THURSDAY, JUNE 30, 1881

ILLUSIONS

Illusions. By James Sully. International Science Series, Vol. xxxiv. (London: C. Kegan Paul and Co., 1881.)

OF the many interesting subjects to which the publishers of the International Science Series have hitherto devoted their volumes, few have presented so formidable a test of the strength of their respective authors as the one which has been assigned to Mr. James Sully. Occupying some of the most obscure regions of physiology, and passing over into the remotest cloudlands of psychology, illusions furnish material alike for the most laborious exploration and the most keen-sighted analysis; but for this very reason they constitute a class of phenomena which invite failure of treatment at the hands of any but the most accomplished psychologist. Mr. Sully is already well known to stand in the first rank as a writer of this class, and the able manner in which he has handled the difficult subject consigned to him shows that it could not have been consigned to a better man. The wide range of his reading, the clearness and force of his style, as well as the soundness of his judgment, give him what we may call exceptional advantages for undertaking a treatise of this kind, while the methodical, not to say laborious, manner in which he has executed the task, shows that he has thrown all his strength into its performance.

First we have presented a "Definition of Illusion," which, standing in a scientific as distinguished from a philosophical treatise, is justly framed so as to exclude any question with the idealist or the sceptic. "For our present purpose the real is that which is true for all. . . . Human experience is consistent; men's perceptions and beliefs fall into a consensus. From this point of view illusion is seen to arise through some exceptional feature in the situation or condition of the individual, which, for the time, breaks the chain of intellectual solidarity which under ordinary circumstances binds the single member to the collective body. Whether the common experience which men thus obtain is rightly interpreted is a question which does not concern us here. For our present purpose, which is the determination and explanation of illusion as popularly understood, it is sufficient that there is a general consensus of belief, and this may be provisionally regarded as at least practically true."

Next we have a very methodical and judicious "Classification of Illusions." As distinguished from hallucinations, illusions "must always have a starting-point in some actual impression, whereas a hallucination has no such basis." Still the one shades off so gradually into the other that no determinate line can be drawn between them. Therefore this distinction, although recognised as a distinction, is not constituted, as it has been constituted by some technical writers, "the leading principle of classification"; but a more popular or common-sense principle is adopted. All immediate knowledge, or knowledge not attained by any conscious process of inference, may be divided into four principal varieties—Internal Perception (Introspection), External Perception, Memory, and Belief, including Unreasoned Expectation. The difficult question as to the relation of Belief to Knowledge is expressly set aside—it being allowed by every one that many of our beliefs are for all purposes of action as good as knowledge. Each of these four sources of immediate or uninferred knowledge is open to the contamination of illusion. Such is notoriously the case with sense-perception, which, as the best-marked variety, is treated first.

In the course of a clear analysis of Perception stress is laid upon what the author calls a "stage of preperception," during which the mind receives the impression of sense, but has not yet interpreted the impression into a coherent percept. "In many of our instantaneous perceptions these two stages are indistinguishable to consciousness . . . But in the classification of an object or the identification of an individual thing there is often an appreciable interval between the first impression and the final stage of complete recognition." [The time, that is, during which, in Mr. Spencer's language, the mind is forming its "integrations"—a process which takes place more rapidly in adults than in children, and in "quick-witted" than in less "ready" individuals.] "And here it is easy to distinguish the two stages of preperception and perception. The interpretive image is slowly built up by the operation of suggestion, at the close of which the impression is suddenly illumined as by a flash of light, and takes a definite precise shape." Now illusions of perception may arise in either of these two stages. Even *in limine* sufficient attention may not be paid to the original impression, and thus a timid man will readily fall into the illusion of ghost-seeing, because too little attentive to the actual impression of the moment. But next, even if the sensation is properly attended to, "misapprehension may arise of what is actually in the mind at the moment." Although this "may sound paradoxical," it means nothing more than that "the incoming nervous process may to some extent be counteracted by a powerful reaction of the centres." Thus, for instance, a sensation of colour may be appreciably modified when there is a tendency to regard it in one particular way.

After giving parenthetically a number of illustrations of errors of perception which have their root in the initial processes of sensation and "preperception," the essay passes on to a further consideration of the more important class of illusions which are connected with the later stages of perception, or the process of interpreting the sense-impression. These misinterpretations of sense-impressions fall into two classes, according as they are connected with a process of *suggestion* or with the process of *preperception*. The illusion of a second shouter in an echo is given as an example of the former, while that of seeing spectres in familiar objects after the imagination has been excited by ghost-stories, supplies an illustration of the latter. The first of these classes of illusions arises from without, the second from within: the one is therefore called Passive, the other Active. Besides these there are other "sub-divisions" which need not here be detailed. Indeed we think that a desirable simplicity of classification might have been attained by ignoring these lesser ramifications, and restricting attention to the main divisions—*i.e.* illusions arising in the initial processes of sensation, in those of preperception, and in those of

perception, passing on to illusions of introspection, memory, and belief.

Taking first the illusions of sensation, preperception, and perception, the following is a brief sketch of Mr. Sully's analysis of their nature and causes.

1. *The Limitation of Sensibility;* the amount of sensation is not always a fair measure of the amount of stimulation, which may be either inadequate or over-adequate in relation to the excitability of the sense-organs. 2. *The Variation of Sensibility;* changes of organic state—whether temporary, as those arising from fluctuating nutrition or fatigue, &c., or permanent, as those arising from age or disease—by supplying us with a variable index of objective phenomena, lead to illusory misrepresentations of these phenomena, unless such variations are duly recognised and allowed for. 4. *Exceptional Relation of Stimulus to Organ;* a man crunching a biscuit can scarcely believe that others do not hear the sound more loudly than he does, or, on rubbing his nose with the points of his third and fourth fingers crossed, that this organ has not become split into two; in such cases the sense perceptions are interpreted by the help of more familiar relations, and so illusion arises. 5. *Exceptional External Arrangements;* unless the fact that we are ourselves moving is clearly presented to consciousness, we instinctively conclude that surrounding objects are moving in the opposite direction, and under similar circumstances are apt to suppose that a train which is just shooting ahead of our own train is moving but slowly; on this principle depends the illusion of the stereoscope, misjudging distances in the clear atmosphere of Switzerland, &c. 6. *Devices of Art;* perspective, effects of light and shade, &c., are all so many devices to ensnare visual perception into a misinterpretation of marks on a flat surface for objects situated in space of three dimensions. 7. *Misconception of Local Arrangement;* the examples given under this head appear to involve exactly the same principle as 5, and nothing more. 8. *Misinterpretation of Form;* the same remark applies to this head—7 and 8 are really species of the genus 5, and ought to have been considered under it. 9. *Illusions of Recognition;* as in general we attend only to what is essential and constant in objects, to the disregard of what is variable or accidental, opportunity is thus furnished for a large class of illusions; imagination and expectant attention likewise play an important part in producing illusions of this kind. 10. *Voluntary Selection of Interpretation.* So far the enumeration has been concerned with what the author calls "Passive Illusions," *i.e.* illusions in which the imagination is inactive, or comparatively so; now we pass to the "Active Illusions," and as an example of voluntary selection of interpretation we may notice that in looking at a geometrical drawing of a truncated pyramid the figure may by a voluntary act be seen to represent alternately a solid upstanding form, or a hollow receding box. 11. *Involuntary Mental Preadjustment;* this resembles the last case, save that the illusion is not due to an act of volition. "The whole past mental life . . . serves to give a particular colour to new impressions. . . . There is a personal equation in perception as in belief." 12. *Sub-expectation;* this has already been alluded to, and is obviously a potent cause of illusion. 13. *Vivid Expectation;* still more obviously so. Indeed vivid expectation may "produce something like a counterfeit of a real sensation." An anxious mother may fancy that she actually hears her child cry in an adjoining room, &c. 14. *Transition to Hallucination;* clearly but a step farther, and illusion passes into hallucination, where imagination has become altogether detached from present surroundings, and has entered on the stage of highest activity. But hallucinations are not invariably of central origin; they may also be of peripheral, and do not always betoken pathological conditions, though they usually reach their highest perfection in the insane Thus there is an apparently unbroken continuity from the scarcely noticeable illusions of normal life leading up to the most startling hallucinations of abnormal. This consideration leads to the following pretty piece of speculation:—

