunsets

AT the present stage of the discussion upon the "green sun" and rosy sunsets it seems to me it would be well to recall attention to a few facts, for there seems to be a tendency on the part of some correspondents to allow imagination to carry them beyond the region of fact into that of fancy. First, then, I would point out that my observations show conclusively that at the time of the green sun there was an altogether abnormal amount of moisture in the upper regions of the atmosphere, while the ordinary hygrometric observations showed the air near the ground to be comparatively dry. I have studied the rain-band spectrum almost daily for the last six or seven years, and I have never before known such a long continuance of the heavy rain-band in a comparatively clear sky—a sky in which there was only a light haze. At sunset and sunrise the intensity of the bands was such as I have before seen only from an altitude of some six or seven thousand feet, and even then rarely. In this connection it may be well to point out that the spectrum as observed by Mr. Donnelly (NATURE, vol. xxix. p. 132), though, as remarked by Mr. Lockyer, resembling that observed here in some respects, yet differed from it in some important points. The "low sun-bands" appeared weak rather than strong, partly perhaps by contrast with the great intensity of the rainband, and the rainband itself was easily divided into lines, of which eight are recorded in my note-book as being seen with a one-prism spectroscope. The band between *b* and F, observed by Mr. Lockyer, was also seen here, and was found to be one ascribed to aqueous vapour, W.L. 504. A spectrum almost in all respects similar to that observed here can be seen by any one who will examine the absorption produced by a *small* cloud passing over the sun as seen with the spectroscope, having a lens in front of the slit. The contrast with the bright spectrum of the sun shows the general absorption in the red very clearly, and if the sun be near the horizon the other bands will be, in most cases, fairly well seen.

It is worth noting that we have had an unusually early and heavy monsoon, ushered in by a remarkable thunderstorm and followed by a period when the spectrum showed an abnormal freedom from vapour, the rainband at times being quite invisible. During this latter period we have had beautiful rosy after-glows, the sunlight being apparently reflected from thin, almost invisible, cirrus clouds.

If the presence of dust can be proved, these phenomena, as I previously indicated, can be readily explained in accordance with the facts so beautifully illustrated by Mr. John Aitken (*Trans. R.S.E.*, vol. xxx. p. 337), for the dust particles would condense moisture in the upper parts of the air, and we would have a light haze, such as was observed here, not sufficiently dense to cause actual clouds, but deep enough to give the special absorption effects, while the dust itself would assist in producing the general absorption.

Against the idea of Java dust, however, have to be set a number of facts of which the following are a few:—The maximum phase of greenness was on the same day (September 10), all over Ceylon and South India, and as far west as long. 64° (at sea). The green sun was not seen at Rangoon nor at the Andaman Islands, though at the latter place the sounds of the eruption were heard. The first rain that fell here afterwards was subjected to careful microscopic analysis, and showed no trace of volcanic dust. The phenomenon reappeared on September 22.

For my own part I think there is strong evidence that the influence of the Javan eruption was an electrical one, and that that was not necessarily propagated by the actual transference of matter. Mr. Whymper's very interesting letter is of course by no means conclusive as regards the effects of dust, for it is, I believe, regarded as virtually proved that the mere existence of dust in large quantities in volcanic ejecta proves the presence of an abundance of water vapour. C. MICHIE SMITH

P.S.—There is a misprint in my letter to Sir William Thomson which, as I have seen it twice quoted, ought to be corrected. It is in vol. xxix. p. 55, line 8, which should read: "After the electricity had gone to *negative*." C. M. S.

The Christian College, Madras, January 23

SINCE the end of October, when I first observed an unusual red glow for a considerable time after sunset, I have been a close observer of the atmospheric phenomena so fully described by your correspondents. For some time past they have appeared with little of their former brilliancy, until the evening of the 7th inst., when there was a remarkably fine display, equalling in many respects those of December. Of this I shall particularly mention but one feature which I had seen three times previously, but never displayed with such intensity and clearness of definition. At 5.30, when the after-glow was at its maximum, a lovely crimson arc appeared opposite it in the eastern horizon, in every respect as described by Mr. Divers in his letter dated from Japan, which appeared in NATURE of January 24 (p. 283). I may remark that I have observed here, from November 10 to this date, but latterly with much diminished intensity, every one of the phenomena he so graphically describes. A. C.

Roscommon, February 11

"The Indians of Guiana"

IN the notice of Mr. Im Thurn's work on the Indians of Guiana, in the current volume of NATURE (p. 305), Mr. Tylor writes: "What is still more curious is that the rude method of making thread by rolling palm or grass fibre into a twist with the palm of the hand on the thigh may be commonly seen in Guiana, although the use of the spindle for spinning cotton is also usual." As such a fact appears to be curious to so eminent an anthropologist as Mr. Tylor, it may be of interest to some of your readers to learn that this mode of twisting fibres is still by no means uncommon in India, though spinning must there have been familiar to the natives for unnumbered generations. I have frequently seen Hindus of various castes twist a mass of jute-fibre into a compact and firm rope of considerable length, between the palm of the hand and the inside of the thigh, and by the same means they will frequently produce long pieces of strongly coherent twine when the need for it arises. From my experience, which, though confined to a small geographical area, comprehended an acquaintance with both Hindus and Mohammedans imported into the tea-districts from almost every part of British India, I should suppose that this custom of twisting fibres into rope and twine is universal throughout the country, though doubtless it is resorted to rather as a makeshift than as a regular mode of manufacturing twisted cords. That such a means should be resorted to by the wild tribes of the north-eastern frontier is by no means strange, though these have acquired not a little skill in spinning and weaving cotton, but that so primitive a method should still prevail amongst peoples so highly cultured as the Hindus and Mohammedans of India often struck me as remarkable.

While noticing Mr. Tylor's interesting article, I cannot refrain from questioning the justice of the supposition that pile-dwellings on the land are due to the "survival of the once purposeful habit of building them in the water." That in New Guinea such is the case there can be little doubt, as Dumont d'Urville and Mr. Wallace, as well as Prof. Moseley, have remarked. And that Mr. Im Thurn's supposition with regard to the natives of Guiana is also correct there can hardly be a doubt. But these two cases scarcely seem to me sufficient upon which to generalise, even when added to Prof. Moseley's pretty and ingenious view as to the origin of the Swiss châlet. As has been pointed out to me by my friend Mr. W. E. Jones, F.R.I.B.A., Lecturer on Architecture in the Bristol University, a somewhat similar development of single-storied into two-storied dwellings is to be traced in the stone buildings as well as in the less substantial dwellings of Western Asia, between the twentieth and the twelfth centuries B.C., and though of course it is not impossible, it certainly seems improbable that a race of ancient lake-dwellers should have perpetuated on sandy plains a practice which must altogether have ceased to be useful long before it reached a region so far removed from its original home. And indeed it seems to me that pile-dwellings may be observed in localities in which it is scarcely possible that the practice could have originated in lake-dwellings, or in any dwellings of any sort erected in water, whether fresh or salt. I allude more particularly to the raised dwellings of the Nagas, Kukis, Cacharis, Khasias, and other hill-tribes of the north-eastern frontier of India, in the midst of which I lived for several years. That these people should ever have dwelt so near the sea that they acquired the habit of erecting pile-dwellings therein seems to me highly improbable when it is remembered that their racial and linguistic affinities place them undoubtedly in that great Mongolian group of which the Thibetans and Burmese are examples; and that therefore they may be regarded as immigrants from more Eastern Asia, rather than as tribes which have been gradually driven back from the Bay of Bengal by the encroaching civilisation of the Hindus. Nor does it seem probable that their pile-dwellings were originally erected in lakes amongst the hills, for in fact the lakes nowhere exist. There are indeed extensive *bheels* or marshes, which during the rainy season sometimes contain a good deal of water. But these *bheels* are, during at least a portion if not the whole of the year, so pregnant with fever and ague that I cannot believe that they were ever employed, as were the lakes of Switzerland and Italy, for the protection of the habitations of man. Yet these north-eastern frontier tribes for the most part build their houses upon piles. These are generally of bamboo, and so of course are very perishable, but occasionally small timber is employed. The floor or platform (of coarse bamboo matting) is seldom raised more than from twenty-four to thirty inches above the ground, though, if my memory serves me, I have occasionally seen it raised as much as between six and seven feet. Beneath this platform a good deal of lumber generally accumulates, and the poultry and pigs frequently congregate for shelter, but I think I never saw an instance of the lower portion of the erection being inclosed by matting to form a "ground floor." Were these pile-dwellings confined to the low, flat lands upon which the Bengali delights to place his paddy-fields, it would be obvious that they were adopted for the purpose of obtaining a dry, wholesome floor, and security against unanticipated floods. But so far is this from being the case that only very rarely is a Naga or Kuki village to be found on low-lying ground, and generally they are to be seen upon the sides and even the summits of considerable elevations, where any danger from floods is quite out of the question. Again, it might be supposed that these elevated dwellings were adopted as a protection against wild animals but for a curious practice occasionally observable amongst the hill-men. This is the habit of building upon the steep side of a hill in such a manner that the back of the dwelling rests directly upon the ground, while the front is supported upon piles which are of a height sufficient to render the floor, throughout its length, horizontal. Such a plan as this reduces the protection afforded from vermin and wild animals to a minimum, and seems to justify the belief that the fear of these creatures at least could have little or no influence upon the architectural habits of the hill-tribes of this part of India; and I long ago came to the conclusion that here at least the object of the pile-dwellings was simply to attain in the easiest way a floor which should be exempt from the damp exhalations of a tropical soil. JAMES DALLAS

"Probable Nature of the Internal Symmetry of Crystals"

UNDER this head Mr. Barlow has published in NATURE of December 20 and 27, 1883 (pp. 186 and 205) an interesting and ingenious memoir. The subject being very important, but also very difficult and intricate, a discussion of the new theory may perhaps contribute to render our ideas a little more precise.

Whilst Haüy, Frankenheim, Delafosse, Bravais, and others think a crystal built up of mere congruent particles, which may be either the chemical molecules or rather certain aggregates of them, Mr. Barlow considers the arrangement of the different chemical atoms in the interior of a crystallised compound, and illustrates some facts by this manner of viewing them. I purpose in the following submitting some objections which arise against the deductions of the author. These objections are of a geometrical, chemical, and physical nature; let us begin with the geometrical ones.

The first problem of Mr. Barlow is "to inquire what very symmetrical arrangements of points or particles in space are possible." He comes to this result: "It would appear that there are but five." Then he describes these five arrangements. What conditions are to be fulfilled by an arrangement of points in space which is to be "very symmetrical," is nowhere said. According to this indefiniteness of the fundamental notion, the five kinds of very symmetrical arrangement seem to be found rather by divination than by systematic reasoning. Therefore the foundation of the theory appears somewhat arbitrary; and we may suspect that it is incomplete. We are in fact confirmed in this presumption if we consider the results of a geometric research published in my "Entwickelung einer Theorie der Krystallstruktur" (Leipzig: Teubner, 1879). In this book I have specified all possible arrangements of points that are regular and infinite, I have called a system of points *regular* if the points are disposed around every one point of the system in precisely the same manner as around every other. *There are sixty-six such regular systems of points possible.* According to the peculiarity of their symmetry they are subdivided into groups, which correspond strictly to the known crystallographic systems. Many of those arrangements of points have a hemihedric or tetartohedric character; others have the structure of a screw; and amongst the latter I could even suggest one particular system which represents the internal structure of quartz. The latter result was obtained (*loc. cit.* pp. 238–245) by comparing the crystallographical and optical properties of quartz with those of the known combination of thin laminæ of mica arranged in the manner of winding-stairs, described by Prof. Reusch fourteen years ago. All sixty-six systems are in agreement with the principal law of crystallography, the law of rational segments of the axes (Wiedemann, *Annalen der Physik*, 1882, vol. xvi. p. 489). For example, if we have reason to suppose that a certain one of these systems should represent the structure of a given substance crystallising in hexagonal pyramids, then we derive geometrically the same series of possible pyramids which nature actually exhibits.

Four of Mr. Barlow's five kinds of "very symmetrical arrangements" prove to be extremely particular cases of four general systems of mine. The first, second, and third kinds of Mr. Barlow's result from the systems which I have called the "rhombendodecahedric, cubic, and octahedric system with 24-points-aggregates" ("Entwickelung," pp. 165–168), if we suppose the twenty-four points of the so-called "24-punkter" coinciding in one point, and if we identify this point with the centre of a sphere of Mr. Barlow. Mr. Barlow's fourth kind of "very symmetrical arrangements" results as a particular case from my "3-gängiges 6-punkt-schraubensystem" (*loc. cit.*, Fig. 46), if the sides of all hexagons are supposed to touch one another, and the layers to have convenient distances. Mr. Barlow's fifth kind of symmetry, not being regular in the sense defined above, cannot be found amongst my sixty-six systems. Though every point is surrounded by six neighbouring points at equal distances, the latter have not throughout an identical arrangement. Every point of the first, third, fifth, &c., layers is situated at the centre of a perpendicular prism (with regular triangular base) whose angles bear the six neighbouring points of the system, but around every point of the second, fourth, sixth, &c., layers, the six neighbouring points are situated at the angles of two regular triangles, which do not lie parallel over one another as before, one of them being turned round in its plane 60°.

As my sixty-six systems comprise four of Mr. Barlow's kinds of symmetry, it may be expected that they include other arrangements besides, which may also pass as "very symmetrical." For example, in a cubic aggregate of points, the centres of the edges of all cubes determine a very symmetrical arrangement of points, where every point has equal distances from the next eight surrounding points (cf. "Entwickelung," &c., p. 160). From this I believe I have shown that the geometrical foundation of Mr. Barlow's theory is somewhat arbitrary and incomplete.

I now come to the chemical objections, which I will explain by an example. A chemical compound of two kinds of atoms, present in equal number—for example NaCl—could, according to Mr. Barlow, crystallise into the first or second of his five kinds of symmetry, for either of these two kinds allows the regular arrangement of two kinds of particles in equal number. In the first kind of symmetry (for example) spheres are so arranged that they constitute a cubic system of points, in which the centre of each cube bears also a point of the system. By putting atoms of one kind (Na) on the angles, and atoms of the other kind (Cl) on the centres of the cubes, we have built up the structure of a crystal of NaCl. Thus eight atoms of Na stand in exactly identical manner around an atom of Cl (and also eight atoms of Cl around an atom of Na). The atom of Cl seems consequently to be in equally close connection with eight atoms of Na; it has exactly the same relation to these eight atoms. It appears therefore as *octovalent*, certainly not as univalent; for it would be entirely arbitrary to suppose any *two* neighbouring atoms of NaCl in an especially close connection and to take this couple for the chemical molecule of NaCl. By this example we see *that from Mr. Barlow's point of view both the notion of chemical valency and of chemical molecule completely lose their present import for the crystallised state.* This objection, of course, will not destroy the theory of Mr. Barlow, since chemical valency does not yet belong to perfectly clear and fixed notions, and since the idea of the chemical molecule in a crystal is also not evident and clear. The author, however, is at all events obliged to show why these two notions, of such great moment for substances in a gaseous state, should become completely insignificant, as soon as crystallised bodies are in question.

Finally for a physical objection. With respect to the fact that most substances change their volume in congealing, Mr. Barlow admits that the atoms themselves undergo an expansion (positive or negative) in the act of crystallisation. Thus he attributes to the atoms variability of volume, *i.e.* one of those qualities, for the explanation of which the atomic theory has been devised. Well, let it be so, but this hypothesis of atomic expansion is not even found sufficient everywhere, but must be assisted occasionally by auxiliary hypotheses. Thus for explaining the isomorphism of substances which contain atoms of the same kind (*e.g.* $CaCO_3$ and $FeCO_3$) Mr. Barlow supposes that the expansion in the act of crystallising is confined to the common atoms, whilst the different atoms in both substances remain unaltered.