"We may, perhaps, express this point of connection between the illusions of normal life and insanity by help of a physiological hypothesis. If the nervous system has been slowly built up, during the course of human history, into its present complex form, it follows that those nervous structures and connections which have to do with the higher intellectual processes, or which represent the larger and more general relations of our experience, have been most recently evolved. Consequently, they would be the least deeply organised, and so the least stable; that is to say, the most liable to be thrown *hors de combat*. This is what happens temporarily in the case of the sane, when the mind is held fast by an illusion. And, in states of insanity, we see the process of nervous dissolution beginning with these same structures, and so taking the reverse order of the process of evolution.[1] And thus, we may say that throughout the mental life of the most sane of us these higher and more delicately balanced structures are constantly in danger of being reduced to that state of inefficiency which in its full manifestation is mental disease."

Next there follows an interesting chapter on Dreams, in which the mechanism of thought in sleep is ably and suggestively laid bare, so far as the complex and difficult nature of the subject permits. Want of space however prevents our entering upon this chapter, and therefore we shall pass on at once to the Illusions of Introspection. This and the next division of the work is perhaps the part that displays most originality. At first sight it seems almost impossible that the mind could be subject to illusion in its consciousness of its present state or contents; but yet it is clearly shown that such is very frequently the case. "No such clearly-defined mosaic of feelings presents itself in the internal region" as that which is presented in the external when interpreted by sensuous perception; "our consciousness is a closely-woven texture in which the mental eye often fails to detect the several threads or strands." Moreover, "many of these ingredients are exceedingly shadowy, belonging to that obscure region of sub-consciousness which it is so hard to penetrate with the light of discriminative attention." Thus numberless illusions of introspection become possible. All cases of "self-deception" fall into this category, whether they arise from a wrong intellectual focussing of the attention, so as to give undue prominence to some feelings over others, or from a mere emotional bias. As examples we may take the self-deception of a man who is really "bored" by a social entertainment, yet making himself

[1] Reference is there made to Dr. J. Hughlings-Jackson's papers in *Brain*.

believe that he is enjoying it ; or that of a conceited man who thinks more highly of himself than a just introspection, untainted by emotion, would show that he deserves. It is pointed out that illusions of introspection have been more generally recognised by theologians than by philosophers; for while the former preach that the heart mistakes the fictitious for the real, and the evanescent for the abiding, the latter frequently regard a "deliverance of consciousness" as bearing the seal of supreme authority. This consideration leads to an interesting section on "Philosophic Illusions," wherein the question is discussed as to how far the introspective method is a trustworthy one for Philosophy to follow. The result of the discussion is that, as the internal experience of individuals, no less than their common environment, has a common nature, individual introspection should always be guided as much as possible in matters of internal experience by the general consensus; and that "the progress of psychology and the correction of illusion proceed by means of an ever-improving exercise of the introspective faculty."

Coming next to the Illusions of Memory, or Representative as distinguished from Presentative Illusions, it is shown that these are distinct from mere forgetfulness or imperfection of memory. To forget a past event is one thing; to seem to ourselves to remember it when we afterwards find that the event was other than we represented it, is another thing. Illusions of memory are classified under three heads:—(1) *Falsification of Dates;* (2) *Misrepresentation of Events; and* (3) *Creation of Events by the Imagination which never happened in Reality.* Each of these classes of illusory representations has its counterpart in the illusions of Presentation. Thus, Class 1 has its visual counterpart in erroneous perceptions of distance; Class 2 in those optical illusions which depend on the effect of haziness or the action of refracting media; and Class 3 in subjective sensations of light or other hallucinations. In the detailed discussion of Class 1 there is a long and careful analysis of time-consciousness, in which numerous causes of erroneous estimate of duration are clearly stated, after which follows a statement of the conditions leading to *Indefinite Localisation;* these sections are exceedingly good. Under Class 2, or Distortions of Memory, it is shown that although we may in some cases account for the confusion of fact with imagination, "in other cases it is difficult to see any close relation between the fact remembered and the foreign element imported into it. An idea of memory seems sometimes to lose its proper moorings, so to speak; to drift about helplessly among other ideas, and finally, by some chance, to hook itself on to one of these, as though it naturally belonged to it." The analogy between this class of mnemonic illusions and that of illusions of perception is obvious. "When the imagination supplies the interpretation at the very time, and the mind reads this in to the perceived object, the error is one of perception. When the addition is made afterwards, on reflecting upon the perception, the error is one of memory." To the several sources of such mnemonic illusions mentioned by Mr. Sully, I may add another, which I have recently had occasion to observe. This consists in what may be called a transposition of associations. In a club I saw a man walk through the smoking room. He was an eminent psychologist, and although I knew him very well I mistook him for another man equally eminent in the same line, and whom I knew equally well. Clearly the similarity of their pursuits caused a most extraordinary transposition of two sets of associations, for the two men bore no personal resemblance to one another. As soon as the man had left the room, I remembered that I had something to ask the man for whom I had mistaken him. I therefore sent a page to find this other member of the club, but without success. I then went to the hall-porter, who said he was sure that this member had not come in. Yet so strong was my conviction of having seen him that I began to think I must have seen an optical illusion, and therefore resolved to write him a letter to ascertain still more certainly that he had not been in the club at that particular hour. And it was not until I had seriously meditated on the matter for ten or twelve minutes that I suddenly perceived the illusion to have been one of memory and not of sense. This I think is a remarkable case, because both the men in question are so well known to me that I have never ventured to tell either of them of my illusion, lest, psychologists though they be, they should suppose that I had been somewhat excessive in patronising the good things which the club had to afford.

It is shown that Hallucinations of Memory may arise either from believing events in dreams to have occurred in fact, or from waking imagination being strong enough to read spurious facts into the past. The former source is clearly common to us all, and the latter is so far from being distinctive of pathological condition that in one respect, at least, it is even more universally present than the other. For "the total forgetfulness of any period or stage of our past experience necessarily tends to a vague kind of hallucination. In looking back on the past we see no absolute gaps in the continuity of our conscious life." Yet it is obvious that we must fill up immense lacunæ without conscious knowledge, and in so far as this is the case, memory is subject to hallucination. From this position there follows a section on "*Illusions with respect to Personal Identity*," the substance of which may be gathered from the following quotation:—"To imagine that we have ourselves seen what we have only heard from another or read, is clearly to confuse the boundaries of our identity. And with respect to longer sections of our history, it is plain that when we wrongly assimilate our remote with our present self, and clothe our childish nature with the feelings and the ideas of our adult life, we identify ourselves over much. In this way, through the corruption of our memory, a kind of sham memory gets mixed up with the real self, so that we cannot, strictly speaking, be sure that when we project a mnemonic image into the remote past we are not really running away from our true personality."

Lastly, we come to "*Illusions of Belief*," the latter word being taken in its widest sense as embracing all representative knowledge other than memory—including therefore anticipation of the future, acquaintance with the experience of others, and "our general knowledge about things." In so wide a field there is boundless scope for illusions of many kinds. These are classified and considered in the latter part of the work, but we have no space left to follow our diligent author into this division of his subject.

The work concludes with a chapter of "*Results*," which shows that illusion in general consists in a "bad grouping of psychical elements," and as such shade off into fallacies of reasoning; in both there is a want of correspondence between internal and external relations. In the future and for the race natural selection and "direct equilibration" can only be expected to remedy the sources of any such mal-adjustment in so far as it may be of actual injury to life. Thus we can have no absolute criterion of illusion. "Science cannot prove, but must assume the coincidence between permanent common intuitions and objective reality. To raise the question whether this coincidence is perfect or imperfect, whether all common intuitions known to be persistent are true, or whether there are any that are illusory, is to pass beyond the scientific point of view to another, namely, the philosophic." This consideration leads to an exceedingly able statement of the relations between scientific and philosophic thought, but the discussion necessarily runs into an abstruseness that it is not desirable here to enter. In general, however, it may be said that in this, as in some of his other works, Mr. Sully shows that while he has perceived more distinctly than most of our leading psychologists the sharpness of the boundary between science and philosophy, he displays an admirable clearness of thought in never allowing the methods of the one sphere to encroach upon those of the other, while in whichever sphere he chooses to work he enjoys the privilege, almost unique among psychologists, of finding himself equally at home.

GEORGE J. ROMANES

OUR BOOK SHELF

Studies in Biology for New Zealand Students. No. 1.—The Shepherd's Purse (*Capsella Bursa-Pastoris*). By F. W. Hutton, Professor of Biology, Canterbury College, University of New Zealand. (New Zealand: By Authority. 1881.)

THIS is a detailed study of the coarse and minute anatomy of a very familiar and widely-diffused weed. A native originally of the palæarctic region, it has now found its way to all temperate climates. It has certainly received at Prof. Hutton's hands, in the Antipodes, a more systematic investigation than ever fell to its lot in Europe. The treatment is much the same as that given to the bean (*Faba vulgaris*) in Huxley and Martin's "Elementary Biology," though with a more botanical bias. The weakest part is the treatment of the root, where nothing is said about the mode of origin of branches. An earlier stage should have been taken, showing the arrangement of the fibro-vascular tissues before they had coalesced into a central cylinder. This however is simply by way of criticism. The method of treatment is excellent, and the Canterbury students are fortunate in being in the hands of a teacher who has such a thorough appreciation of the biological method as applied to botany.

A Text-Book of Indian Botany, Morphological, Physiological, and Systematic. By W. H. Gregg, Lecturer on Botany at the Hugli College. (Calcutta: Thacker, Spink, and Co., 1881.)

THIS is the first eighty pages of a book which, when completed in 500–600, will apparently be practically Henfrey's Elementary Course, adapted to the local requirements of Indian students. There does not seem anything particularly novel or noteworthy in the treatment of the subject, as far as can be judged from the portion printed. As is usual in books of this type, some space is devoted to the Linnean classification. But, as the author points out, there is the excuse that Roxburgh's *Flora Indica*, which is still unsuperseded, is arranged in accordance with it.

LETTERS TO THE EDITOR

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

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

Re W. I. Bishop

I CANNOT but feel greatly surprised that Mr. Romanes, when reporting the result of the investigations made by his colleagues and himself upon the power of "thought-reading" claimed by Mr. W. I. Bishop, should have stated that the letter of introduction which I gave to Mr. Bishop was "doubtless intended to recommend him to the attention of the credulous," since this letter most distinctly expressed my desire to obtain for him "an assemblage of gentlemen specially qualified to appreciate the importance" of what I described in it as (in my judgment) "experiments of great value to the Physiologist and Psychologist." Nor can I see how my having thus recommended "him to the attention of the scientific" is a thing "to be regretted"; since the careful testing of the one set of experiments which Mr. Bishop has shown to Mr. Romanes and his colleagues has resulted in a precise confirmation of my statement that the power of "thought-reading" which he claims is "derived from his careful study of the indications *unconsciously* given by the subjects of his experiments, and from his peculiar aptness in the interpretation of those indications."

What I think "is to be regretted" is that Mr. Bishop did not offer for like careful testing another remarkable set of experiments which he had repeatedly performed in the presence of distinguished medical and scientific men in the United States (from whom he brought introductions to me), and also before a like assemblage in Edinburgh; showing his power of naming words and numbers previously written and sealed up in private, by his acute recognition of indications *unconsciously* given by their writers when the alphabet or digits were "called."

As I have never credited Mr. Bishop with any other power of "thought-reading" than this, I have been surprised to learn that I am accused of "fathering a new humbug."