All these objections do not overthrow the author's theory, but they shake it. Perhaps they will induce Mr. Barlow to establish his theory in a more solid and more general way, and in this case also I shall have attained my aim. L. SOHNCKE

University of Jena

Holothurians

THE observations which I made in 1883 among the coral-reefs of the Solomon Group on the habits of the Holothurians support the view that these animals do not subsist on living coral. I carefully examined the material voided by about twenty individuals, and found its composition to be of a mixed character. In addition to the calcareous sand and gravel which formed its bulk, there were numerous tests of the large foraminifer—Orbitolites—and several small univalve and bivalve shells, besides the joints of a stony alga and the operculum of a young nerite, &c. This observation is supplementary to those contained in my previous letter on this subject (NATURE, vol. xxvii. p. 7).

Traders in this group tell me that when collecting a species known in the trade as the "large tit-fish," they have frequently found a small eel inside the animal, which usually escaped before it could be secured. One man received a smart electric shock, whilst handling a trepang containing one of these eels.

H. B. GUPPY

H.M.S. *Lark*, Auckland, N.Z., January 1

Unconscious Bias in Walking

SURELY Mr. W. G. Simpson has written from imperfect memory when he tells us in NATURE (vol. xxix. p. 356), "if the majority of people, as Mr. Darwin argues, are left-legged, they would circle to the *left* in a mist, as Mr. Larden says they do." In Mr. Larden's letter (p. 262) the following passage occurs: "This theory (his own) involving as further consequences that those in whom the left leg is the strongest would circle to the *right*," &c.; again, "I myself am right-legged and in a mist I always circle to the left." Although Mr. Simpson has misquoted Mr. Larden, he has arrived at the same conclusion that I did (see NATURE for January 31, p. 311), but gives his views in different words, namely, that "there is a bias *towards* the stronger limb, irrespective of length." JOHN RAE

The Storm of January 26

THE lowest reading, reduced to the sea-level, of the barometer here, about six miles south-east of Omagh, during the gale on Saturday, the 26th ult., was 27·68, and occurred at 4.15 p.m. Dublin time. ROBERT DIXON

Clogherny, Beragh

PALESTINE EXPLORATION

THE following communication has been forwarded to us for publication:—

Mediterranean Hotel, Jerusalem, January 18, 1884

DEAR PROFESSOR OLIVER,—A chest in a waterproof cover leaves here to-morrow for London to Messrs. Cook and Son, Ludgate Circus. It should arrive on February 25 or sooner, and I have directed that it should be forwarded immediately to Kew. I hope to arrive soon after. It contains all my dried plants. They are made up in various packages, with localities written outside. Of course you will have them kept dry and looked after, but I think they had better not be overhauled until I come, as I should like to open them as they are, while the contents of each package and its associations are fresh in my memory. The earlier desert plants are in many cases only valuable for recognition, I fear, as they are withered remains, but I frequently obtained a lingering flower and many seeds. All my seeds and bulbs I have sent according to promise to Mr. Burbidge, of the College Botanic Garden, Dublin. In the mountains about Sinai and Jebel Catherine I obtained better specimens, and things gradually improved to Akaba. We got through a good deal of unexplored country and had a most efficient conductor. Along the Wady Arabah I made frequent detours into the mountains on either side, and was especially fortunate in having a good collection on Mount Hor and at Petra and its neighbourhood. The flora of Mount Hor (5000 feet) is extremely rich—a warm sandstone. I also collected mosses and lichens in the desert, and am still gathering all I can. My collections reach to here, including a run down to the Jordan. The pace is now (horses) often too rapid, but the camel was an admirable companion on a long march. We were delayed in the Ghor-en-Safiet, at the south-east end of the Dead Sea for ten days, an unparalleled sojourn in this most interesting place. It was early a little, but I made large collections there, and was very glad of the difficulties that opposed our departure. I found many unexpected plants—three ferns, for instance, on Mount Hor, and a *Stapelia*. I knew the names of very few of the things, and had no books, but Redhead and Lowne's papers were a help, though they gave a very poor idea of the real state of affairs. There is a fine *Acacia* in the Ghor-en-Safiet, distinct in many respects and far finer than *A. seyal*. It is the true "scent" about which there seems a lot of confusion. Hoping my collections will be satisfactory,

I remain yours very truly,

(Signed) HENRY CHICHESTER HART

P.S.—Here in Jerusalem there are about six plants in flower; down below in the Jordan I gathered about a hundred two days ago! (Signed) H.

FAIRY RINGS

THE dark green circles of grass known as "fairy rings" formed the subject of a paper in the *Philosophical Transactions* of the new-born Royal Society in 1675; but it was only last year that the Rothamsted chemists, Messrs. Lawes, Gilbert, and Warington, announced what is no doubt a correct explanation of these phenomena.

The original theory of the electrical origin of the rings was succeeded by that of "chemical causes" propounded by Dr. Wollaston at a meeting of the Royal Society in 1807, and by Prof. Way in a paper read to the British Association in 1846. Besides the "mineral theory" which was here pressed into the service of a discussion that commenced, as already stated, more than two hundred years ago, De Candolle applied his famous "excretory theory" to its elucidation. At Rothamsted, however, the causes of fairy rings were still regarded as having been unsatisfactorily explained.

Sir John B. Lawes and his colleague Dr. Gilbert commenced their inquiries on this subject many years ago. Almost from the commencement of their experiments at Rothamsted they had regarded the alternate growth of fungi and grass as a striking example of what may be called the "natural rotation" of crops. As long ago as 1851 they described fairy rings in the *Journal of the Royal Agricultural Society* as "a beautiful illustration of the dependence for luxuriant growth of one plant upon another of different habits." It will be remembered that the experiments at Rothamsted led to the substitution of what is called the "nitrogen theory" for the "mineral theory" of former days, and practical agriculturists who know the value and the cost of nitrogen as an all-important agent of fertility will learn, perhaps without surprise, that the rich verdure of a fairy ring is due to the effect of nitrogen. Nitrogen is the *sine quâ non* of plant growth, and fungi require a large amount of it. From what source do they obtain it? At the present time few, if any, chemists would maintain that they obtained it by the absorption of free nitrogen from the atmosphere, but in 1851 the eminent investigators at Rothamsted attributed the nitrogen of the fungi to their extraordinary power of accumulating that substance from the atmosphere; and this they thought enabled them to take up the minerals which the grasses, owing to their more limited power of obtaining nitrogen, could not appropriate from the soil. They assumed that it was the nitrogen rather than the mineral constituents of the fungi to which the manuring action was mainly to be attributed, and in this they were right; but the theory has required some correction nevertheless, inasmuch as they have since proved the source of nitrogen in the fungi to be the soil, not the atmosphere.

As doubts were entertained at first on this point, direct experiments were tried at Rothamsted, and in 1874 samples of soil were taken within a fairy ring, immediately upon it, and outside, and these yielded on analysis the lowest percentage of nitrogen in the soil within the ring, a higher percentage under the ring, and a higher still outside it. The soil therefore had lost nitrogen by the growth of the fungi, and the obvious conclusion was that the fungi possess a greater power than the grasses of abstracting nitrogen from the soil.

The analyses of the various species of fairy-ring fungi do not greatly differ. Two species occurring at Rothamsted—*Agaricus prunulus* and *Marasmius orcadum*—contain nitrogenous compounds to the amount of one-third of their dry substance, the ash being rich in potash and phosphoric acid. Their occurrence on pastures, like that of the common mushroom, is probably due to the manuring of the ground by animals and their continuance and growth depend on certain conditions of soil and season. They are rarely developed on rich soils, or on those which are highly manured, or in seasons favourable to the general herbage of the turf; and when they do appear under these conditions they will probably not be reproduced, or only in patches. The recent wet seasons have dispersed fairy rings in situations where they have usually proved persistent. They prevail wherever the growth of the grasses is inferior, especially on the poor downs of the chalk districts, and on poor sandy soils where the natural herbage is wanting in vigour.

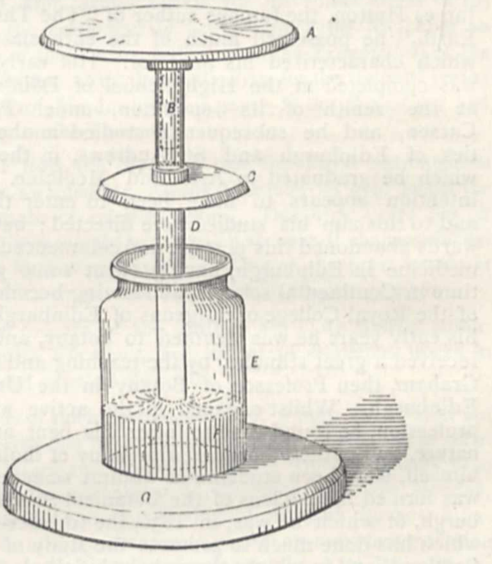
The history of fairy rings, as it has now been written at Rothamsted, will attract close attention from all who are interested in the nutrition of plants, including the student of agriculture, and all, in fact, who are specially concerned in the question of the food supply. It was not previously known that any kind of plant could feed directly on the organic nitrogen of the soil itself. It was recognised that the root-development of plants differed, and that the greater extension of their roots enabled some plants to secure a larger proportion of the constituents of the soil than others. But here is a race of plants possessing quite unsuspected powers of assimilation! Instead of rising from the ashes of the phœnix they feed upon its undecayed body, that is, upon the organic nitrogen of the soil. The Leguminosæ, for example, such as beans and clover, are known to assimilate more nitrogen from a given soil than the Gramineæ, such as wheat and barley, and this has been attributed to absorption by their leaves, or to the superior development of their roots. Another alternative is now suggested, and possibly a new departure may be taken in the science of agriculture, as the result of the recent discoveries in connection with fairy rings.

HENRY EVERSHED

A CHEAP INSULATING SUPPORT

INSULATING-SUPPORTS are so indispensable in the work of an electric laboratory that several forms have come into extensive use. The plan devised by Sir W. Thomson for securing high insulation by surrounding a glass stem with concentrated sulphuric acid to absorb the moisture which otherwise would condense from the air and form a conducting film over the surface of the glass is remarkably efficient, and has many advantages. Modifications of this form of insulator have been largely used by Prof. Clifton, F.R.S., in the Clarendon Laboratory, and by Profs. Ayrton and Perry in the laboratories of the Technical College at Finsbury. Another modification due to M. Mascart, was described in NATURE, vol. xviii. p. 44; and this pattern has come into extensive use under the name of the *support isolant Mascart*. Though excellent in every way it is very expensive, as its manufacture necessitates a special piece of glass-blowing. The central support of glass is solidly fused into the bottom of a glass vessel with a very narrow neck into which acid is poured through a tubulure at the side.

The insulating support which I have recently described before the Physical Society of London is a much simpler affair, and can be made very quickly and cheaply from the materials at hand in every laboratory. The figure shows the form of the support. A wide-mouthed glass bottle, E, about 10 cm. high, and from 5 to 6 cm. diameter, is selected. A piece of stout glass tubing about 20 cm. long is then taken. One end is closed in the blowpipe flame, and blown into a thick bulb; and while yet hot the bulb is flattened, so as to form a foot for the stem. The flattened bulb should be as large as is compatible with its insertion into the mouth of the bottle. To hold it in its



place some paraffin wax is melted in the bottle—from 50 to 70 grm. is quite sufficient—and when it has cooled so as nearly to have become solid the stem, previously warmed, is inserted. When cool, the paraffin holds the stem firmly in its place. To keep out the dust a disk cut out of sheet guttapercha is fitted on as a lid. If dipped into hot water for a minute it can be moulded to the required form. It fits loose-tight upon the stem, as shown at C, and when the stand is not in use is slid down over the mouth of the bottle. A brass disk, A, having a short brass stem, B, below it, slips into the upper open end of the tube, and forms the top of the stand. It is also found convenient to make from rods of glass other supports, shaped at the top in the form of hooks, which can be slipped down into the central tube. These are very useful for holding up wires that pass over the experimenting table and require to be well insulated. The bottle is let into a wooden foot, G. In cases where very perfect insulation is required I have poured a little strong sulphuric acid into the bottle above the paraffin. In practice, however, the insulation of the paraffin is amply sufficient for most purposes, provided dust is properly excluded.

SILVANUS P. THOMPSON

JOHN HUTTON BALFOUR

IN Prof. Balfour, whose death we announced in our last issue (p. 365), has passed away another of that group of eminent teachers, including Goodsir, Syme, Simpson, Christison, &c., which maintained the reputation and added lustre to the fame and prestige of the Medical School in our great northern University during the middle decades of this century; one, too, of that band of working British botanists of the first half of the century which counted amongst its members the Hookers, Munby, Carmichael, Greville, Walker Arnott, Babington, Parnell, Prior, the Macnabs, &c, the majority of whom have now left us; and where are their successors? By his death a figure—in later years picturesque with grey locks and patriarchal beard—familiar all over Scotland, and where scientific men do congregate, has been removed. Few men were more universally esteemed and popular, and few quit their sphere of active and busy life leaving behind them more pleasant reminiscences than he whose decease we have recorded. Compelled by failing health to retire about five years ago from public life, his powers since then gradually weakened, until on the 11th inst. he quietly breathed his last.

John Hutton Balfour was born in Edinburgh on September 15, 1808. Related, as his name indicates, to James Hutton, the famous author of "The Theory of the Earth," he possessed much of the enthusiasm and fire which characterised his ancestor. His early education was completed at the High School of Edinburgh, then at the zenith of its reputation, under Pillans and Carson, and he subsequently studied in the Universities of Edinburgh and St. Andrews, in the former of which he graduated in Arts and Medicine. His first intention appears to have been to enter the Church, and to this aim his studies were directed; but he afterwards abandoned this purpose and commenced to practise medicine in Edinburgh, having spent some preparatory time in Continental schools, and having become a Fellow of the Royal College of Surgeons of Edinburgh. During his early years he was devoted to botany, and his taste received a great stimulus by the teaching and example of Graham, then Professor of Botany in the University of Edinburgh. Whilst engaged in the active work of his profession, he found time to foster his bent and love for nature, and gathered around him many of those who, like himself, were keen students of natural science, and thus was formed the nucleus of the Botanical Society of Edinburgh, of which he was, in 1836, the founder—a society which has done much to promote the study of botany in Scotland, and in which, throughout his whole life, he was a guiding spirit. In 1840 Balfour found time amidst his medical duties to commence lecturing on botany in Edinburgh, and his ability as a lecturer was at once proved by the large numbers attracted to his classes. But it was not until 1842, when he was appointed to the Chair of Botany in the University of Glasgow, vacated by the translation of Sir William Hooker to Kew, that he was able to give up medicine, and devote himself solely to botany. After four years in Glasgow, the death of Prof. Graham made an opening in the East of Scotland, and Balfour was elected Professor of Botany in the University of Edinburgh, shortly thereafter obtaining the appointments of Regius Keeper of the Royal Botanic Garden and Queen's Botanist for Scotland. Subsequently he undertook the duties of Dean of the Medical Faculty in the University, and his energy on behalf of the Royal Society of Edinburgh led to his appointment as Secretary. From all these positions he retired in 1879, when a fitting tribute to the value of his services was paid by the presentation of his portrait, and he was then elected Assessor in the University Court for the General Council, and each of the three Universities with which he had been connected conferred on him the degree of LL.D. For many years he was an F.R.S., and also a member of a vast number of British and foreign scientific societies.

As a botanical investigator Balfour was a systematist, belonging to that school which is now, by a species of reaction, often held in contempt by those within whose reach the modern developments of physics and chemistry have placed methods of morphological and physiological research denied their predecessors. He had an acute perception of resemblances and a keen eye for a species. But it is not upon his original investigations that Balfour's reputation rests; his work of that character was not extensive, for the time which might have been devoted to it was fully occupied by his official duties as Dean of the Medical Faculty and Secretary of the Royal Society, and he was one of those who sacrificed scientific laurels for the good of the institutions he served. But as a teacher his fame was world-wide, and as a great teacher he will be remembered. He had in a remarkable degree the power of lucid exposition, and the inestimable qualification of infusing in his pupils the enthusiasm which possessed himself. Painstaking and conscientious in his work, no trouble was too great for him if it could contribute to the better comprehension by his students of the subject taught, and the wealth of illustration and the earnestness of manner which clothed his lectures impressed all who heard him. Though the natural cast of his own mind made taxonomy his favourite branch of botany, yet in his teaching, especially in his earlier years, this was given no undue prominence; his success, indeed, was in great part due to the way in which all branches of the science were handled, and he had the credit of being the first to introduce in Edinburgh classes for practical instruction in the use of the microscope. His text-books reflect the character of his teaching, and "if," as a critic remarked on their first appearance, "we recall the dry and dictionary-like manuals to which students were forced to have recourse in our young days—as inviting as so many pages of Johnson's Dictionary—we can but envy their successors." In later years his books and he himself fell behind—and who does not?—in the rapid march of science; but any one examining his books cannot fail to recognise how thoroughly they represent the state of science at their date of publication, and to appreciate the industry and the skill with which the author seems to have exhausted every source of information.