Another "experiment" which he performed in my own house some time ago struck me as well worthy of careful testing:—

The "subject" of the experiment being asked to draw a card from the pack, to identify it, and then to return it to Mr. Bishop, the latter, after shuffling the pack, dealt out sixteen cards *with their faces downwards*, arranging them in four rows (which I indicate by letters and numbers), as thus:—

	A	B	C	D
E	1	2	3	4
F	5	6	7	8
G	9	10	11	12
H	13	14	15	16

The "subject," having been caused to stand at the table with the cards directly before him, Mr. Bishop, standing at his right side, and taking his right hand into his own left, said to him, "Drop your left hand down on either row (whether *horizontal*, as A, B, C, D, or *vertical*, as E, F, G, H), that you wish taken away." Row B having been selected and taken away, there remained the three rows, A, C, D. "Now," said Mr. Bishop, "drop down on another row." Row D being selected, there remained rows A and C. "Now drop down on a third row." Row A being selected, there remained only row C. "Now drop down upon either the two upper or the two lower cards of the remaining row." The two upper (3 and 7) being selected and taken away, there remained only the two lower (11 and 15). "Now drop down

upon either of the two remaining cards." The lower (15) being selected, and the remaining card (11) being turned up, this proved to be the card originally drawn.

Having seen this experiment twice made successfully with members of my family, I offered myself as the next "subject" of it, with the determination to watch carefully for any manual guidance by which Mr. Bishop might be influencing my choice. The experiment succeeded with me as it had done with my predecessors, and yet I could not, any more than themselves, tell how I was led to make the five successive selections of the cards to be taken away, so as to leave behind the card I had originally drawn.

It may, of course, be assumed that Mr. Bishop knew where he had placed this card, although his "subject" did not; and he informed me that experience has taught him the positions to which the choice of his "subject" can be most easily and certainly guided. The influence of the eyes being excluded by the relative positions of Mr. Bishop and his "subject," the guidance *must* be conveyed through the hand which Mr. Bishop holds in his own; and yet I altogether failed to detect the mode in which it was given.

Of course it may be said that this is only a variation of the conjuror's trick of "forcing" the card which he has determined that the drawer shall choose. (I remember seeing it stated that Louis Napoleon, when Emperor, had defied Houdin then to "force" a card upon him; and that Houdin made him draw the card which in the French pack is designated Cæsar.) But though the same principle of "suggestion" is involved, the conditions under which it acts are altogether different. The conjuror stands *opposite* the drawer, looks at his face as well as at his hand, and continually shifts the position of the cards he holds, so as to prevent a *wrong* card from being drawn, while presenting the *right* one in the manner which he knows by experience to be the most suggestive. But Mr. Bishop does no such thing. The cards remain in their places with their faces downwards; and of the guidance given him by Mr. Bishop standing at his side, the "subject"—even when on the watch for it—remains quite unaware.

If I have made myself understood by your readers, I think I shall have satisfied them that this "experiment" (which may by no means invariably succeed) is of great psychological interest, as showing the large measure in which we may be guided in our choice among things "indifferent," by *influences of which we are ourselves unconscious.* WILLIAM B. CARPENTER

American Meteorological Observations

IN your valued journal (vol. xxiv. p. 16) I find an expression of your regret that it should have been decided that the printing of the *Bulletin* of Simultaneous Meteorological Observations should hereafter take place one year after date, instead of six months. It may be interesting to those of your readers who made use of the *Bulletin* in studying the general atmospheric phenomena of the northern hemisphere, to know that for several years past the data for several distant land stations in Greenland, Iceland, Siberia, Alaska, &c., have been omitted, merely because the mail facilities did not enable us to receive the reports in time for publication in the *Bulletin*. Thus a large portion of the region covered by our maps has been left unrepresented, for which the necessary data come regularly to hand a few weeks or months later. The case is still worse in reference to the marine reports for vessels off on long voyages; for instance, we regularly pay for and receive a large collection of material from the London Meteorological Office that never appears in our published *Bulletin* or charts. The proposed postponement of publication is in fact merely the outcome of several suggestions and recommendations from co-operating nations, in the propriety of which recommendations myself and assistants fully concur.

W. B. HAZEN,
Chief Signal Officer, U.S.A.

Office of the Chief Signal Officer, Washington, D.C., June 15

A Meteor

LAST night, June 24, at 11h. 29m. G.M.T., I observed a meteor, as bright as Jupiter, cross the tail of the great comet 4° or 5° above the head and disappear some 20° to the left, on the vertical of Beta Ursæ Minoris and at an altitude equal to that of the comet's head. It left a bright streak for some seconds. I did not see the beginning, and perhaps not the end, as it may have continued behind a cloud bank. The duration for the above path was three seconds, determined afterwards by experiment. Place of observation, lat. 51° 32′, long. 0° 11′ W.

G. L. TUPMAN

27, Hamilton Terrace, St. John's Wood, June 25

LOOKING at the comet last night from my garden at 11.25 p.m. I saw a large meteor pass nearly horizontally from a little east of north to within a short distance of the comet, rather above the head. It was as large as Venus when brilliant, but with a red or orange tinge. The motion was rather slow. A.

Adsett Court, Westbury-on-Severn, June 25

Earthquake in Van

IT may perhaps be considered worthy of a note in your columns that an earthquake was experienced in this neighbourhood on Monday, May 30, at a few minutes before 6 a.m.

Here in Van the shock was slight, consisting only of a tremulous motion lasting a few seconds; but I have to-day received information that at Bitlis the shock was so severe as to cause people to rush out of their houses in fright, and that a village named Téout, situated near the western shore of the Lake of Van, was destroyed by it, with the loss of a considerable number of lives. I have as yet heard no details, but if any further circumstances of interest should come to light I will communicate with you again.

It is well known that the environs of the Lake of Van show many signs of ancient volcanic action; at least three volcanoes with distinct craters forming prominent features on or near its shores. Of these the Nimroud Dagh, on the western shore of the lake, is said by tradition to have been active not more than 400 years ago. It contains an immense crater five or six miles across, in which are situated hot springs. The village Téout which has been destroyed lies at the foot of the eastern slopes of this mountain. EMILIUS CLAYTON

Van, Turkey in Asia, July 6

Freshwater Actineæ

I YESTERDAY noticed in a small *freshwater* aquarium four specimens of a small freshwater Actinia of a very pale olivaceous colour. They have each six tentacles more than 1 inch in length when fully extended, but then so extremely fine at the ends as to be almost invisible. The body or stalk is about 0·1 inch long by 0·05 inch in diameter when at rest, and about 0·5 inch long and 0·015 inch in diameter when expanded.

I was not aware before of the existence of freshwater Actinia, but as the specimens to which I now refer are in all respects similar to sea-anemones, there can be no doubt on the subject.