Another feature of Balfour's teaching was the "excursion." Amongst the 8000 students whom it was his pride to have passed through his classes will be many to whom the announcement of his death will recall pleasant recollections of these outings on hill and in glen; how, as they neared the habitat of some rare Alpine herb, the wiry and energetic Professor—"Woody Fibre" as they called him—would outstrip all in his eagerness to secure it; or how, toiling up some long barren slope, his constant flow of jokes and puns would enliven and rouse their flagging spirits. In these rambles, to which many will look back as not only healthful and recreative, but as giving them their first lessons in accurate observation of nature, Balfour visited almost every part of Scotland, ascended every important peak, and gathered every rarity in the flora. No one knew Scotland and its plants better. In this way Balfour became associated with his students in a way no other Professor did, and his position as Dean of the Medical Faculty brought him still more in contact with them. The Rhadamanthus of the examination-hall he enjoyed a unique popularity, and the esteem with which old pupils regarded him may be traced to the intimate relationships thus established, to the way he identified himself with and interested himself in them and showed himself always anxious to merge the professor in the friend. In all he did Balfour was methodical, and his powers of organisation and administration found exercise in the management of the Royal Botanic Gardens, which, under his direction and with the Macnabs—father and son—as curators, was greatly increased in extent, provided with a magnificent palm-house and other plant-houses, as well as with a botanical museum and improved teaching accommodation, and made one of the finest in the country. The latest addition to the garden—the arboretum—accomplished just before he retired from public life, was part of a scheme (perhaps chimerical) he encouraged with the view of establishing a School of Forestry in Edinburgh—a scheme now receiving some attention in Scotland.

Ready and rapid with his pen, Balfour's contributions to botanical and other literature are very numerous. Besides contributing to several Encyclopædias, he was for many years one of the editors of the *Annals of Natural History* and of the *Edinburgh New Philosophical Journal*. Of independent works, his text-books, to which we have already alluded, were very popular in their day, and are now valuable for reference, and he published works on Botany and Religion, Plants of the Bible, &c.

We should fail to give an adequate idea of the veteran Professor were we not to allude to that which gave a character to all he did—his religion. To him all nature was a symbol. He was one of that band of which Faraday, Clerk Maxwell, Greville, Wm. Allen Miller, and others were in the van, who "recognised the harmony between the word and the works of God," and who saw "in the objects of nature around indubitable evidences of a great designing mind."

By those who knew him—and his was a wide circle of friends—he will be remembered as a genial companion with the best attributes of humanity, and his name will always remain inseparably linked with the progress of botany in Scotland during this century, and as that of one of the eminent teachers in the University and city to which he belonged.

CAPTAIN HOFFMEYER

IN the early death of Niels Hoffmeyer, which occurred at Copenhagen on the 16th inst., modern meteorology has lost one of its most diligent and successful students, and one whose place it will be hard to fill.

Like more than one of our own physicists, Hoffmeyer was an artillery officer, and had attained the rank of captain in the service. At the close of the Prussian war he had fallen into bad health, and accordingly, on the reduction of the Danish army which then ensued, his name was placed on the retired list, and he was for a time unoccupied.

The Danish Meteorological Institute was organised in 1872, and Hoffmeyer was nominated its first director. There could scarcely have been a more fortunate appointment, for Hoffmeyer was gifted not only with unusual energy, but also with a very pleasant manner, so that he made friends for the new office and for its work wherever he went. He will best be known by his Atlas. He undertook to prepare daily weather-maps of the Atlantic—in great measure at his own expense—and he actually published them for a period of three and a quarter years, from September, 1873, to November, 1876. It is only a few months ago that he announced his intention to resume the work in combination with Dr. Neumayer, of the Deutsche Seewarte at Hamburg.

The most important results which Hoffmeyer had deduced from his own maps were contained in his pamphlet, "Étude sur les Tempêtes de l'Atlantique Septentrional, et Projet d'un Service Télégraphique International Relatif à cet Océan," Copenhagen, 1880; and up to the very last he never ceased to use his utmost efforts for the establishment of a meteorological telegraphic service with America, *viâ* the Faroes and Iceland.

While Hoffmeyer's chief work was in the domain of synoptic meteorology, he by no means disregarded climatology, and the service which the Danish Office has rendered to that science by the maintenance of stations in Iceland and Greenland has been very material.

When Capt. Hoffmeyer was in London last summer as Danish Commissioner to the Fisheries Exhibition, he was complaining of great weakness of the heart. During December he was laid by for some time, but he had somewhat recovered, when he was seized last week with rheumatic fever, to which he soon fell a victim. He leaves a widow, but no children. He was an Honorary Member of the Royal Meteorological Society (London). He had been one of the secretaries of the Meteorological Congress at Rome, 1879, and of the Conference on Maritime Meteorology in London, 1874, but his chief official service of this nature was as Secretary to the International Polar Commission, where his loss, coming after that of Weyprecht, will be severely felt.

NOTES

THE Council of the Royal Society of Edinburgh has awarded the Keith Prize for the biennial period 1881–83 to Mr. Thomas Muir for his researches into the theory of determinants and continued fractions, the most recent instalment of results obtained by him being in a paper on permanent symmetric functions. Also the Macdougall-Brisbane Prize for the period 1880–82 to Prof. James Geikie for his contributions to the geology of the north-west of Europe, including his paper on the geology of the Faröes, published in the *Transactions* of the Society, 1880–81. And the Neill Prize for the triennial period 1880–83 to Prof. Herdman for his papers in the *Proceedings* and *Transactions* on the Tunicata.

WE learn from the *Standard* that the Royal Astronomical Society has awarded Mr. Ainslie Common its gold medal for his photographs of celestial bodies. This high award has, it is believed, been mainly bestowed on account of the magnificent photograph he has succeeded in taking of the great nebula in Orion, of which we gave an illustration in a recent number.

WE regret to learn of the death of M. T. du Moncel, editor of *La Lumière Électrique*, and author of numerous works in theoretical and practical electricity.

THE needs of the higher education of women in London are gradually being met in the manner that has been found so satisfactory at Oxford and Cambridge, where women students have long enjoyed the advantages of collegiate life. On Monday, February 11, there was a gathering of many of the most influential friends of the movement to inspect an important extension of the College Hall of Residence established at Byng Place, Gordon Square, in October 1882. The success which attended the first development of the scheme, and the growing demand on the part of students for admission, has encouraged the committee to provide additional accommodation by adapting the adjoining house, No. 2, Byng Place. With the new extension they look forward to a yearly surplus instead of a deficit. With the power of accommodating thirteen extra students the receipts would be increased by 876*l*. for the short session, and there would not be a proportionate increase in the expenditure. The advantage of holding the two houses is therefore evident. The second house was opened at the commencement of the current term, and there are now seventeen students in residence. Of this number two are pursuing the course of instruction provided at University College for the B.A. degree, two that for the matriculation examination of the London University, and another, a foreign lady, is a student of English literature at the same college; another student is preparing for the examination of the Pharmaceutical Society. Four ladies are students of the London School of Medicine for Women, and preparing for the M.B. degree (Lond.), and the remainder are studying art at the Slade School and elsewhere. The first student of the Hall who went up for the examination for the B.A. degree passed successfully last October, and has now an appointment as teacher at a school in York. The expenses for board and residence vary, according to the size and position of the room occupied, from 51 to 75 guineas for the

University College session of about thirty-three weeks. Even these fees, moderate as they are, are beyond the means of a large number of students, so that the committee, without such assistance as would be afforded by exhibitions, are unable to extend to them the advantages of the Hall. Besides help in this direction a need is felt for a reference library, as the books necessary for many of the courses at University College and the School of Medicine are numerous and costly. A special fund has been started for this purpose, and it is hoped that further subscriptions may be obtained. It is worth mention that the committee have recognised a principle which, so far as we know, has never been adopted in institutions of this kind. We refer to the representation of students on the governing body. This liberal measure, which invites the co-operation of students and gives them a means for the legitimate expression of opinion, will enable the students in residence to have a member elected annually as their representative on the committee. It is hoped that the benefit of this may be felt in strengthening the bond of a common interest. We have not touched on many of the advantages of the Hall which are felt by those who know the difficulties incident on a student's life in lodgings, as they were dwelt upon when we recorded in this journal the commencement of the scheme in the winter of 1882. It is therefore only necessary to state that the Hall in its enlarged scale offers the same comfortable and well adapted academic residence as that originally provided, and that under Miss Grove, the able principal, the high tone which has marked the institution from the beginning is still maintained. When we point out that the scheme has received the support of the late and present Presidents of the Royal Society, the late Sir William Siemens, Sir John Lubbock, M.P., Mr. Samuelson, M.P., Dr. Gladstone, Prof. Carey Foster, and many others, we have said enough to commend it to all our readers. In the nature of things Science and Art, as well as Literature, will gain by this and similar attempts to put the higher education on a more satisfactory basis.

Dr. Reusch has communicated to *Naturen* the result of his analysis of a portion of volcanic ash from the Krakatoa eruption, given him by Prof. Kjerulf, who had received it direct from Batavia. He finds the principal constituents of the ash to be ordinary pumice-stone, some fragments of which are more than 1 mm. in length, while others are reduced to a condition of colourless or slightly brownish vitreous pumice-powder. Intermixed in the general mass are fragments of larger crystals of felspar (Plagioklas) and of some rhomboidal mineral of the nature of augite.

At a meeting of the Norfolk and Norwich Naturalists' Society on the 29th ult., an account was read from the *Perth Enquirer* of a volcanic eruption in Western Australia, contributed by a highly respected settler who had lived in that district some years. The phenomenon he describes was witnessed by him on the same day as that on which the calamity occurred in the Sunda Straits, although he was in total ignorance of that disturbance at the time. He writes:—"I was travelling inland with a flock of sheep, when late in the afternoon of Saturday, August 25, to my profound astonishment, a shower of fine ashes began to rain upon me and my party. The fall of the ashes commenced just about sunset, and the shower, which was at first but very slight, soon became thicker, until it resulted in a steady and heavy rain of light calcined fragments. After the sun set I noticed a bright ruddy glare on the horizon towards the north-east; this was at first only just perceptible, but as the time wore on it increased in both brilliancy and extent. The glare was not at all diffused, and it was of such a nature that it was impossible to mistake it for a display of the *Aurora Australis*. On the contrary, I could easily see that the source of the glare was strictly circumscribed, or, in other words, it was confined to one spot; but as it increased in intensity the fervid glow mounted higher and higher in the heavens. So far as I could roughly calculate, the source of this extraordinary illumination must have been situated about 400 miles inland to the north-east of Roeburne. The showers of ashes ceased just after sunset, and I observed that the steady glare was still to be seen until before sunrise, but as the sun rose the lurid appearance of that portion of the horizon gradually decreased, and at last quite died away when the orb of day made its appearance. Fortunately, I afterwards had an opportunity of questioning some natives who had recently come from that part of the country, and they described the cause of the glare plainly enough. 'Big mountain burn up big,' they said; and then they added, 'He big one sick. Throw him up red stuff, it run down side and burn grass and trees. We frightened and run away, and fire-sticks (*i.e.* I presume the ashes) fall on us. Two, three days after we go look again; mountain only smoke then, and red sick turned black and hard, just like stone.' A plainer description of a volcano in a state of eruption could hardly be given by uncivilised beings; and I am therefore compelled to conclude that I was the far-distant witness of the first eruption of a volcano that has occurred in Australia within the memory of living men."

Nine lectures on the principal types of the human species will be delivered in the theatre of the Royal College of Surgeons, on Mondays, Wednesdays, and Fridays, at 4 o'clock, commencing on Monday, February 25, by Prof. W. H. Flower, LL.D., F.R.S., as follows:—Introduction, anthropology and ethnology; Physical or zoological anthropology; Nature and extent of the differences between the permanent types or races of men, illustrated by comparison between the European and the Tasmanian native; Methods of estimating the differential characters of the various modifications of the human species, elements of craniometry; Characteristics of the black, or frizzly-haired races, in their typical and modified forms; Characteristics of the yellow, or so-called Mongolian races; Characteristics of the white, or so-called Caucasian races; Races not readily grouped under either of the above principal types; Classification of the races of the human species. The course will conclude on Friday, March 14.

We regret to learn that the Council of the Geographical Society have decided to discontinue the examinations which they have held for a number of years for pupils attending our public schools. The number of candidates has been diminishing every year. The Council are, we understand, considering a scheme for establishing a Professorship of Geography; but, while we recognise their anxiety to promote in this way their branch of science, we confess that we are doubtful if this is the best means of attaining the object. The sphere of geography is at present quite undefined; in Germany it embraces something of nearly every science, while in this country it is often regarded as almost synonymous with topography.

Preparations for the holding of the International Health Exhibition are proceeding rapidly. The General Committee now numbers nearly 400 members, and from these 17 Sub-Committees have been formed. These have all been doing valuable work in advising the Executive Council as to the nature of objects which it is desirable should be fully illustrated, in obtaining the co-operation of many persons of eminence in the various branches on which the Exhibition will treat, and in supervising the applications for space. The allotment of space, which has been largely applied for, is being rapidly proceeded with, and applicants will soon be informed of the decision of the Executive Council with regard to their applications. In response to a request made by His Royal Highness the Prince of Wales, President of the Exhibition, the eight Water Companies of London have resolved to exhibit, in a pavilion which is being erected for them, their appliances for the supply, filtration, &c., of water, together with diagrams showing the various processes and localities; and a powerful Sub-Committee, under the active chairmanship of Col. Sir Francis Bolton, has been formed to carry out this branch of the Exhibition. The Water Companies have also determined to put up in the grounds a large fountain, which will be illuminated at night by electricity. It is impossible, as yet, to give any definite information with regard to foreign countries; but, so far as one can judge at present, Belgium, China, and India will be the best represented.

ACCORDING to information received in St. Petersburg everything is well with the Russian Meteorological Expedition wintering at Cape Sagasta at the mouth of the Lena. Every preparation was made last autumn for the wintering—the second one—the Governor of Yakutsk having provisioned the station most plentifully. During the previous winter—1882–83—the cold was rarely before January 40° C. below zero, but in January and February the thermometer frequently fell lower. The greatest cold occurred on February 9, when it fell to 52·3° C. below zero. In March even the cold was 40° in the night and 19° in the day. One of the members of the expedition, Dr. Bunge, has forwarded to St. Petersburg some valuable reports on the fauna in and about the mouth of the Lena.

THE Academy of Sciences has received a requisition from M. Ferry to appoint three delegates to the International Commission which is to meet at Washington on October 1 next in order to determine the choice of a first meridian. It is the first time that places have been offered to the Academy on a diplomatic commission.

PROF. HULL, who has returned with his party, brings with him, it is stated, materials for the construction of a geological map of the Holy Land very much in advance of anything which could hitherto be attempted. He is reported to have traced the ancient margin of the Gulfs of Suez and Akaba to a height of 200 feet above their present level, so that, according to Prof. Hull, the whole country has been submerged to that extent, and has been gradually rising. As one result of this rise, the Professor is of opinion that at the time of the Exodus there was a continuous connection of the Mediterranean and the Red Sea. As regards the Dead Sea, Prof. Hull believes he has discovered that it formerly stood at an elevation of 1400 feet above its present level—that is to say, 150 feet above the level of the Mediterranean. The history of this gradual lowering of the waters will form a special feature in Prof. Hull's forthcoming report. He believes he has also found evidences of a chain of ancient lakes in the Sinaitic district, and of another chain in the centre of the Wady Arabah, not far from the watershed. The great line of the depression of the Wady Arabah and the Jordan Valley has been traced to a distance of more than a hundred miles. The materials for working out a complete theory of the origin of this remarkable depression are stated to be now available. They are bound to differ in many details from the one furnished by Lortet, whose patient observations have hitherto been received with respect. The terraces of the Jordan have been examined, the most important one being 600 feet above the present surface of the Dead Sea. The relation of the terraces to the surrounding hills and valleys shows, according to Prof. Hull, that these features had already been formed before the waters had reached their former level. Sections have been carried east and west across the Arabah and Jordan Valley. Two traverses of Palestine have also been made from the Mediterranean to the Jordan. Prof. Hull has in hand, besides his scientific report, a popular account of his journey, which will first appear in the *Transactions* of the society. Captain Kitchener's map-work is in the hands of Mr. Armstrong, who was for many years on the survey of Western Palestine. He has himself been ordered on service up the Nile; but it is hoped that his absence will not retard the publication of a new and very interesting piece of geographical work.

WE have received the following communication from the Royal Victoria Coffee Hall:—"By the kindness of the Gilchrist Trustees the Committee of the Royal Victoria Coffee Hall, Waterloo Road, have been enabled to arrange another series of Penny Science Lectures on Tuesday evenings, as follows:—March 4, Prof. H. G. Seeley, F.R.S., on Ancient English Dragons; 11, Wm. Lant Carpenter, B.Sc., F.C.S., on Air, and why we Breathe (with experiments); 18, P. H. Carpenter, M.A., D.Sc., on Fossils, and what they teach us; 25, Edward Clodd, on the Working-Man 100,000 Years Ago. April 1, E. B. Knobel, F.R.A.S., F.G.S., Hon. Sec. R.A.S., on the Planets; 8, J. W. Groves, on the Dangers and Safeguards of Beauty in Animals. All the lectures will be illustrated by means of the oxyhydrogen lantern. If any of your readers can distribute handbills among working people, or cause window bills to be displayed in suitable situations, we shall be grateful for their help, and beg they will communicate with the Honorary Secretary. The difficulty of making anything known in this crowded, busy London is acknowledged on all hands, but it is believed that if these lectures could be made known in the right quarters, people would come long distances to hear them."

IT appears from the report of Drs. Brouardel, Segond, Descout, and Magnin, who conducted the autopsy of Tourguenief, that the brain of this eminent Russian author weighed 2012 grms. This extraordinary weight, which is only known to have been exceeded in the case of Rudolphi, is inexplicable, for Tourguenief, although tall, was not of exceptionally high stature. The brain is said to have been remarkably symmetrical, and distinguished by the extreme amplitude of the convolutions. According to generally accepted views, however, symmetry of the circonvolutions is not a favourable cerebral characteristic.

AN Anthropological Society has been founded at Bordeaux with Dr. Azam as president, and Dr. Testut as vice-president; both being members of the Faculty of Medicine of Bordeaux.

A SPECIAL commission has been established by the French Government to investigate the several processes proposed as a cure for phylloxera. It was stated officially at the last meeting of this body that every suggestion had proved abortive.

KING OSCAR of Sweden has personally conferred upon Mr. Carl Bock the Order of St. Olaf.

"IN our issue of December 14," *Science* states, "we published an article on 'The Signal-Service and Standard Time,' criticising the action of the chief signal-officer in not adopting the new standards of time at signal-service stations. We have since learned that our criticism was not well founded, as the information upon which it was based gave an incomplete idea of the position of the service in this matter. It is true that the observers of the service are still governed by the local times of their respective stations; but this is only a temporary arrangement, and will be changed as soon as possible. The reason of the delay is this: the international observation, which is taken at many stations of observation throughout the whole world, is made at 7 a.m., Washington time. It is proposed to make this observation eight minutes earlier, or at 7 a.m. of the time of the 75th meridian, which is exactly Greenwich noon; but, before this change can be made, the cooperating weather-services and numerous independent observers must first be notified, and their consent obtained. Correspondence has already been begun, and a circular letter sent to all who cooperate in the international work asking consent to the proposed change. Favourable replies are being received; and there is little doubt that the change will be made, probably Jan. 1, 1885. It should be remembered that the international observation is made largely by observers who kindly cooperate with the chief signal-officer, but who are not under his orders: a change of this kind cannot, therefore, be summarily ordered, but must be made by mutual consent."

THE Commissioners on Technical Education have now practically concluded their labours, and are likely to have only one more meeting to formally sign their Report, the greater part of which is in type. It will consist of at least five octavo volumes, it being found impracticable, even after careful consideration, to bring the mass of evidence and information within smaller compass. It is stated that any *résumé* of the series of conclusions and recommendations at which the Commission have arrived would not be useful or fully intelligible to the public without the explanatory details with which they will be accompanied. It is, however, hoped that the complete Report may be presented soon enough to permit of the House of Commons proceeding during the present session with such legislation, based upon the recommendations, as may be thought necessary. Meantime it is understood that technical training will form an important part of the measures of which the Government and Mr. A. O'Connor have given notice with regard to education in Ireland.

MESSRS. W. EAGLE CLARKE and W. Denison Roebuck, Leeds, are preparing a supplement to their "Handbook of the Vertebrate Fauna of Yorkshire," and would be glad to have notes of additions or corrections to that work, or notices of the occurrence of any species of quadrupeds, birds, reptiles, or fishes in Yorkshire which their friends may be pleased to communicate. As they wish to publish in the April magazines, it is hoped that the desired information may be sent in immediately. Communications may be addressed to No. 9, Commercial Buildings, Park Row, Leeds.

AT the Royal Institution Prof. Tyndall will begin a course of six lectures on "The Older Electricity—its Phenomena and Investigators," on Tuesday next (February 28), illustrated by experiments; and Capt. Abney, R.E., will begin a course of six lectures on "Photographic Action, considered as the Work of Radiation," on Saturday (March 1). Prof. Hughes will give a discourse on Friday evening next, on "The Theory of Magnetism," illustrated by experiments.

WE have already referred to the International Ornithological Congress which is proposed to be held in Vienna on April 16-23, under the protectorate of the Crown Prince Rudolf. It is now announced that arrangements are in progress for an International Ornithological Exhibition, which is to precede the Congress, and which will occupy from April 4-14. Single specimens and collections of living birds of all kinds, including domestic birds; all apparatus serving for the protection, cultivation, breeding, and conveyance of birds; implements used in bird catching and bird shooting, falconry, carrier-pigeon-post; aviaries, and bird cages; scientific objects and products which originate in or refer to the feathered world, will all be included in the programme of the Exhibition. All details will be furnished to intending exhibitors or partakers in the Congress by the Secretary of the Vienna Ornithological Society, Dr. Gustav von Hayek, III. Marokkanergasse 3 Vienna. The main subjects to be discussed at the Congress are—(1) An international law relating to the better protection of birds; (2) the establishment of a system of ornithological observing stations all over the inhabited globe; and (3) investigations concerning the origin of the domestic fowl, and measures for the amelioration of the cultivation and breeding of domestic birds generally.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Miss Furniss; two Common Roe (*Capreolus capræa* ♀ ♀) from Dorsetshire, presented by Messrs. Charles Hambro and J. C. Manuel Pleydell; a Passerine Owl (*Glaucidium passerinum*), European, presented by Mr. G. R. Lake; a Naked-necked Iguana (*Iguana delicatissimus*), a Banded Basilisk (*Basilicus vittatus*) from Nicaragua, presented by Mr. Albert Vidler; two Prairie Marmots (*Cynomys ludovicianus*) from North America, a Shaw's Gerbille (*Gerbillus shawii*) from North Africa, a Military Macaw (*Ara militaris*) from South America, two Iceland Falcons (*Hierofalco islandus*) from Sweden, deposited; a Red-eared Monkey (*Cercopithecus erythrotis* ♀) from Fernando Po, two Slow Loris (*Nycticebus tardigradus*) from the Malay Countries, a Red-eyed Ground Finch (*Pipilo erythropthalmus*) from South America, an Eyebrowed Weaver Bird (*Hyphantornis superciliosus*) from West Africa, four Asiatic Quails (*Perdicula asiatica* ♂ ♂ ♀ ♀) from India, purchased.

OUR ASTRONOMICAL COLUMN

AUSTRALIAN OBSERVATORIES.—The eighteenth Annual Report of the Director of the Observatory at Melbourne to the Board of Visitors (who in their turn report to the Governor of Victoria) has been issued. The new transit-circle was expected in a short time, and would find the new circle-room ready to receive it, but the instrument which had been in use for twenty years continued to give excellent and trustworthy results; nevertheless each year had forced upon Mr. Ellery the necessity of greater optical scope for the meridian work. The inevitable loss of reflective power in the great telescope increases a little year by year, but does not yet sensibly affect the work upon which it is employed. Indeed, Mr. Ellery says, "Some photographs of faint objects obtained lately are clear evidence of the immense light-gathering power it still possesses, and of the trivial loss occasioned so far by the slight tarnish apparent." The instrument had not been kept quite so closely to its special work—the revision of the southern nebulæ—as before, owing to the number of nights occupied with the great comet and in experimenting in celestial photography. Among the subjects of observation Mr. Ellery refers to the transit of Venus, the Port Darwin Expedition for determination of longitude of Australian observatories, and measures of differences of declination of the minor planets *Sappho* and *Victoria* for determination of the solar parallax, according to the scheme arranged by Mr. Gill. The great comet of 1882 was kept in view for 250 days, or until April 26. A large portion of the work connected with the telegraphic determination of the longitude of Australian observatories from Greenwich fell upon the Melbourne establishment, which is now assumed to be in longitude 9h. 39m. 53·37s. E., subject perhaps to some very small correction. As soon as the new transit-circle was properly adjusted, it was Mr. Ellery's intention to devote it to the revision of a rather large catalogue of stars at the request of the "Astronomische Gesellschaft," besides its more special work. The great telescope would be applied more exclusively to the continuation of the revision of Sir John Herschel's nebulæ, several of which, by the way, the Melbourne observers have not been able to find.

Mr. H. C. Russell sends us an historical account of the Observatory at Sydney and of the observations which preceded the erection of the present one in that colony. With the details of the actual observatory the reader will be probably acquainted through the volumes of results which have been issued therefrom; that for 1877-78 contains a general view of the building; but Mr. Russell mentions circumstances attending the erection of the first observatory on Australian soil which are perhaps little known. He extracts from the "History of New South Wales," by Col. Collins, the following note:—"Among the buildings that were undertaken shortly after our arrival [that of the first colonists in 1788] must be mentioned an observatory which was marked out on the western point of the cove, to which the astronomical instruments were sent, which had been sent out by the Board of Longitude for the purpose of observing the comet which was expected to be seen about the end of this year. The construction of this building was placed under the direction of Lieut. Dawes, of the Marines, who, having made this branch of science his peculiar study, was appointed by the Board of Longitude to make astronomical observations in this country." The observatory was erected as soon as the colonists landed, but, being found small and inconvenient, a new one for the better reception of the instruments and the residence of Lieut. Dawes was built of stone, for which ample materials were found upon the spot.

The comet to which reference is here made was that of 1661, supposed to have been identical with the comet of 1532, and again expected about the end of 1788 or beginning of 1789. It is not difficult to explain how this body came to be associated with the arrival of the first Australian colonists. Halley, who had calculated the orbits of the comet observed by Apian in 1532, and that observed by Hevelius in 1661, gave very similar elements in his "Synopsis of Cometary Astronomy." Pingré considered the comets identical, and thought he had recognised several previous appearances, as detailed in his "Cometographie," which was published in 1783. Maskelyne appears to have adopted Pingré's opinion, and was at the trouble of preparing sweeping ephemerides, which he communicated to the Royal Society, and we may conclude that it was through his interest with the Board of Longitude that Lieut. Dawes was supplied with instruments and charged with a search for the comet. Mr. Russell says there is no record of what was done at the Dawes' Point Observatory, but since the comet was not observed as expected, we may infer there were only negative results to be reported, though Lieut. Dawes did occupy himself in other ways to assist in the progress of the colony.

CHEMICAL NOTES

THE water supply of Boston (U.S.A.) became contaminated about a year ago with some substance or substances which imparted to it a peculiarly nauseous odour and taste. Chemical examination resulted in showing a large percentage of "albuminoid ammonia," and also that the "free ammonia" increased somewhat rapidly when the water was kept. The production of ammonia, and also the odour and taste, was finally traced to the decomposition of a freshwater sponge (*Spongilla fluviatilis*, Anct.) present in large quantities on the sides and bottom of one of the storage basins; removal of this sponge was followed by improvement in the water (see *Analyst*, viii. p. 184).

PROF. CLEVE describes, in the August number of the *Journal of the Chemical Society*, methods for extracting and purifying the earth *samaria*. From determinations of the amount of sulphate obtained from quantities of this oxide, Cleve deduces the number 150 as the atomic weight of the metal *samarium*. Various salts of samarium are described; the metal is closely allied to didymium.

HARTLEY showed some time ago (*C.S.J. Trans.* for 1882, p. 84 *et seq.*) that the ultra-violet spectra of elements belonging to the *same series* (in the nomenclature of the periodic law) exhibit fairly marked analogies as regards general character; recent observations of the spectrum of beryllium and comparison of this spectrum with that of allied metals have led Hartley to the conclusion that this metal probably belongs to the group which contains magnesium, calcium, &c., and not to that containing aluminium, scandium, &c. But if this is so, oxide of beryllium must be represented as BeO, and the atomic weight of the metal—about which there has lately been so much dispute—must be taken as 9 (*C.S.J. Trans.* for 1883, p. 316).

V. MEYER has recently separated, from benzene oils, a compound to which he gives the name of *Thiophen*. The composition of this body is represented by the formula C_4H_4S; it presents the closest analogy in general reactions with benzene, yielding a sulphonic acid, a methyl derivative, &c.; it reacts with diketones to form highly coloured compounds. The further study of this interesting compound, now being carried on in Prof. Meyer's laboratory, is likely to lead to important results (*Berichte*, xvi. 2968).

OSTWALD has recently made a further advance in his study of chemical affinity. He has examined the action of acids on methylic acetate, determining the velocity-coefficients of various acids, and from these calculating the relative affinities of the acids in terms of hydrochloric acid taken as 100. His results are entirely in keeping with the theory of Guldberg and Waage, and confirm the supposition that each acid possesses a specific affinity constant. The determination of affinity constants for groups of compounds must evidently be a work of preeminent importance to chemical science. Ostwald's results, *e.g.* for acetic and trichloracetic acids, enable us to see that in these constants we shall find materials for constructing a theory which will represent the connection between molecular structure and reactions as resting on a real basis, and not, as is done at present, on a purely formal conception (*J. für pract. Chem.* (2) xxviii. 449).

A NUMBER of redeterminations of atomic weights have recently been published. The most important are these:—

Thorpe,	Ti =	48·0,	*Berichte*, xvi. 3014.
Baubigny,	Ni =	58·75,	*Compt. Rend.* xcvii. 951.
,,	Cu =	63·46,	,, ,, 906.
Brauner,	Te =	125·0,	abstract in *Berichte*, xvi. 3055 (original in Russian).
Marignac,	Bi =	208·16,	*Archiv. des Sci. Phys. et Nat.* (3) x. 5.
,,	Mn =	55·07,	,, ,, ,,
,,	Zn =	65·29,	,, ,, ,,
,,	Mg =	24·37,	,, ,, ,,
Löwe,	Bi =	207·33,	*Zeitschr. Anal. Chem.* xxii. 489.

IT is known that Dr. Landolt, after laborious researches into the refracting power of chemical compounds, arrived at the conclusion that it may be expressed, for organic bodies, by a very simple equation: the refracting power of the compound is equal to the sum of the same powers of carbon, hydrogen, and oxygen, multiplied each by the number of atoms of each of these bodies which enter into the compound. This law proved, however, not to be quite exact with regard to several organic bodies, and the researches of Herr Bruhl established that in the lower compounds the refracting power received from the equation must be increased by two units for each double pair of atoms of carbon. These results had been arrived at with liquid compounds. As to the solid ones, which were the subject of the researches of Dr. Gladstone, it was desirable to pursue these researches to the same degree of accuracy as the researches of Landolt and Bruhl. M. Kanonnikoff has prosecuted this work on a great many solid bodies belonging to both groups of the fatty series, the aromatic series and the group of terebenes and camphors. He publishes now in the *Memoirs* of the Kazan University and (abridged) in the *Journal of the Russian Chemical Society* (vol. xv. fasc. 7) the results of his researches. It appears from them that the method of determining the refracting power of a solid from its solution, applied by Dr. Gladstone, is quite satisfactory, the dissolved body not changing its refrangibility when dissolved, and that the laws discovered by Landolt and Bruhl for liquid bodies are quite true also with regard to solids. This inquiry at the same time enables M. Kanonnikoff to arrive at most interesting conclusions as to the structure of the investigated bodies.