I have succeeded in transferring two specimens, which have duly rooted and expanded themselves in a bottle and a tumbler, and I shall be happy, if they are of sufficient interest, to send one to your office or elsewhere for inspection. W. SEDGWICK

Royal Naval School, New Cross, June 24

The Observation of Hailstorms

IN the most casual survey of the literature relating to the phenomenon of hail one cannot fail to be struck with the remarkable contradictions which everywhere make themselves apparent. Some writers say that hail falls oftenest in the tropics; others assert that it is altogether unknown there! Howard states that the maximum hailfall in this country occurs in the summer season, while Dalton and others say that it is in winter. I think these singular discrepancies are attributable, in many cases at least, to imperfect observations. Most of the meteorologists who have given special attention to the phenomenon of hail have had their pet theories, and naturally their observations have been guided to a considerable extent by the requirements of the particular theories which they advocated. Thus we find Kämtz ascribing the formation of hail to the conflict of opposing currents of wind, Volta to the electrical condition of two separate layers of cloud, Leslie to the presence of strata of air at different temperatures, von Buch to ascending currents of air, and so on, all which theories are based, not upon invariable phenomena, but upon isolated features which happen to have come repeatedly under the notice of those particular observers in the particular hailstorms which they witnessed. I think it would enhance the

value of observations in some degree if all those who have opportunities of making them would draw up their notes on some regular and uniform plan. I do not presume to submit a scheme, but would suggest the following points as being of some importance:—

1. Date, and hour of the day.
2. Area of storm. If it assume the tornado form, give (*a*) length of the course, (*b*) breadth, (*c*) direction of motion, (*d*) rate of progression.
3. Physical features of the locality—(*a*) elevation, (*b*) mountains and plateaux, (*c*) rivers and valleys, (*d*) forests, &c.
4. Temperature (*a*) before the storm, (*b*) after the storm, and if possible to be observed (*c*) changes during the storm.
5. Barometrical readings (frequently taken during time of hailstorm).
6. Wind—(*a*) direction near the earth's surface, (*b*) direction in the higher regions as indicated by the cloud motion, (*c*) force.
7. Preceded or followed by rain.
8. Aspect of the clouds. Note if there be any appearance of two separate strata at different elevations.
9. Electrical phenomena. Should there be lightning, note the relation between the discharges and the fall of the hail—whether the lightning precede the hail, or *vice versâ*.
10. Duration of the storm at one spot.
11. Sound. Note if a peculiar noise precede the descent of hail.
12. Conformation and size of the hailstones.
13. General character of the weather before and after the storm.

Notes.—(1) The precise date of a hailstorm is an important point, as it determines the period of their occurrence. Respecting the *annual* period we have the most conflicting testimony. Shortly after the establishment of hail insurance companies valuable statistics were published by those bodies. From particulars furnished by the Farmers' Insurance Institute the following table was drawn up:—

Hailstorms in	January	0
,,	February	1
,,	March	2
,,	April	3
,,	May	7
,,	June	10
,,	July	17
,,	August	4
,,	September	2
,,	October	0
,,	November	0
,,	December	0
		46

Dalton gives the following as the result of five years' observations:—

In	January it hailed on	11	days.
,,	February ,,	7	,,
,,	March ,,	5	,,
,,	April ,,	8	,,
,,	May ,,	11	,,
,,	June ,,	6	,,
,,	July ,,	2	,,
,,	August ,,	1	,,
,,	September ,,	6	,,
,,	October ,,	7	,,
,,	November ,,	7	,,
,,	December ,,	13	,,

Giddy thus sums up twenty-one years' observations at Penzance:—

January	23	July	1
February	25	August	0
March	25	September	5
April	27	October	17
May	7	November	22
June	5	December	43

Thomson ("Introd. to Met." p. 174) gives the following as the relative proportions:—

Winter to all the other seasons	as	45·5	to 54·5
Spring	,, ,,	29·5	to 70·5
Autumn	,, ,,	22·0	to 78·0
Summer	,, ,,	3·0	to 97·0

From a comparison of these tables we see that Dalton, Giddy, and Thomson agree in making winter the season of maximum hailfall, while the insurance statistics point to the opposite conclusion, the hailstorms in June and July being much in excess of those in the other months of the year. I strongly suspect however that Dalton, and other observers who have arrived at similar results, included in their enumeration of hailfalls what we may call, in absence of a better name, *winter hail*. It is very unfortunate that the word *hail* has in our language been used to denote two entirely different phenomena, the French *grèle*, or hail proper, and *grésil*, or that small round powdery snow which often falls towards the end of a snowstorm and in the early part of a very frosty night. *Grésil* has nothing in common with *grèle*. The one falls exclusively in winter, and the other, I venture to say, as exclusively in summer.

(6) Dalton observed that the winds which brought hail-showers in the north of England were always south-west, west, or north-west. The wind often shifts erratically. Howard mentions a hailstorm during which it was first east, then south, afterwards west, again east, and finally west. Beccaria makes the following singular statement:—"While clouds are agitated with the most rapid motions, rain generally falls in the greatest plenty; and if the agitation be very great, it generally hails."

I shall be glad to receive references to memoirs and papers on the subject of hail, also particulars of storms, from any of your readers who have them at hand. J. A. B. OLIVER

Athenæum, Glasgow, June 6

How to Prevent Drowning

IN the discussion that Dr. MacCormac's letter has elicited, the essential principle upon which the whole art of swimming is fundamentally based appears to have been overlooked. As Dr. MacCormac says, the human body naturally floats in water, and freely so in salt water; but *how* does it float, supposing the necessary condition of buoyancy, the inflation of the lungs, is maintained? If the limp, dead body of a man is thrown into water in this condition it floats with the head and face immersed, but with that part of the back just between the shoulders upwards, and just bobbing out of water. This is a drowning position, and the first business of swimming is to counteract the tendency to this position, that is, to balance the body in such wise that the head shall be upwards and the lower part of the face uppermost, in spite of the natural tendency of the head to sink, it having a greater specific gravity than water, or the average of the whole body. Dr. MacCormac, in his letter (p. 166), says that "it is just as easy, if we only knew it, to tread water as to tread earth." Quite so; but it is also about as difficult. No human being can "tread earth" without training, the principal effort in this training being directed to keeping the centre of gravity within the base covered by the soles of the feet; and in like manner we must learn to keep the centre of gravity of the body and the centre of its buoyancy in a perpendicular line with mouth and nostrils in the air. I have been a swimmer since I was eight years of age, and consequently swim as naturally as I walk, and float easily in fresh or salt water, without any treading or paddling of any kind; but though I can thus lie basking luxuriantly and motionless, I am just as unable to sleep floating as to sleep standing upright. I have often tried, and immediately I begin to doze my mouth is under water. The effort of keeping the face upwards is as automatic and unconscious as that of standing still on the ground, but there is an effort of balancing nevertheless.