THE atomic weight of tellurium not corresponding to what it ought to be according to Prof. Mendeléeff's theory of periodicity, M. Brauner has tried to determine it again with greater accuracy. The chief difficulty is to have the tellurium free from selenium, but this difficulty has been overcome, and the body has been obtained in beautiful crystals. As to Berzelius's method for the transformation of tellurium into anhydride, M. Brauner discovered that it is liable to considerable losses, and to avoid them he has had to take the most minute precautions. The process was controlled also by transforming tellurium into a new salt, $Te_2O_4SO_3$, and by the synthesis of the telluric copper, Cu_2Te. The results are four series of figures varying from 124·94 to 125·40, which would give, on the average, an atomic weight of 125, that is, corresponding to the theory.

WE find, in the last number of the *Journal of the Russian Chemical Society*, an interesting theory of solutions, by M. Alexeyeff; the forces of gravitation, cohesion, and chemical affinity being considered as three different degrees of one single force, which differ from one another only by the distances at which the action of the force is exercised. M. Alexeyeff asks, Which of these two last forces, of cohesion or of chemical affinity, is manifested in solutions? and pronounces himself for the former. The simplest cases of solutions are, in fact, those where there is no chemical affinity between the bodies dissolving and dissolved. Such cases were well known long since for gases and solid bodies. The solution of gases in solid bodies is quite analogous to imbibition of solids with liquids, and the much greater solubility of gases in liquids may be easily explained by the easier penetration of gases between the molecules of a liquid; the law of solubility of gases given by Dalton is perfectly agreeable with the supposition that the dissolved gases maintain their own aggregation when dissolved. The same is true with regard to solutions of liquids. The simplest of these is the solution of phenol and aniline in water. The stability of the compound formed by phenol with aniline shows that both have no affinity to water. Further, M. Alexeyeff discusses the applicability of his theory to bodies which easily pass from one state to another, and the relations of water to colloids. The solutions of liquids in liquids being, on his hypothesis, quite like emulsions. He is engaged now in experiments intended to show that the common emulsions have the properties of solutions.

M. FLAVITSKY proposes, in the *Journal of the Russian Chemical Society*, the following interesting theory of chemical affinity. According to this theory, the atoms of each simple chemical body, when its molecule is dissociated, move in circles parallel to one another, and to a certain plane, the position of which is constant in space. Each chemical element has its own plane of motion, and the circles described by the atoms of different elements cross one another under different angles. Besides, the atoms of opposite elements (such as metals and haloids) move in opposite directions. The chemical relations between different elements would thus depend upon the masses of the atoms, their velocities, their positions on their orbits, the direction of the motion, and the angles between the orbits; while the chemical combinations would be nothing more than the mutual destruction (or rather equilibration) of the velocities of the atoms of the respective chemical elements which enter into a combination. This supposition would explain all the variety of chemical relations even without a great difference in the masses of the atoms and their velocities; a complete stop might be brought only when the orbits are parallel, or the orbits being inclined with regard to one another—when a certain number of velocities acting under different angles make together the necessary resultant. This mutual action of the atoms on one another could be imagined—the author says—at a distance, by means of the ethereal medium which would be thus the medium of transformation of the physical energy into the chemical one.

TECHNICAL EDUCATION[1]

General Objects

THE object of the Central Institution is to give to London a College for the higher technical education, in which advanced instruction shall be provided in those kinds of knowledge which bear upon the different branches of industry, whether manufactures or arts.

Just as the Royal School of Mines gives a technical training to mining engineers, so the Central Institution is intended to afford practical scientific and artistic instruction which shall qualify persons to become—

1. Technical teachers.
2. Mechanical, civil, and electrical engineers, architects, builders, and decorative artists.
3. Principals, superintendents, and managers of chemical and other manufacturing works.

The main purpose of the instruction to be given in this Institution will be to point out the application of different branches of science to various manufacturing industries; and in this respect the teaching will differ from that given in the Universities and in other institutions in which science is taught rather for its own sake than with the view to its industrial application. In order that this instruction may be efficiently carried out, the Institution, in addition to the lecture theatres and class rooms, will be fitted with laboratories, drawing offices, and workshops; and opportunities will be afforded for the prosecution of original research, with the object of the more thorough training of the students, and for the elucidation of the theory of industrial processes.

Students

It is probable that the students seeking admission into the Central Institution will belong to one or other of the following classes:—

1. Persons who are training to become technical teachers.

These will be students entering the College by means of exhibitions under category 2 (*b*); or students selected at the May examinations in technology who pass with special distinction in the Honours Grade; or teachers of the Institute, registered under the scheme of technological examinations, who, during certain months of the year, when they are disengaged, will receive gratuitous instruction, and will have the opportunity of using the laboratories, collections of machinery, instruments, and apparatus with which the College will be provided.

2. Persons not under sixteen years of age who, having passed a matriculation or entrance examination, are prepared to take a complete course of instruction with a view to some professional or industrial occupation. These students will probably belong to two classes—

(*a*) Persons who pay full fees, and will receive in this Institution an education similar, in many respects, to that which they may acquire in one of the technical high schools of the Continent.

(*b*) Persons who are received into the Institution from the Finsbury Technical College, or other similar colleges in the provinces, by means of exhibitions, which will cover the whole or part of their educational and other expenses.

It is probable that many of the persons in sub class (*b*) will be select pupils from the public elementary and national schools, who, having received a preliminary science training, and distinguished themselves at the Finsbury Technical College or elsewhere, will proceed to the Central Institution in the hope of qualifying themselves for some of the higher posts in engineering or manufacturing industry.

3. Persons who, having been already engaged in industrial pursuits, desire to attend special courses, with the view of acquainting themselves more fully with the scientific principles underlying their work.

Conditions of Entrance

The matriculation or entrance examination for students intending to take the ordinary science curriculum, with the view of subsequently obtaining a diploma, will include mathematics, pure and applied; chemistry; physics; drawing, and modern languages. Whilst considerable freedom will be allowed to students entering the College as regards the courses of instruction which they desire to follow, a definite scheme of instruction will be drawn up for each of the different branches of industry, and students intending to spend two or three years in the College and to devote their whole day to study will be recommended to follow the scheme laid down. The fee for the courses to be pursued by a matriculated student will be about 30*l*. per annum, and a fee of about 20*l*. per annum will be charged to students wishing to take special courses and to occupy themselves for the greater part of the day with laboratory practice and research work. With the view of encouraging research work, the Institution will be provided with separate laboratories in which the students will have the opportunity of working without distraction or disturbance. The permission to use these laboratories will be reserved for the advanced students who have previously passed through the ordinary courses of the College, and for non-matriculated students under very special circumstances.

Subjects of Instruction

As the object of this Institution is to train technical teachers, proprietors and managers of chemical manufactories and of other industrial works, as well as mechanical, civil and electrical engineers, architects, builders, and persons engaged in art industries, the Institution will comprise five chief divisions, viz.:—(1) Chemical Technology; (2) Engineering, mechanical, civil, and electrical; (3) General Manufactures; (4) Architecture and Building Construction; (5) Applied Art; and the subjects of instruction may accordingly be grouped under the general headings of Chemistry, Engineering, Mechanics and Mathematics, Physics, Manufacturing Technology and Art. Inasmuch as the Royal School of Mines is already established as a training school for mining engineers, no provision will be made for the instruction of students in this branch of industry; and consequently the sciences of geology, mineralogy, and metallurgy will not necessarily be included in the subjects of instruction at the Central Institution.

Professorial Staff

Chemistry.—The main object of the instruction in this department will be to afford to students facilities for acquiring a knowledge of the highest branches of Chemistry, and of its application to such industries as alkali manufacture, the manufacture of artificial colouring matters, brewing, soap boiling, the manufacture of oils and varnishes, dyeing, &c. To provide the requisite instruction in this department, it will be necessary to

[1] The scheme for the organisation of the Central Institution of the City and Guilds of London Institute, recommended to the Council for adoption at a meeting of the Executive Committee held January 21, 1884, is now being circulated. We regard the matter as so important, and the scheme so perfect in its way, that we give it in full.

have one chief professor, who shall devote the whole of his time to the work of the Institution, and who will be expected to direct and superintend the students in his department and to train them in the methods of original research. In addition to this appointment, it will be advisable to have two assistant professors, who shall respectively take charge of the research and of the technical departments. A separate laboratory will be placed under the direction of each professor; and the arrangements of the building, which provide three large laboratories, besides several smaller rooms which may be used as such, render possible this division of the work. Besides these professors, demonstrators, laboratory and lecture assistants and attendants will be required to complete the staff in this department.

Engineering.—The instruction to be given in this subject will have for its object the practical scientific training of persons who intend to enter any branch of the engineering profession. The instruction will be adapted to those who have already spent some time in the office of a civil engineer or in engineering works, as well as to those who desire to obtain in the College a sound theoretical knowledge of the principles of science applicable to their future career, and an insight into the practice and manipulative work in which they will be subsequently engaged. The professor appointed to take charge of this department will be expected to devote the whole of his time to the work of the College, and to lecture on such subjects as the strength of constructive materials; the construction of docks, roads, bridges, and roofs; machine designing; hydraulic and other machinery; steam-engines, gas-engines, &c. He will also be required to give instruction in levelling and surveying, to superintend the laboratory practice of the students in the testing and engine rooms, and to direct their work in the machine shops and drawing offices. He will need the assistance of a teacher of machine drawing, and of a workshop instructor, besides one or two laboratory demonstrators, and the necessary attendants to look after the engines and machines. Later on, an additional professor will be required to take charge of some of the work of this department.

Mechanics and Mathematics.—Immediately connected with the teaching of engineering and physics is the instruction required by the students of a technical college in mechanics and mathematics. There is little doubt that the student's progress in the several branches of engineering depends very much upon his possessing such a knowledge of pure and applied mathematics as enables him to use it as an instrument of his ordinary work, and for this purpose it is necessary that his knowledge should be in advance of such applications of it as he may at any time be required to make. The professor appointed to this post will be expected to give practical instruction in the application of mathematics and mechanics to the solution of engineering and physical problems. He will be required to devote the whole of his time to the work of the College, and to give courses of instruction, illustrated by laboratory practice, on the principles of dynamics and of mechanicism, on graphical statics, on descriptive geometry, and on some of the higher parts of pure and applied mathematics. He will need the services of two demonstrators to assist in the mechanical laboratory and in the drawing office.

Physics.—In view of the present and future applications of electricity to engineering problems, considerable importance attaches to the character of the instruction to be given under this heading. The teaching of practical physics has only recently been introduced into schools of applied science, and the number of students receiving laboratory instruction in this subject in our own colleges, and in foreign polytechnic schools, is still very limited. The large number of students in attendance at the courses of electricity in the Finsbury Technical College shows that there is already a strong demand for instruction in the practical applications of this important branch of physical science. In order to supply the requisite teaching staff in this subject, it will be necessary, in the first instance, to appoint a professor, who shall devote the whole of his time to the work of the College, and who shall be responsible for the work of his department. This appointment will be supplemented by that of an additional professor, whose duties will depend very much upon the particular branch of physics to which the chief professor may devote his attention. Whilst it is highly desirable that every facility should be afforded in the Central Institution to students desiring to become electrical engineers, of receiving practical instruction in the theory and application of electricity to such technical subjects as telegraphy, electric lighting and the transmission of power, for experiments in which subjects special laboratories will be set apart, it will be the duty of the chief professor or of the additional professor to give courses of lectures on heat, light, and sound; to superintend and encourage laboratory practice in these branches of physics; and to take up from time to time the consideration of other technical subjects, such as the principles of thermo-dynamics in their application to the theory and working of steam-engines, gas-engines, ventilation, &c. To complete the teaching staff of this department, the professors will require the assistance of one or more demonstrators, according to the number of students in attendance at their laboratories.

Technology.—Under this heading is included instruction in the processes and practical details of various manufactures, some of which will be treated of by the professors of the several departments already referred to, whilst others will need the assistance of specialists who will be engaged to give lectures on these subjects. The gentlemen appointed to give these lectures will be either the Institute's examiners in technology, or other persons equally well acquainted with the technical details of particular manufacturing processes. They will be appointed from time to time as required, and will not necessarily form part of the permanent staff of the College.

The lectures will probably be of two kinds, according as they are delivered during the session or during the long vacation. The one course will form part of the curriculum of the ordinary students of the College, whilst the other course will be especially arranged for the instruction of teachers of the Institute, registered under the scheme of Technological Examinations. The lectures given during the session will be attended by the matriculated students towards the close of their regular course of study, those delivered during the recess by teachers of technical classes in London and the provinces, who will be invited to hear them without payment of fee. Arrangements will also be made by which other persons seeking information on technical matters may be admitted to these lectures.

The lectures will embrace several of the subjects included in the programme of Technological Examinations, such as Alkali Manufacture, Spirit Distilling, Glass Manufacture, Pottery and Porcelain, Printing, Weaving, the Manufacture of Cotton, Wool, Linen, &c., and will treat of the technical details involved in these and other industrial processes. For the illustration of the lectures, specimens of materials in various stages of manufacture, models and diagrams of machinery, will be required; and these should be found ready for use in the Museum of Technology, a room for which has been provided in the Institution. Facilities will be afforded to the lecturers and students for carrying on experimental work in explanation of the lectures; and considering the varied character of the work which may have to be performed in connection with this department, for which it is impossible to make provision at the outset, it is very important that here and there rooms should be left available to be fitted with such arrangements and apparatus as experience may show to be desirable. These lectures will form a special and characteristic feature of the instruction to be given in the Central Institution.

Architecture and Building Construction.—To give completeness to the instruction which this Institution should afford, a department of Architecture and of Building Construction should be added to those already enumerated. The establishment of a special school for Architects and Builders would not involve any great addition to the professorial staff which it is suggested should be provided for the other departments of the College. But as the funds at the disposal of the Institute are not sufficient to enable the Council to give effect at starting to a complete scheme of higher technical instruction adapted to all the different industries of the country, it would seem advisable at first to restrict within certain limits the work to be carried on in the Institution, and to defer for some little time the organisation of this special school.

Applied Art.—Under this heading instruction might be given in decorative art, and in several special branches of applied art, particularly in those in which artistic effects are produced by a combination of art with processes involving applications of science, such as Chromo-lithography, Enamelling, Photo-engraving on Metals, Photo-lithography and Photography. Lectures might be delivered on these subjects, and on the scientific principles connected with them; and the processes themselves might be practically illustrated under the direction of experienced teachers in the workshops of the building. Lessons might also be given in designing for, and in the execution of, glass painting, mosaic work, wood and ivory inlaying, the inlaying of metals into various substances, wood-engraving and wood-carving.

Instruction of this kind would be very serviceable in creating and developing art industries in this country, and it would be especially valuable in the training of teachers; and it is hoped that means will be found, at a very early date, for giving such instruction.

Modern Languages.—In view of the increasing importance to students of applied science of being able to read foreign scientific and trade journals so as to understand what is being done abroad in the particular branch of industry in which they are engaged, the students will have the opportunity in the Central Institution of pursuing their studies in the French and German languages. It is true that they might obtain these lessons elsewhere, but it is found, as a fact, that students very rightly object to the loss of time involved in going from place to place in pursuit of the instruction they require, and commonly neglect the lectures which they have not the opportunity of attending in the Institution in which they pass the greater part of their day. Moreover, students are attracted to a place of learning in which they can obtain all the instruction they need. For these reasons, it is thought desirable that teachers of French and German should, as soon as possible, be appointed. At the same time it is hoped that, as the teaching of modern languages becomes so far improved that students, seeking admission to the College, will be able to translate with ease passages from French and German into English, the necessity of supplementing the technical instruction, which the Institution is intended to afford, by providing for this branch of education will cease to exist.

Courses of Instruction

Systematic courses of instruction will be drawn up for matriculated students, which will be obligatory upon those who seek the Diploma of the Institute. These courses will cover a period of three years, and will be varied according to the branch of engineering or of manufacturing or art industry for which students are preparing. The details of these courses will be best settled in consultation with the several professors; but it is understood that, besides the general and special lectures and class work already referred to, the instruction will consist largely of laboratory practice in chemistry, mechanics, and physics; and that for students who may not previously have acquired any manipulative skill, the workshops of the Institution will be available; whilst machine drawing will form an important part of the ordinary curriculum. It is hoped, too, that the professors will have opportunities of conducting their students to some of the different factories and works in and near London.

Diplomas

It is desirable that the Institute should grant diplomas, in accordance with the power conferred upon the Council by the Articles of Association, Sec. 51. The diplomas should be of two kinds, the Associateship of the Institute, and the Fellowship of the Institute.

The Associateship should be awarded to students of the Central Institution, who shall have gone through the complete course of instruction as laid down for them, and have satisfactorily passed their several examinations. Of these examinations, the first would be the Matriculation or Entrance Examination, and candidates unable to pass it would be recommended to spend one year, at least, in some suitable College, in preparation for it. A subsequent examination would be held at the end of each year on the College work, and the final examination, at which external examiners would be selected to assist the Professors of the Institution, would be essentially practical in character. The diploma might be granted to students educated at any other College affiliated to, or associated with, the Institute, who should pass the Matriculation and other examinations.

The Fellowship would be conferred upon persons who, having obtained the Associateship, and spent at least five years in actual practice, should produce evidence of having done some original and valuable research work, or of having otherwise contributed to the advancement of the industry in which they are engaged.

Evening Instruction

Although, at the outset, the education of day students is all that can with advantage be attempted, it is desirable that, later on, the experiment shall be made of giving evening instruction in the Central Institution.

The instruction so given should consist of courses of lectures dealing with some of the applications of science or art to special branches of industry, and serving the double purpose of imparting information and of showing the importance of more systematic technical teaching. These lectures should be somewhat of the character of the Cantor lectures periodically delivered at the Society of Arts, and somewhat similar to the well-attended and varied courses held at the Conservatoire des Arts et Métiers at Paris. Whilst differing from class lessons, they would have a distinctly educational value; and, as distinguishing them from the Cantor lectures as well as from those given at the Paris Conservatoire, opportunities would be afforded to some of the students attending them of themselves doing laboratory work on one or more evenings of the week. It would be necessary that the evening instruction should be so arranged as not to interfere with the ordinary day courses.

Appointment of Chief Professors

Should the scheme now proposed for the organisation of the Central Institution be adopted, there are numerous details connected with it which will need to be carefully worked out. But before entering further into the consideration of these details, it is desirable that the chief professors should be appointed, not with the view of their entering immediately upon their duties, but in order that the Sub-Committee may confer with them as to the courses of instruction to be given, and as to the fittings of the several laboratories and class rooms, the preparation of which will occupy some considerable time.

It is recommended, therefore, that the Committee should at once appoint—

A Professor of Chemistry.
A Professor of Engineering.
A Professor of Mechanics and Mathematics.
A Professor of Physics.

These gentlemen having been elected, the appointment of the other professors, the demonstrators, and lecturers on technology may be deferred, it being understood that some of these additional posts must be filled before the opening of the first session. Meanwhile, however, the work of preparing the fittings and of arranging the courses can be advanced.

Management

The following Rules have been drawn up for the regulation of the educational and administrative work of the Central Institution:—

1. There shall be a Board of Studies, composed of the Professors of the Institution, for the consideration of all matters connected with the education of the students.

2. Any lecturer holding an annual appointment and giving a separate course of instruction may be appointed by Sub-Committee A as a member of the Board.

3. Subject to a general scheme of instruction to be laid down by the Institute, the Board shall arrange courses of instruction for students, and shall recommend to the Institute with respect to the appointment and removal of instructors, teachers, demonstrators, and attendants.

4. The Organising Director and Secretary of the Institute shall have a branch office in the Central Institution, and shall have a right to visit its classes, laboratories, and workshops, and to call for any information he may think necessary for the use of the Sub-Committee A. He shall also have a right to be present at any time he may think it desirable at the meetings of the Board, and to take part in the discussions, but without a vote.

5. All communications from the Board to the Institute shall be made in writing, and shall be addressed to the Organising Director and Secretary.

6. The Institute, at the outset, shall appoint, for the period of a year or longer, from among the professors, a Dean, who shall preside at the meetings of the Board, and who shall attend any meeting of Sub-Committee A at the request of the Sub-Committee or of the Board for consultation on any special business.

7. The minutes of the meetings of the Board shall be recorded, and shall be laid on the table at the meetings of Sub-Committee A.

8. The chief clerk of the Central Institution shall act as secretary to the Board, receiving in that capacity his instructions from the Dean, and shall take minutes of the proceedings.

9. The Dean shall consult with the Organising Director and Secretary, who shall confer with the Chairman of the Executive

Committee, or, in his absence, with one of the honorary secretaries, with respect to any *ad interim* arrangement that may have to be made requiring the subsequent sanction of Sub-Committee A.

10. All the administrative work of the Central Institution, general questions of discipline, and the superintendence of the library and museum, shall be in charge of the Organising Director and Secretary of the Institute, who shall act under instructions from Sub-Committee A.

GEOLOGICAL SURVEY OF THE UNITED KINGDOM [1]

THE completion of the one-inch Geological Survey Map of England and Wales affords a fitting opportunity for directing public attention to the history and progress of this great national undertaking.

As far back as the year 1832 that enthusiastic geologist, Henry T. De la Beche, began at his own expense to prepare geological maps of the mining districts of Cornwall and Devon. Being impressed with the great public utility of such maps in a country deriving so large a portion of its wealth from its mineral resources, he applied to the Government of the day for recognition and assistance. Eventually he and his two or three assistants were incorporated as a portion of the staff of the Ordnance Survey. From this modest beginning De la Beche's genius conceived the idea of founding a great central establishment in London, in which specimens of all the ores and other mineral products of the country should be selected and arranged for public inspection and reference, and where should also be preserved copies of the plans of mines and collieries, from which it would be possible to learn at any moment what areas had been exhausted and the condition of the abandoned underground workings. But besides the practical applications of science, he contemplated the foundation of a school in which all the sciences concerned in mining operations should be taught by the ablest professors in the country, and of a museum in which the rocks, minerals, and fossils of the British Islands should be thoroughly illustrated and made completely available to the public for instruction as well as for economic purposes. Being gifted with indomitable perseverance and no common measure of personal tact, he succeeded in impressing his views upon the Government. By degrees the Geological Survey was fully organised and equipped, and the Mining Record Office and the Royal School of Mines were established, De la Beche himself becoming the Director-General of the whole scheme. The accommodation afforded him at first in the buildings in Craig's Court soon proving inadequate, Parliamentary sanction was in the end obtained for the erection of the present establishment in Jermyn Street, which was opened in 1851, and which, as was then said by the late Sir Roderick I. Murchison, "stands forth, to the imperishable credit of its author, as the first palace ever raised from the ground in Britain which is entirely devoted to the advancement of science."

In the meantime, while its offshoots were showing such vigorous growth, the original and parent Geological Survey was extending its operations over the country. The objects for which it was created were twofold. In the first place it was meant to advance geological science by the production of an accurate and detailed geological map of the United Kingdom, with the necessary sections and descriptive memoirs, and by the collection of a full series of specimens to illustrate the mineralogy, petrography, and palæontology of the various geological formations. In the second place it was designed to be "a work of great practical utility bearing on agriculture, mining, road-making, the formation of canals and railroads, and other branches of national industry." This original conception of the object of the Survey has been steadily kept in view. From the districts first surveyed in Devon and Cornwall the mapping was pushed forward into the south-west of England, and then into South Wales. In 1845, the importance of the work having now been fully realised by the Government, some changes were made in the organisation. In particular, the charge of the whole scheme was transferred from the Board of Ordnance to the Office of Woods and Works. A branch of the Survey was likewise equipped for the investigation of the geology of Ireland, where some progress had already been made by Capt. Portlock, R.E. Nine years later—viz. in 1854—the operations of the Survey were extended to Scotland, and the whole establishment was finally placed under the Science and Art Department, which had now been created. The basis of the Geological Survey map is the one-inch map of the Ordnance Survey. In Ireland and Scotland, where Ordnance county maps on the scale of six inches to a mile have long been in existence, the geologists of the Survey made use of this larger scale for their field work, which was subsequently reduced and published on the one-inch scale. In England corresponding six-inch Ordnance maps having meanwhile appeared, the Geological Survey of the northern counties was carried on upon them. The surveys of the northern coalfields and other mineral tracts have been engraved and published on this larger scale. These maps embody a mass of accurate information regarding the structure and resources of our mineral districts, and have been much appreciated by those who are practically interested in the development of this branch of the national industry.

The Ordnance Map of England and Wales is divided into 258 squares, known as sheets or quarter-sheets. These can now be procured as sheets of the Geological Survey, except those last completed, which are now in preparation. As the whole ground has been surveyed, the remaining maps may be expected to appear with no great delay. To make the maps fully available for the information of the public, sections and memoirs are issued. The sections are of two kinds. One of these, called Horizontal Sections, of which 130 have been published, are drawn on a true scale of six inches to a mile, the profile of the ground being accurately shown by levelling, with the geological structure underneath. Many of these sections are accompanied by explanatory pamphlets. For various economic purposes, such as railway-cutting, tunnelling, water-supply, mining, road-making, building, and so on, these Horizontal Sections are of the utmost value. The second kind, called Vertical Sections, are drawn on the scale of forty feet to an inch, in explanation of the detailed structure of our coalfields. One of the most valuable parts of the work of the Survey is embodied in its "Memoirs." At first these were issued in goodly octavo volumes, either embracing a number of disconnected essays, some of which, like Edward Forbes's famous paper on the history of the British flora, have become classics in geological literature, or devoted entirely to the description of a particular area, such as John Phillips's well-known treatise on the Malvern Hills. After 1855, when, on the death of Sir Henry De la Beche, Sir R. I. Murchison became Director-General, this form of memoir was postponed in favour of shorter explanatory pamphlets with which each sheet or quarter-sheet was to be accompanied. These were designed to supplement the map and sections, and to make their information at once intelligible to the public by giving detailed information regarding the natural sections, characteristic fossils, economic minerals, &c., in each district. It was fully determined, however, that, as the Survey advanced, ample monographs should be prepared for each geological formation or important district. Among the other publications of the Survey are the "Decades" and "Monographs" of organic remains, of which seventeen have been issued; the "Mineral Statistics" of the Mining Record Office, which have appeared as an annual volume for the last thirty years; and various catalogues and other works, which swell up the total separate printed publications of the Survey of the United Kingdom to upwards of 270. It ought to be stated here that, first under De la Beche, and subsequently under Murchison, the work of the Survey depended largely for its efficiency and breadth of view on the Local Director, Prof. (now Sir A. C.) Ramsay, who on Murchison's death was appointed Director-General in 1872, and continued in that post until his retirement from the service at the end of 1881. He was then succeeded by Prof. Geikie, who had for more than fourteen years held the office of Director of the Survey in Scotland, and who since his appointment has pushed on the completion of the one-inch map of England and Wales, which is now announced by him as accomplished. The completion of the map of what is termed the "Solid Geology" of England and Wales—that is, the rocks underlying the superficial deposits—terminates indeed an important part of the work of the Survey.

But much remains to be accomplished. The one-inch map of Ireland will be completed in a few years; but that of Scotland, not having been begun till much later, and having always had a much smaller staff, will require longer time. From the last published report of the present Director-General we learn that such of the staff as are qualified for the difficult mountainous area of Scotland wlll be transferred to that region as soon as

[1] From the *Times*.

they have prepared their recent work for the engraver. The staff retained in England will have to complete the survey of the superficial deposits, which is so valuable as a basis for the agricultural valuation of land, as well as for other purposes. For some years past the mapping of these deposits has advanced simultaneously with that of the rocks underneath them. Two kinds of maps are supplied to the public, one indicating the superficial accumulations, and therefore invaluable as an agricultural map, and the other showing the "solid geology" or older rocks that lie below. The importance of mapping the superficial deposits, however, both from an industrial and scientific point of view, was not recognised until comparatively recently. Over the larger part of the country, therefore, these deposits are not expressed upon the Survey maps, and it is to the completion of this work that one part of the energy of the staff must now be directed. It will be desirable also to resume the survey of the coalfields on the scale of six inches to a mile, which has been temporarily interrupted in order to hasten the completion of the one-inch map. The South Wales coalfield, for example, was mapped some forty years ago, and so much has been done in the interval towards the development of that vast mineral basin that the maps are so antiquated as to be of comparatively little practical value. We learn from the same report that the most important work lying before the Survey in England and Wales is the geological description of the country. As the issue of explanatory pamphlets to accompany the one-inch maps was not begun until 1857, there is a large area of ground of which no published account has been given, except on the maps and sections. Printed explanations of each sheet are now to be supplied, and from these and all the data in possession of the Survey a series of Memoirs or Monographs is to be compiled which will embrace a generalised view of the geological structure and of the minerals and industrial resources of the whole country. It is the fate of geological maps, as well as of other human productions, to get out of date. As the nation has expended so ungrudgingly to carry on a Geological Survey which is acknowledged to stand at the head of the geological surveys of the world, it would be worse than folly to lose the benefit of all this expenditure by allowing the maps to become obsolete. New openings are continually being made which throw fresh light on what lies beneath us. It will be the duty of Parliament to see that a permanent staff, which need not be a large or costly one, is always retained for the purpose of keeping the maps up to date. Meanwhile it is pleasant to see that the work of this worthy national enterprise is being carried on with vigour, and that its staff are fully alive to the importance of the duties that still lie before them.

THE ORIGIN OF THE SCENERY OF THE BRITISH ISLANDS[1]

THE Scottish Highlands must be looked upon as the relics of an ancient tableland cut out of highly crumpled and plicated schists. Among the eastern Grampians large fragments of the plateau exist at heights of more than 3000 feet, forming wide undulating plains terminating here and there at the edge of precipices. In the Western Highlands, the erosion having been more profound, the ridges are narrower, the valleys deeper, and isolated peaks are more numerous. It is the fate of a tableland to be eventually cut down by running water into a system of valleys which are widened and deepened, until the blocks of ground between are sharpened into ridges and trenched into separate prominences. The Highlands present us with far advanced stages of this process. In the youngest of British tablelands—that of the volcanic region of Antrim and the Inner Hebrides—we meet with some of the earlier parts of the change. That interesting tract of our islands reveals a succession of basaltic sheets which appear to have spread over the wide valley between the Outer Hebrides and the mainland, and to have reached southwards beyond Lough Neagh. Its original condition must have been like that of the lava-fields of Idaho and Oregon—a sea-like expanse of black basalt stretching up to the base of the mountains. What may have been the total thickness of basalt cannot be told; but the fragment remaining in Ben More, Mull, is more than 3000 feet thick. So vast has been the erosion since older Tertiary time that the volcanic plateau has been trenched in every direction by deep glens and arms of the sea, and has been reduced to detached islands. It is strange to reflect that all this revolution in the topography has been effected since the soft clays and sands of the London Basin were deposited.

The intimate relation of a system of valleys to a system of drainage lines, first clearly enunciated by Hutton and Playfair, has received ample illustrations from all parts of the world. Yet the notion is not yet extinct that in some way or other valleys have been as much, if not more, determined by subterranean lines of dislocation as by superficial erosion. Some favourite dogmas die hard, and though this dogma of fracture has been demolished over and over again, it every now and then reappears, dressed up anew as a fresh contribution to scientific progress. We have only to compare the surface of a much dislocated region with its underground structure, where that has been revealed by mining operations, as in our coal-fields, to see that valleys comparatively seldom, and then only as it were by accident, run along lines of dislocation, but that they everywhere cut across them, and that faults rarely make a feature at the surface, except indirectly by bringing hard and soft rocks against each other.