I have taught many to swim, and my first lesson is on balancing the body; the easiest formula for attaining this power is to *keep the hands down and look at the sky* while the chest is expanded as much as possible by throwing the shoulders well back in military attitude. Any man or woman of ordinary specific gravity who can do this can float *and breathe*, but to do it, simple as it is, requires practice or training, physical training of the muscles, and cerebral training in order to acquire that command of all the faculties without which there can be no treading of water or other device for keeping the mouth and nostrils in the air. If this were taught, not on paper, but in the water, to everybody, Dr. MacCormac's object would be attained. As it is, the human being compared with four-legged animals is relatively as inferior to them in water as it is on land. The calf or the colt walks a few minutes after it is born, the kitten or puppy in a few days; but the human infant only after many months. W. MATTIEU WILLIAMS

Royal Polytechnic Institution, June 27

Buoyancy of Bodies in Water

IN NATURE, vol. xxiv. p. 166, Dr. W. Curran says:—"It is, I think, generally assumed in books and courts of law that all bodies, human and bestial, sink as a rule in water as soon as life is extinct." How far this statement may be true as regards animals generally, I am not prepared to say, but it certainly does not hold good as regards the reindeer. The Eskimos spear many reindeer whilst crossing lakes, and it sometimes occupies them an hour or two in "towing" them all to land, yet it is a rare exception that any are lost by sinking, even of the full-grown males, which in autumn are heavily weighted with large antlers.

4, Addison Gardens, June 25 JOHN RAE

An Optical Illusion

WILL you allow me to add something to the letter from William Wilson in NATURE, vol. xxiv. p. 53.

1. The results described may be produced without bending the card or using a square hole. A flat card, with a pin-hole, is held some distance from the eye, and a pin moved so as to be in a right line between the eye and the hole; the results described by Mr. Wilson follow. 2. Some few trials may be necessary in order to get a clear image (if this is the proper term), but it will be found that considerable variation in the distances from the eye to the pin and from the pin to the hole can occur without destroying the effect. 3. The image seems to me to be close to the card in every case, while the distance from the eye to the card may vary a great deal. CLARENCE M. BOUTELLE

State Normal School, Winona, Minn., U.S., June 10

Resonance of the Mouth-Cavity

IN reply to Mr. George J. Romanes, I beg to say that the object of my communication printed in NATURE, vol. xxiv. p. 100, was to show that the mouth-cavity will give a distinct resonance to different rates of vibration *already in the air* by being shaped suitably for each of them (and providing they come within its limit). The mouth thus gives the means of analysing the composite nature of sound. Any one successfully repeating my experiments given on pp. 100, 126, would be satisfied that they pointed to something different to the boys' amusement mentioned in Mr. Romanes' letter (p. 166).

5, West Park Terrace, Scarborough JOHN NAYLOR

American Cretaceous Flora

IN several of the interesting and valuable papers on the Tertiary flora which Mr. J. Starkie Gardner has contributed to the English journals he has referred to the fossil plants in our Cretaceous rocks as representing a flora really Tertiary in character; and, influenced by the modern aspect of the plants contained in our Dakota group (Lower Cretaceous), he has expressed a doubt whether even that should be regarded as truly of Cretaceous age. In a former number of NATURE I endeavoured to show that our Dakota flora was Cretaceous, inasmuch as it is found in rocks which are overlain by several thousand feet of strata containing many mollusks, fishes, and reptiles which are everywhere recognised as Cretaceous, and none that are Tertiary.

Mr. Gardner was not however convinced by my facts or arguments, and in the April number of the *Popular Science Review* he reiterates and emphasises his formerly expressed opinion, referring all our Cretaceous strata to the Maestricht beds, and intimating that, in common with that formation, they should be separated from the Cretaceous system. His language is as follows:—

"The presence of *Mosasaurus* in the Maestricht beds, and the far newer aspect of its fauna, show that it must have belonged to an altogether different period, probably the one represented in America by a great so-called Cretaceous series containing a mixture of Cretaceous and Tertiary mollusks, dicotyledonous plants, and *Mosasaurus*. . . . .

"No American or European so-called Cretaceous land flora can be proved to be as old as our White Chalk."

Now in no spirit of criticism, for I appreciate and value the excellent work that Mr. Gardner is doing, but simply for the vindication of the truth of geology, I ask him to qualify these statements.

I am impelled to this course by the following facts:—

In our Triassic series we have in some places beds of coal and the remains of a vegetation decidedly Mesozoic in character, consisting of Cycads, Conifers, and Ferns, but, as far as we yet know, without a single Angiosperm.

In the Jurassic age the eastern half of the North American Continent formed a land-surface, for the sediments of the Jurassic sea are confined to a somewhat irregular area in and west of the Rocky Mountain belt.

Of the Jurassic flora of North America we as yet know little or nothing; but the continent that bordered the Jurassic sea ultimately became covered with a new, varied, and highly-organised flora, of which the origin is yet unknown.

In the Cretaceous age all the continent lying east of the Wasatch Mountains was affected by a subsidence which brought the sea in from the Gulf of Mexico with a front 1000 miles wide, and the great inland sea thus formed gradually extended northward till it reached nearly, if not quite, to the present shore of the Arctic Ocean.

The waves of the Cretaceous sea in their advance swept before them a shore that was covered with a luxuriant forest of at least one hundred species of Angiospermous trees; and the remains of trunks and twigs, leaves and fruit, were buried up in the sheet of beach material which accumulated all along the advancing shore line, and which now forms the Sandstones of the Dakota group. Up to the present time very few mollusks have been found in this group, and they are not sufficient to fix with exactness its relation to the Cretaceous series of other countries. The plants, too, are distinct from any found in Europe, though they include, with many extinct forms, genera which are common in the living forests of America, such as *Quercus salix*, *Magnolia*, *Fagus*, *Liquidambar*, *Liriodendron*, &c.

When the subsidence which produced the Dakota group was at its maximum the sea stood several thousand feet deep over the central portion of the trough between the Alleghanies and the Wasatch Mountains, and here we now find at least two thousand feet of marine, calcareous, organic sediment, which have furnished hundreds of species characteristic of the Cretaceous age, and a large number that are identical with those contained in the Upper Greensand and Chalk of Europe.

It is true that up to the present time no Neocomian fossils have been found in the interior of the Continent, but with that exception the entire Cretaceous series of the Old World is represented there. Hence it is not true that our Cretaceous "contains nothing so old as the Chalk."

Nor is it true, as intimated by Mr. Gardner, that our "so-called Cretaceous rocks" contain a Tertiary flora and fauna, as no Tertiary species of either has yet been found there. The flora of the Dakota group is more modern in its aspect than that of the Lower and Middle Cretaceous of Europe, but its plants are specifically different from any found in Europe in our Middle Cretaceous (Colorado group), Upper Cretaceous (Laramie group), or Tertiary beds (of Green River, Fort Union, and Oregon). The facts apparently indicate that the earliest development of Angiospermous plant-life took place here, and this in a *temperate flora* of which the descendants long afterwards—in Tertiary times—occupied Greenland, Spitzbergen, &c., and spread by land connections into Europe and Asia.