In Britain, as in other countries, there is a remarkable absence of coincidence between the main drainage system and the geological structure of the region. We may infer from this fact that the general surface, before the establishment of the present drainage system, had been reduced to a base-level of denudation under the sea, the original inequalities of configuration having been planed off irrespective of structure; or at least, that the present visible rocks were buried under a mass of later unconformable and approximately level strata, on the unequally upraised surface of which the present drainage system began to be traced. Where the existing watershed coincides generally with the crest of an anticline, its position has obviously been fixed by the form of the ground produced by the plication, though occasionally an anticline may have been deeply buried below later rocks, the subsequent folding of which along the same line would renew the watershed along its previous trend. Where drainage lines coincide with structure, they are probably, with few exceptions, of secondary origin; that is, they have been developed during the gradual denudation of the country. Since the existing watershed and main drainage lines of Britain are so independent of structure, and have been determined chiefly by the configuration of the surface when once more brought up within the influence of erosion, it may be possible to restore in some degree the general distribution of topography when they were begun.

One of the most curious aspects of the denudation of Britain is its extraordinary inequality. In one region the framework of the land has been cut down into the very Archæan core, while in the immediate vicinity there may be many thousands of feet of younger strata which have not been removed. This inequality must result from difference in total amount of upheaval above the base-line of denudation, combined with difference in the length of exposure to denudation. As a rule the highest and oldest tracts will be most deeply eroded. Much of the denudation of Britain appears to have been effected in the interval between the close of the Carboniferous and end of the Triassic period. This was a remarkable terrestrial interval, during part of which the climate was so arid that salt lakes were formed over the centre of England. Yet the denudation ultimately accomplished was enormous, thousands of feet of Carboniferous rock being entirely removed from certain areas, such as the site of the present Bristol Channel. An interesting analogy to this condition of things is presented by the Great Basin and adjoining tracts of Western America, where at the present time great aridity and extensive salt-lakes are accompanied by great erosion.

This deeply-eroded post-Carboniferous land was eventually screened from further degradation, either by being reduced through denudation to a base-level or by being protected by submergence. It was to a large extent covered with Secondary rocks, though the covering of these may have been but thin over what are now the higher grounds. The present terrestrial areas emerged at some period later than the Chalk. In England there were three tracts of land—Wales, the Pennine Chain, and the Lake District. The eastern half of the country, covered with Secondary rocks, was probably the last portion to be uplifted above the sea; hence the watersheds and drainage lines in that tract may be regarded as the youngest of all.

The history of some of the valleys of the country tells the story of the denudation. The Thames is one of the youngest

[1] Abstract of the third of a course of lectures given at the Royal Institution, February 19, by Archibald Geikie, F.R.S., Director-General of the Geological Survey. Continued from p. 348.

rivers, dating from the time when the Tertiary sea-bed was raised into land. Originally its source probably lay to the west of the existing Jurassic escarpment of the Cotswold Hills, and it flowed eastward before the Chalk escarpment had emerged. By degrees the Chalk downs have appeared, and the escarpment has retreated many miles eastward. The river, however, having fixed its course in the Chalk, has cut its way down into it, and now seems as if it had broken a path for itself across the escarpment. As all the escarpments are creeping eastward, the length and drainage area of the Thames are necessarily slowly diminishing. The Severn presents a much more complex course; but its windings across the most varied geological structure are to be explained by its having found a channel on the rising floor of Secondary rocks between the base of the Welsh hills and the nascent Jurassic escarpments. The Wye and Usk afford remarkable examples of the trenching of a tableland. The Tay and Nith are more intricate in their history. The Shannon began to flow over the central Irish plain when it was covered with several thousand feet of strata now removed. In deepening its channel it has cut down into the range of hills north of Limerick, and has actually sawn it into two.

SCIENTIFIC SERIALS

THE *American Journal of Science*, January, 1884.—The effect of a warmer climate on glaciers, by Capt. C. E. Dutton. The author fully discusses the theory of those who argue that the more copious snowfall required for a more extended system of glaciation implied more atmospheric moisture, greater evaporation, and a generally higher temperature; in fact, a warmer climate than at present, due probably to a greater rate of solar radiation. He concludes that the possibility of obtaining a greater snowfall by a warmer climate would be necessarily limited to the Arctic regions, or to altitudes far above the present snow line. Elsewhere a higher temperature would add to the rainfall, and actually diminish the snowfall. The advocates of the theory have failed to perceive that the additional moisture postulated could fall only as rain. Not until the air has discharged as rain all the moisture in excess of the quantity which saturates it at zero, can it begin to yield snow.—On the application of Wright's apparatus for distilling, to the filling of barometer tubes (one illustration), by Frank Waldo.—Account of a new method of measuring the energy expended on or rendered by a dynamo or a magneto machine in connection with the production of electricity in a large way, by C. F. Brackett. —On some points in climatology: a rejoinder to Mr. Croll, by Simon Newcomb. The assumed lower mean temperature of the northern hemisphere at some former geological epoch is attributed by Mr. Croll to a greater eccentricity of the earth's orbit, combined with a position of the perihelion near the northern solstice, causing a short perihelion summer and a correspondingly long aphelion winter. To this the author replies that too little is known of the laws of terrestrial radiation of heat through the atmosphere to justify the establishment of any theory of the glacial epoch, and that, in any case Mr. Croll fails to show why the mean temperature should be different at the supposed periods. Hence the conclusion, not that Mr. Croll's theory is false, but that it is not proven.—An account of some recent methods of photographing the solar corona without an eclipse, and of the results obtained (one illustration), by Dr. W. Huggins.—Elliptical elements of comet 1882 I., by F. J. Parsons.—The Minnesota Valley in the Ice Age, by Warren Upham.—On the so-called dimorphism in the genus Cambarus, by Walter Faxon. —Evolution of the American trotting horse, by Francis E. Nipher. In reply to the criticism of Mr. W. H. Pickering, the author argues that the known facts are not opposed to the conclusion that the trotting horse may finally trot his mile in about the same time that the running horse will cover the same distance.—On the origin of jointed structure, by G. N. Gilbert.—A theory of the earthquakes of the Great Basin, by the same author.

Revue d'Anthropologie, tome vi. fasc. 4, Paris, 1883.—The larger portion of this number is devoted to M. Mathias Duval's lecture on Transformism, of which two parts have already appeared in the earlier fascicules of the *Revue* for 1883. For English readers generally the address lacks the interest of novelty, as it is little more than an exposition of the works and opinions of Darwin and of the principal authorities, chiefly English, whose observations corroborate his views. It is satisfactory, however, to find that, while maintaining with patriotic zeal Lamarck's claim to be regarded as the originator of the theory of evolution, M. Duval recognises in Darwin the one man who, through varied yet profound scientific acquirements, intellectual qualifications, and special personal and social conditions, was alone capable of giving to novel conclusions of such extraordinary significance the authoritative force and stability of a true science.—On so-called Wormian or supernumerary bones in domestic animals, by M. Cornevin, Professor in the Lyons Veterinary College. The author finds that while in man such bones are generally cranial, in animals they are facial, and he believes himself justified in drawing from his observations two important conclusions (which, however, need support) that in animals the Wormians appear some time after birth, developing more and more with age, and that they are of frequent occurrence in the less carefully bred races, while they are very rarely found in the high breeds of horses, oxen, sheep, pigs, &c.—On the Kalmuks, by M. Deniker. The author, who is a native of the regions which he describes, has made the presence of an encampment of Kalmuks in the "Jardin d'Acclimatation," at Paris, the occasion for bringing together all the most reliable historical, geographic, ethnic, and socio-physical data in connection with this people, whose various migrations, including their great exodus from the region of the Volga in the eighteenth century, he treats at great length. He considers the oblique opening of the eye, which most writers accept as an ethnic characteristic, as of little scientific value, since it is not of specially frequent occurrence among pure Mongols such as are the Kalmuks; but he recognises, on the other hand, that such an ethnological peculiarity is to be found in a peculiar introversion of the upper eyelid which in young Kalmuk children has often the effect of obliterating the eyelashes; while the general narrowness of the opening imparts a triangular form to the eye. Black, scantily developed hair, dark brown eyes, slightly yellow skin, and a stature somewhat below the mean (the adult Kalmuk presenting the proportions of Europeans of thirteen to fourteen years of age), constitute the chief physical characteristics of the Mongol race. The paper, which is illustrated by an admirable map of the Kourghees and Kirghees territories of South Russia and West Thibet, will be continued in a subsequent number.

Journal of the Russian Chemical and Physical Society, vol. xv. fasc. 7.—On the relations between the refracting power and the chemical constitution, by S. Kanonnikoff.—On the velocities of chemical reactions, by A. Potylitzin. The thermo-chemical equivalents obtained separately for several pairs of elements allow to foresee only the direction which will be taken by the reaction when they are brought together; the heat disengaged by one pair of elements brought into reaction in the presence of other bodies, which are also liable to chemical modifications, is not equal to the whole of the thermo-chemical work of the pair, a part of it being employed for chemical work in the accessory bodies; the thermo-chemical equivalents are proportionate to the velocities during the first moments of the reaction.—Sketch of the present state of the theory of explosive substances, by S. Tcheltsoff. The actual tendency of the technics to substitute determined chemical combinations, instead of the mixtures which were used at first as explosives, is quite rational. Not only the decomposition goes on with more regularity in a chemical compound, but also the potential energy is greater.—On the chloride of pyrosulphuryl, by D. Konovaloff.—On the cause of the changes in the galvanic resistance of selenium under the influence of light, by N. Hesehus. The author concludes in favour of the dissociation transmitted into the interior of the body as the cause of this change, and, following the hints of Messrs. Bidwell and Siemens, tries to prove it by mathematical arguments.—Notes on radiophony, by M. Geritch; and on resounding tubes, by M. Bachmetieff.

Zeitschrift für wissenschaftliche Zoologie, vol. xxxix. Part 2, November 6, 1883, contains:—Researches on the brain structures in Petromyzons, by Dr. F. Ahlborn (plates 13-17). A very excellent and detailed memoir, based chiefly on the brain in *Petromyzon planeri* and *P. fluviatilis*.—On the biology and anatomy of Clione, by N. Nassonow, assistant in the Zoological Museum of Moscow (plates 18 and 19). These investigations were carried on at the biological station at Sebastopol, and on an apparently new form called *C. stationis*, found in the shells of *Ostrea adriatica*, in it the oscula are prominent orange-coloured. Branching plasmodia were traced through the shell-structure, reminding one of the mycelial threads of a fungus.—Contributions to the histology of the Echinoderms, by Dr. Otto Hamann (part 2).—The nervous system of the Holothuria pedata: Cuvier's organ. The nervous system and sense organs of the Holothuria apedata (plates 20-22).—On some new species of Thalassema, by Kurt Lampert, Erlangen.

Vol. xxxix. Part 3, December 21, 1883, contains:—On the Rotifers of the environs of Giessen, by Karl Eckstein, natural history student, Giessen (plates 23-28), enumerates and describes in detail fifty species (one new genus Distyla, with two new species, *D. giessensis* and *D. ludwigii*). A list of all known genera is given, with a general description of the anatomy, development, and habits of the group. A very complete bibliography is appended.—On the digestive apparatus of the Decapods, by Dr. F. Albert (plates 29-31, and woodcuts).

Vol. xxxix. Part 3, December 31, 1883, contains:—On Bucephalus and Gasterostomum, by Dr. H. Ernst Ziegler (plates 32 and 33) (*Bucephalus polymorphus* was found in considerable quantities in *Anodonta mutabilis*).—On the central nervous system in *Periplaneta orientalis*, by Dr. Max Koestler (plate 34).—On the varieties of the cerebral fissures in Lepus, Ovis, and Sus, by Dr. Victor Rogner (plate 35).—On the structure and fissiparity of *Ctenodrilus monostylus*, sp. nov., by Max Graf Zeppelin (plates 36 and 37).—On the nervous system of the snout and upper lip in oxen, by Ivan B. Cybulsky (plates 38 and 39).—On the anatomy and physiology of the proboscis in Musca, by Dr. Karl Kraëpelen (plates 40 and 41).—On the connective tissue of the epiphyses in Plagiostomes, Ganoids, and Teleostea, by Dr. J. Th. Cattel.

SOCIETIES AND ACADEMIES

London

Royal Society, January 10.—"On the Amount of Light Reflected by Metallic Surfaces." By Sir John Conroy, Bart., M.A. Communicated by Prof. Stokes, Sec.R.S.

In a paper which Prof. Stokes did me the honour of communicating to the Royal Society, and which appeared in the *Proceedings*, vol. xxxv. p. 26, I gave an account of some experiments I had made on the amount of light reflected by polished metallic surfaces when ordinary unpolarised light was incident upon them.

The light of a paraffin lamp fell either directly, or after reflection from the metallic surface, on a photometer, and the readings were made by altering the distance at which another similar lamp had to be placed from the photometer in order to produce an equal illumination.

I have repeated the experiments with the steel and speculum metal mirrors with polarised light. The polish of the tin and silver mirrors being defective, it was not thought worth while to re-examine them.

The general arrangement of the apparatus remained the same; but in order to obtain a more intense light, a magic lantern (the one known as the "Sciopticon" being used) was substituted for the paraffin lamp carried by the goniometer.

The metal plates were clamped to the vertical stage, and their adjustment examined by placing a second, or analysing, Nicol in the path of the reflected light and crossing the Nicols, the former being placed with its principal section either in or perpendicular to the plane of incidence, and adjusting the stage screws till the light reflected from the plate was completely extinguished.

The experiments were made in the manner described in the former paper, the light being polarised in, or perpendicularly to, the plane of incidence by the Nicol. It was found that the illumination of the paper varied with the position of the Nicol, being always greatest when the light which fell on the paper was polarised in the plane of incidence.

Four sets of observations and their means, made with the steel and speculum metal mirrors, are given in the tables.

TABLE I.—*Steel, with Light Polarised in the Plane of Incidence*

Angle of incidence °	A	B	C	D	Mean
30	57·01	61·67	63·06	61·05	60·70
40	61·73	64·04	68·18	62·90	64·21
50	65·31	67·41	71·97	69·41	68·52
55	68·76	70·41			
60	70·88	74·55	77·96	74·31	74·42
65	77·22	76·02	81·40	74·83	77·37
70	81·48	80·77	85·22	81·57	82·26
75	84·09	84·92	90·32	84·71	86·01
80	84·58	86·34	91·55	89·01	87·87

TABLE II.—*Steel, with Light Polarised Perpendicularly to the Plane of Incidence*

Angle of incidence °	A	B	C	D	Mean
30	49·27	50·53	53·67	47·28	50·19
40	45·53	45·39	49·79	44·40	46·28
50	40·45	41·24	43·47	38·78	40·98
55	37·47	37·34			
60	35·54	33·79	36·90	32·89	34·78
65	29·57	28·88	31·97	29·70	30·03
70	25·69	26·61	27·72	26·14	26·54
75	23·71	25·55	25·38	24·30	24·73
80	26·29	26·46	27·60	26·04	26·60

TABLE III.—*Speculum Metal, with Light Polarised in the Plane of Incidence*

Angle of incidence °	A	B	C	D	Mean
30	64·58	64·09	63·37	66·18	64·55
40	67·76	68·22	65·14	69·86	67·74
50	72·65	72·23	69·04	71·90	71·45
60	76·63	78·65	77·57	77·95	77·70
65	79·65	79·68	79·44	81·26	80·01
70	83·09	81·25	84·94	83·90	83·29
75	82·94	84·20	86·93	88·01	85·52
80	87·52	86·78.	90·96	89·72	88·74

TABLE IV.—*Speculum Metal, with Light Polarised Perpendicularly to the Plane of Incidence*

Angle of incidence °	A	B	C	D	Mean
30	59·31	57·86	59·83	59·63	59·16
40	53·30	54·01	56·41	54·29	54·50
50	49·47	51·44	49·61	49·69	50·05
60	41·50	43·36	44·02	43·83	43·18
65	39·95	39·12	40·50	40·85	40·10
70	38·27	35·84	37·42	38·29	37·45
75	36·20	34·45	36·84	35·88	35·84
80	40·51	38·67	41·22	41·15	40·39

The amount of light which, according to Cauchy's theory, ought to have been reflected by the mirrors was calculated out by the formulæ, the principal incidences and azimuths for the two mirrors having been determined—

$$J^2 = \frac{\theta^2 + \cos^2 i - 2\theta \cos \epsilon \cos \iota}{\theta^2 + \cos^2 i + 2\theta \cos \epsilon \cos i}$$

and

$$I^2 = \frac{\theta^2 \cos^2 i + 1 - 2\theta \cos \epsilon \cos i}{\theta^2 \cos^2 i + 1 - 2\theta \cos \epsilon \cos i},$$

and the observed and calculated results are set forth in Tables V. and VI.