The best authorities we have had on questions relating to the Cretaceous fauna—Messrs Gabb and Meek—were fully agreed in regarding our Middle Cretaceous as of the age of the Chalk. Mr. Gabb divided the Cretaceous series of California into four members—

1. The Tejou group.
2. The Martinez group.
3. The Chico group.
4. The Shasta group.

Of these the oldest, or Shasta, group was regarded by him as of Neocomian age, the Chico and Martinez groups—which should perhaps be united—as the representatives of the Upper and Lower Chalk, and the Tejou group as the equivalent of the Maestricht beds.

The coal-beds and the fossil plants of Vancouver's Island lie at the base of the Cretaceous series as it exists there, and the molluscous remains indicate that it is the equivalent of the Chico group. The plants are apparently all distinct from those of the Dakota group of the interior. They include palms and cinnamons, and evidently grew in a warmer climate than that which produced the temperate flora of the Lower Cretaceous of Kansas, Nebraska, and the Atlantic coast.

Among the Vancouver Island Cretaceous plants is one well-known species, *Sequoia Reichenbachii*, H., which is found in

various localities in the Upper Greensand and Chalk of Europe, and also occurs at Kome.

The fossils collected by Mr. Richardson on Queen Charlotte's Island have been shown by Mr. Whiteaves to represent the very base of the Cretaceous series, and to include some forms that are rather Jurassic than Cretaceous. The plants of this group, though few and imperfect, seem to be chiefly Conifers, as in the oldest Cretaceous flora of Europe.

Our present knowledge of the age of the American Cretaceous flora may then be epitomised as follows:—

1. The oldest Cretaceous rocks known in North America, those of Queen Charlotte's Island, represent the Neocomian of Europe, and have so far furnished no Angiospermous plants.

2. The Shasta group of California, supposed to be the equivalent of the upper part of the Neocomian, has yielded no plants.

3. The coal-strata and plant-beds of Vancouver's Island, probably a little later than the Dakota group of the interior, contain many Angiosperms, and are of the age of the Gault or Upper Greensand. Lesquereux's identification of Vancouver's Island plants in the Laramie of Colorado and Eocene of Mississippi is evidently a mistake. There are no species common to these very distinct formations.

4. The Dakota group, the mechanical base of the Cretaceous series of the interior of the continent, which has yielded at least 100 distinct species of Angiospermous woody plants, is certainly older than the Chalk of the Old World.

5. The Raritan sands and Amboy clays of New Jersey, the lowest members of the Cretaceous on the Atlantic coast, contain a flora not less rich than that of the Dakota, with which it has a few species in common. This group of plants has not yet been described, but a large number of specimens are in my hands, from which drawings and descriptions are being made for the State of New Jersey. The flora is that of a temperate climate, consisting mainly of Angiosperms, but it also includes many beautiful Conifers.

6. The Colorado group, or great series of marine Cretaceous beds of the interior of the Continent, represents the strata known in the Old World as the Gray and White Chalk, and the Maestricht beds. Few plants have been obtained from this group in the United States, but I am informed by Dr. Dawson that an interesting collection of plants has been obtained from it on Peace River, in Canada. These will soon be described by him.

7. The Laramie group, or "Lignite series" of the central part of the continent, underlies unconformably the Coryphodon beds, the base of the Eocene, and is in my opinion the upper member of the Cretaceous system. Many of its plants have been described by Mr. Lesquereux in his "Tertiary Flora," but so far as my observation extends it contains no species identical with any found in unmistakable Tertiary rocks.

School of Mines, New York, May 20 J. S. NEWBERRY

GEORGE ROLLESTON, M.D., F.R.S.

PROF. ROLLESTON'S death, which took place at Oxford on June 16, and which we briefly announced in our last number, may well be called premature, as he was in the prime of life, and but a few months ago seemed to all, except a few closely observant intimate associates, still in the plenitude of his powers, and capable of much good work in time to come.

The son of a Yorkshire clergyman, he was born at Maltby on July 30, 1829, and had therefore not completed his fifty-second year. His early aptitude for classical studies, carried on under the instruction of his father, must have been most remarkable if, as has been stated in one of his biographies, he was able at the age of ten to read any passage of Homer at sight. He was not educated at one of the great public schools, but entered at Pembroke College, Oxford, took a First Class in Classics in 1850, and was elected a Fellow of his College in 1851. He then studied medicine at St. Bartholomew's Hospital, joined the staff of the British Civil Hospital at Smyrna during the latter part of the Crimean war, was appointed assistant-physician to the Children's Hospital in London, 1857, but took up his residence again at Oxford in the same year on receiving the appointment of Lee's Reader in Anatomy at Christ Church. In 1860 he was elected to the newly-founded Linacre Professorship of Anatomy and Physiology, which he held to the time of his death. He was elected a Fellow of the Royal Society in 1862, and a Fellow of Merton College, Oxford, in 1872. He was a member of the Council of the University, and its representative in the General Medical Council, and also an active member of the Oxford Local Board.

In 1861 he married Grace, daughter of Dr. John Davy, F.R.S., and niece of Sir Humphry Davy, and he leaves a family of seven children.

The duties of the Linacre professorship involved the teaching of a wide range of subjects included under the terms of physiology and anatomy, human and comparative, to which he added the hitherto neglected but important subject of anthropology, as well as the care of a great and ever-growing museum. In the present condition of scientific knowledge it requires a man of very versatile intellect and extensive powers of reading to maintain anything like an adequate acquaintance with the current literature of any one of these subjects, much more to undertake original observations on his own account. Even a man of Rolleston's powers felt the impossibility of any one person doing justice to the chair as thus constituted, and strongly urged the necessity of dividing it into three professorships, one of physiology, one of comparative anatomy, and one of human anatomy and anthropology. The work which he did however contrive to find time to publish, and by which he will be chiefly known to posterity, is remarkable for its thoroughness. He never committed himself to writing without having completely mastered everything that had been previously written upon the subject, and his memoirs bristle with quotations from, and references to, authors of all ages and all nations. The abundance with which these were supplied by his wonderful memory, and the readiness with which, both in speaking and writing, his thoughts clothed themselves with appropriate words, sometimes made it difficult for ordinary minds to follow the train of his argument through long and voluminous sentences, often made up of parenthesis within parenthesis.

The work which was most especially the outcome of his professorial duties is the "Forms of Animal Life," published at the Clarendon Press in 1870. Though written chiefly with a view to the needs of the university students, it is capable of application to more general purposes, and is one of the earliest and most complete examples of instruction by the study of a series of types, now becoming so general. As he says in the preface, "The distinctive character of the book consists in its attempting so to combine the concrete facts of zootomy with the outlines of systematic classification, as to enable the student to put them for himself into their natural relations of foundation and superstructure. The foundation may be wider, and the superstructure may have its outlines not only filled up, but even considerably altered by subsequent and more extensive labours; but the mutual relations of the one as foundation and the other as superstructure which this book particularly aims at illustrating, must always remain the same."