TABLE V.—*Amount of Light Reflected by Steel Mirror*

	Observed		Calculated	
°	J^2	I^2	J^2	I^2
30	60·70	50·19	63·17	54·95
40	64·21	46·28	66·44	51·31
50	68·52	40·98	70·80	42·09
60	74·42	34·78	76·72	39·24
65	77·37	30·03	79·52	35·32
70	82·26	26·54	83·04	31·62
75	86·01	24·73	86·85	29·46
80	87·87	26·60	90·97	32·39

TABLE VI.—*Amount of Light Reflected by Speculum Metal Mirror*

	Observed		Calculated	
°	J^2	I^2	J^2	I^2
30	64·55	59·16	69·78	62·82
40	67·74	54·50	72·53	59·74
50	71·45	50·05	76·18	55·37
60	77·70	43·18	80·77	49·59
65	80·01	40·10	83·42	46·38
70	83·29	37·45	86·32	43·53
75	85·52	35·84	89·44	42·29
80	88·74	40·39	92·77	45·88

As far as regards the general character of the phenomena the agreement is complete and in accordance with the observations of

M. Jamin, but the actual values of the observed intensities always fall short of the calculated intensities, the difference being least with the steel mirror.

The polish of the mirrors was examined at the end of the experiments by the method suggested by Prof. Stokes, and described in the paper already referred to; both the mirrors stood the test satisfactorily, the polish of the steel being very slightly the best.

These experiments appear to show that the generally received formulæ for metallic reflection are approximately correct, but that the actual intensity of the reflected light is always less than the theoretical intensity, and that therefore, unless this be due to defects in the metallic surfaces, the formulæ do not completely express the laws of metallic reflection. If, as appears to be the case, a change in the reflective power of a plate can occur without any change in the values of the principal incidence and azimuth, it is necessary to regard the formulæ as only approximately true, and there is additional reason for thinking that, as Prof. Stokes has suggested, three constants are required to define a metal optically.

Linnean Society, February 7.—Sir J. Lubbock, Bart., president, in the chair.—Mr. Henry Groves of Florence and Mr. F. L. Keays of Cobham were elected Fellows.—Mr. F. O. Bower showed specimens of the leaf of *Tomeia menziesii*, with adventitious buds situated at the base of the lamina. These buds appear at the same point in all the leaves, and under normal circumstances, so that their development seems to be a constant character of the species. Their origin is exogenous, and the buds are found already present at the period when lignification of the xylem of the young vascular bundles begins. Mr. Bower compared this development with that already known in *Cardamine pratensis* and *Athyrurus ternatus*.—There was exhibited, on behalf of Mr. Arthur C. Cole, a box containing mounted preparations illustrative of his "Studies in Microscopic Science," a work devoted to animal and vegetable histology, now being issued in parts.—A note on the gemmæ of *Aulacomnion palustre* was read by Mr. F. O. Bower. Specimens kept in a warm and damp atmosphere flourished well, but showed no sign of sexual organs. It was found, however, that the ordinary vegetative axes often bore towards their apices structures which were undoubtedly of a foliar nature, with a special adaptation for effecting asexual or vegetative reproduction of the plant. Indeed, these gemmæ were found to be capable of immediate germination when laid on damp soil or even floating on water.—The second part of the Rev. A. E. Eaton's monograph on the recent Ephemeridæ or mayflies was read in abstract, its contents being a descriptive account of the genera and species from *Potamanthus* to *Callibetes* inclusive.—Another paper taken in abstract was by the Rev. A. M. Norman, on European and North Atlantic Crustacea. In this an attempt has been made to gather together all the present known and recorded forms of the group. Notices of many of the species are only to be found in obscure periodicals, &c., difficult of access almost in every language; consequently, since the production of Milne-Edward's "Histoire Naturelle des Crustaces" in 1834, the numbers have increased nearly threefold—revision therefore being highly necessary.—Mr. B. T. Lowne gave an interesting communication embodying his researches on the compound vision of insects. He compares the structures of the simple ocellus with those of the compound ocellus (common in larval insects), and with those of the compound eye. The compound eye, according to him, is but composed of aggregated compound ocelli, or one of the latter in the larval insect is merely equivalent to a single segment of a compound eye. He refers to the development of the compound eye, and points out that in many larvæ during the moulting stages the "segregate" retina is finally replaced by another. He describes a deep, spindle-like layer in intimate connection with the nervous structures, and which layer he regards as playing an important part in the phenomena of compound vision rather than that this kind of vision is solely dependent on the number of corneal facets.

Mathematical Society, February 14.—Prof. Henrici, F.R.S., president, and subsequently Sir J. Cockle, F.R.S., vice-president, in the chair.—Messrs. A. B. Basset and D. Brocklebank were admitted into the Society.—The following communications were made:—On the intersections of a triangle with a circle, by H. M. Taylor.—On the difference between the number of $(4n + 1)$ divisors and the number of $(4n + 3)$ divisors of a number, by J. W. L. Glaisher, F.R.S.—On a general theory, including the theories of systems of complexes and spheres, by A. Buchheim.—Prof. Sylvester, F.R.S., made some remarks on matrices with reference to nonions, &c. (see forthcoming paper in the *American Journal of Mathematics*).

Chemical Society, February 7.—Dr. W. H. Perkin, president, in the chair.—It was announced that a ballot for the election of Fellows would be held at the next meeting of the Society (February 21). The following papers were read:—On the expansion of liquids, by D. Mendeléeff; translated from the Russian by B. Brauner. In this paper the author, principally from data furnished by Thorpe (*Chem. Soc. Journ. Trans.*, 1880, p. 141), gives the equation $V = \frac{1}{1 - \kappa t}$ as expressing approximately the expansion of liquids. κ is named the "determinator of expansion." It is a coefficient characterising each liquid, just as each liquid has a specific gravity, boiling point, &c. The author states that the above expression, although many liquids deviate slightly from it, is sufficient in the majority of physico-chemical investigations.—Researches on secondary and tertiary azo-compounds, by R. Meldola, No. 2. The author describes, in continuation of his former researches, the action of diazotised paranitraniline upon tertiary monamines. In the case of dimethylaniline the resulting product is paranitrobenzenazo-dimethylaniline. This, on reduction with ammonium sulphide, furnishes an amido-compound, which is a most delicate test for nitrous acid. The nitro-azo compounds of the meta-series could not be reduced by ammonium sulphide without complete decomposition. The author concludes that the β-naphthylamine compounds of para- and meta-nitrodiazo-benzene do not contain an amido-group, as they yield with nitrous acid nitroso derivatives.—Note on the nitrogenous matters in grass and ensilage from grass, by E. Kinch. The author has determined the albuminoid and non-albuminoid nitrogen in a sample of grass and in the ensilage made from the grass. In the grass 9 per cent. of the nitrogen was non-albuminoid; in the ensilage 55 per cent. of the nitrogen was non-albuminoid. The albuminoids were determined by the phenol, the copper hydrate, the mercuric hydrate, and the lead hydrate methods. The author points out the importance of this serious diminution in the albuminoids, with reference to the food-value of ensilage.—On the influence of the temperature of distillation on the composition of coal-gas, by L. T. Wright. The author finds that more gas is obtained at high temperatures, but that it contains more hydrogen and less hydrocarbons.

Physical Society, February 9.—Prof. R. B. Clifton, president, in the chair.—Annual General Meeting.—The motion to make past presidents permanent vice-presidents was carried, and the articles of the Society altered accordingly.—Prof. Clifton read a report on the business of the past year, which showed that steady work had been done by the Society. Dr. Atkinson read the balance-sheet, showing a flourishing condition of the Society. A proposal to adopt certain letters to indicate membership of the Society when placed behind the name was, on the motion of Prof. G. Forbes, supported by Prof. Adams, Prof. McLeod, and others, held in abeyance for the present. The officers and Council for the ensuing year were then elected, and were as follows:—President: Prof. F. Guthrie, F.R.S.; Vice-Presidents: Profs. R. B. Clifton, F.R.S., W. E. Ayrton, F.R.S., W. Chandler Roberts, F.R.S., Dr. J. Hopkinson, F.R.S., Lord Rayleigh, F.R.S.; Secretaries: Prof. A. W. Reinold, M.A., Mr. W. Baily, M.A.; Treasurer: Dr. E. Atkinson; Demonstrator: Prof. F. Guthrie; other Members of Council: Mr. Shelford Bidwell, M.A., LL.B., Mr. C. W. Cooke, Prof. F. Fuller, Mr. R. T. Glazebrooke, F.R.S., Mr. R. J. Lecky, F.R.A.S., Prof. H. McLeod, F.R.S., Dr. Hugo Müller, F.R.S., Prof. J. Perry, Prof. S. P. Thompson. Honorary Member, Prof. H. A. Rowland. Prof. Clifton then resigned the chair to Prof. Guthrie, whose zeal for the Society he warmly praised. Prof. Guthrie expressed his high appreciation of the courtesy and kindness of the retiring President while in the chair. Mr. W. Lant Carpenter proposed a vote of thanks to the Lords of the Committee of Council on Education; Mr. Whipple moved the cordial thanks of the meeting to Prof. Clifton; Mr. Griffith and Prof. Adams proposed a vote of thanks to the secretaries, demonstrator, and treasurer; Prof. G. C. Foster proposed a vote of thanks to the auditors.—The meeting was then resolved into an ordinary one, and the Secretary read a paper by Dr. O. J. Lodge and J. W. Clark on the phenomena exhibited by dusty air in the neighbourhood of strongly-illuminated bodies, which we hope to print next week.

Mineralogical Society, February 12.—Rev. Prof. Bonney, F.R.S., president, in the chair.—Messrs. T. Vaughan Hughes and W. Semmons were elected members, and the Grand Duke of Leuchtenberg, M. E. Bertrand, and Prof. von Lang, corresponding members.—The following papers were read:—Note on a case of replacement of the quartz constituent of a granite by fluor spar, by the President.—On an arsenical copper ore, "garbyite," from Montana, U.S.A., by Mr. W. Semmons.—On an altered siderite from Alston Moor, by Dr. C. O. Trechmann.—Notes on a picrite (Palæopicrite) and other rocks from Gipps Land, and a serpentine from Tasmania, by the President.—Prof. Judd, on invitation by the President, submitted some slides of dust from the volcano of Krakatoa, which were exhibited under the microscope, and explained the principal features noticeable in these deposits.—The President exhibited some slides of dust from Cotopaxi, which had fallen on Chimborazo at the time that Mr. Edward Whymper was ascending the latter mountain.

SYDNEY

Royal Society of New South Wales, December 5, 1883.—Hon. Prof. Smith, C.M.G., president, in the chair.—Three new members were elected and seventy-eight donations received.—A paper on additions to the census of the genera of plants hitherto known as indigenous to Australia, by Baron Ferd. von Müller, K.C.M.G., F.R.S., was read.—Prof. Smith exhibited Stroh's apparatus for producing attraction and repulsion by vibrations of air.—The following specimens from the Solomon Islands, collected by Dr. H. B. Guppy of H.M.S. *Lark*, were exhibited and described by Prof. Liversidge, F.R.S.:—1. White flint from Ulana or Contrariété Island. 2. Flints, including chips and cores, from Ugi, also a large flint tomahawk weighing about four pounds. The flints possess all the characteristics of those from the chalk of Europe, and cannot by mere inspection be distinguished from them. Prof. Liversidge remarked that some years ago Mr. Brown, the Wesleyan missionary, brought from New Britain a soft white limestone which was quite undistinguishable from chalk, not only physically but chemically, and pointed out that this discovery of flints afforded another very strong proof of the probable presence of true chalk of Cretaceous age in the South Sea Islands. 3. Samples of water from the fresh-water lake of Wailava in the Island of Santa Anna. 4. Water from the boiling spring in the Island of Simbo; temperature 212°. 5. Water condensed from one of the fumaroles in the Solfatara on the south-west point of Simbo, at an elevation of about 300 feet above the sea. 6. Water condensed from one of the fumaroles on the summit of the South Hill in the Island of Simbo, elevated about 1100 feet above the sea. 7. Two kinds of fruits ejected from the crops of pigeons shot on a small island off the south coast of St. Christoval.

BERLIN

Physical Society, January 25.—Dr. Kayser spoke on the results of an investigation, recently published by Prof. Bunsen of Heidelberg, into the condensation of carbonic acid on smooth glass surfaces, results which did not coincide with those of other physicists, the speaker among the rest. Prof. Bunsen had found that the condensation of carbonic acid was a continuous process which could not be regarded as finished even after a period of three years. According to the views hitherto entertained, the process referred to came to a conclusion in a very short time. Dr. Kayser was of opinion that the diverging result of Prof. Bunsen's examination was to be explained on the ground that in his experiments he made use of an absorbing vessel stoppered by a greased glass cock. Carbonic acid appeared, however, to diffuse itself thoroughly through fat, as had been proved by an experiment set in operation some weeks ago. Two cruciform glass vessels were set up, one arm of which, directed downwards, passed into a capillary tube dipped in quicksilver, while the three other arms were closed up in one vessel by greased glass plates and hermetically sealed in the other. Both were filled with carbonic acid. In the grease-stoppered vessel the volume of carbonic acid showed a slow progressive diminution, but in the other vessel it continued unaffected. Anything like condensation of the carbonic acid was here quite out of the question, though on the other hand there was clearly a case of osmose through the grease, a subject which Dr. Kayser would further prosecute.—Prof. Vogel exhibited instantaneous photographs of various animals in motion—horses, cows, dogs, and stags—which had been executed by Mr. Muybridge in San Francisco. Prof. Vogel having explained the mode of their production, directed attention to particular pictures completely at variance with the representations of animals in motion hitherto customary among artists. When, however, whole series of these figures, which were occasionally very curious, were viewed through the stroboscope, it was recognised how true to nature these representations were.—Prof. Neesen laid before the Society two new apparatus—one a call-apparatus for telegraphic purposes, constructed by Herr Abakanowicz, which, from the small number of its vibrations, would exercise no disturbing influence on neighbouring conductors; the other an electro-magnetic tuning-fork constructed by Herr König, in which the quicksilver contact common in other instruments of the kind was replaced by a metallic contact.—Dr. Aron communicated a practical experiment he had made on an old frictional electrical machine. By the application of cacao-butter as grease for the amalgam, he elicited from an old machine, which was no longer able to be charged, beautiful sparks of four inches long, and he recommended this fat for trial, particularly in the case of old electrical machines.

VIENNA

Imperial Academy of Sciences, December 20, 1883.—F. von Hoehnel, on the mode of occurrence of some vegetable raw materials in stem plants.—F. Strohmer, on quantitative determination of pure aqueous solutions of glycerine by means of their refractive index.—E. Lippmann, on the action of organic hyperoxides on organic compounds (sealed packet).—V. Hilber, on a recent land-snail found in the loess from China (second paper).—C. Auer von Welsbach, on the earths of the gadolinite of Ytterby (on a modification of spectral analysis).—A. Arche, on cerite and its breaking up to cerium, lanthan, and didymium compounds.—E. Stefan, on the calculation of the coefficient of induction of wire coils.

January 3, 1884.—R. Andreasch, contribution to a knowledge of allyl urea.—R. Rumpf, on the andesin in the lignite of Trifail (Styria).—A. Wassmutt, on the heat produced by magnetism.—L. Fodor-Mayerhofer, contribution to the theory of the varying vertical sun-dial.—H. Zukal, studies on lichens.—M. Kretschy, researches on kynurinic acid.—S. von Wroblewski, on the use of boiling oxygen as a freezing mixture, on the temperature obtained thereby, and on the solidification of nitrogen.

January 10.—F. Hoehnel, on wood-tissue with a story-like structure.—T. Wolfberger and F. Strohmer, on a generally applicable method of analytical determination of acidity by weight (sealed packet).

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