Besides this work, Prof. Rolleston's principal contributions to comparative anatomy and zoology are the following:—"On the Affinities of the Brain of the Orang Utang," *Nat. Hist. Review*, 1861; "On the Aquiferous and Oviductal System in the Lamellibranchiate Molluscs" (with Mr. C. Robertson), *Phil. Trans.* 1862; "On the Placental Structures of the Teurec (*Centetes ecaudatus*) and those of certain other Mammals, with Remarks on the Value of the Placental System of Classification," *Trans.* Zool. Soc. 1866; "On the Domestic Cats of Ancient and Modern Times" (*Journal of Anatomy*, 1868); "On the Homologies of Certain Muscles Connected with the Shoulder-Joint" (*Trans.* Linn. Soc., 1870); "On the Development of the Enamel in the

Teeth of Mammals" (*Quart. Journ.* Micros. Soc., 1872); and "On the Domestic Pig in Prehistoric Times" (*Trans.* Linn. Soc., 1877).

Latterly he did much admirable work in anthropology, for which he was excellently qualified, being one of the few men who possess the culture of the antiquary, historian, and philologist on the one hand, and of the anatomist and zoologist on the other, and could make these different branches of knowledge converge upon the complex problems of man's early history. The chief results of his work of this nature are contained in his contribution to Greenwell's "British Barrows" (1877), a book containing a fund of solid information relating to the early inhabitants of this island. In this department of science Prof. Rolleston stood almost alone in this country, and we know of no more fitting tribute which the University of Oxford could pay to his memory than to found a chair of anthropology, a subject in the cultivation of which England is fast being outstripped by every other civilised nation. His last publication, and one which is on the whole the most characteristic as exhibiting his vast range of knowledge on many different subjects, was a lecture delivered in 1879 at the Royal Geographical Society on "The Modifications of the External Aspects of Organic Nature produced by Man's Interference."

That Dr. Rolleston has not left more original scientific work behind him is easily accounted for by the circumstances under which he lived at Oxford. The multifarious nature of the subjects with which the chair was overweighted; the perpetual discussions in which he was engaged consequent upon the transitional condition of education both at Oxford and elsewhere during the whole term of his office; the immense amount of business thrust upon him, or which he voluntarily undertook, of the kind that always accumulates round the few men who are at the same time capable and unselfish, such as questions pertaining to the local and especially the sanitary affairs of the town in which he lived, or connected with the reform of the medical profession, both in and out of the Medical Council, which constantly brought him to meetings in London; his own wide grasp of interest in social subjects, and deep feeling of the responsibilities of citizenship, and his sense of the duties of social hospitality, which made his house always open to scientific visitors to Oxford; all these rendered that intense concentration requisite for carrying out any continuous line of research impossible to him.

He was often blamed for undertaking so much and such diverse kinds of labour, so distracting to his scientific pursuits; but being by constitution a man who could never see a wrong without feeling a burning desire to set it right, who could never "pass by on the other side" when he felt that it was in his power to help, nothing but actual physical impossibility would restrain him. For several years past, when feeling that his health and strength did not respond to the strain he put upon them, he resorted to every hygienic measure suggested but one, and that the one he most required, rest; but this he never could or would take. During the last term he spent at Oxford, before his medical friends positively forced him (though unfortunately too late) to give up his occupations and seek change in a more genial climate, he was working at the highest pressure, rising every morning at six o'clock, to get two uninterrupted hours in which to write the revised edition of the "Forms of Animal Life" before the regular business of the day commenced.

It is impossible for those who had no personal knowledge of Rolleston to realise what sort of a man he was, and how great his loss will be to those who remain behind him. No one can ever have passed an hour in his company, or heard him speak at a public meeting, without feeling that he was a man of most unusual power, of lofty sentiments, generous impulses, marvellous energy, and wonderful command of language. In brilliant repartee, aptness of quotation, and ever-ready illustration from poetry, history, and the literature of many nations and many subjects, besides those with which he was especially occupied, he had few equals. "In God's war slackness is infamy" might well have been his motto, for with Rolleston there was no slackness in any cause which he believed to be God's war. He was impetuous, even vehement, in his advocacy of what appeared to him true and right, and unsparing in denunciation of all that was mean, base, or false. To those points in the faith of his fathers which he believed to be essential he held reverently and courageously, but on many questions, both social and political, he was a reformer of the most advanced type. Often original in his views, always outspoken in giving expression to them, he occasionally met with the fate of those who do not swim with the stream, and was misunderstood; but this was more than compensated for by the affection, admiration, and enthusiasm with which he was regarded by those who were capable of appreciating his nobility of character. The loss of the example afforded by such a nature, and of his elevating influence upon younger and weaker men, is to our mind a still greater loss, both within and without the University in which he taught, than the loss of what scientific work he might yet have performed.

Dr. Rolleston's personal appearance corresponded with his character. Of commanding height, broad-shouldered, with a head of unusual size, indicating a volume of brain commensurate with his intellectual power, and with strongly-marked and expressive features, in which refinement and vigour were singularly blended, in him we saw just such a man as was described by the public orator at the late Oxford Commemoration, in words with which we may conclude this notice—"Virum excultissimi ingenii, integritatis incorruptissimæ, veritatis amicum, et propugnatorem impavidum." W. H. F.

THE ZOOLOGICAL SOCIETY'S INSECTARIUM

IN our notice of this recent addition to the Regent's Park collection (*antea*, vol. xxiv. p. 38) we regret to find we have made an error in the name of the curator of the Insectarium. Mr. *William* Watkins (not *E.* Watkins as there given) has made many good additions to the collection of living insects under his charge since we last wrote, and attracts a host of visitors every day to inspect his living wonders. In a report on the Insectarium read at a recent scientific meeting of the Zoological Society by the secretary, Mr. Watkins gave the subjoined account of the progress of the development of the large moths of the family Bombycidæ during the month of May.

GLOVER'S SILK-MOTH (*Samia Gloveri*).—Specimens of this species emerged almost daily through the month, and fertile eggs were obtained, which hatched on the 12th instant. The larvæ when hatched are a shining black, with numerous spines of the same colour; after the first change, which took place in six days, they assume a yellowish colour; at the second moult they become green with paler coloured spines, each tipped with bright red. A choice of many shrubs were given them, but although they ate plum and sallow they left these for gooseberry.

CECROPIAN SILK-MOTH (*Samia Cecropia*).—This species emerged through the month, and copulation was frequent. A large number of eggs were obtained, but many are not fertile, perhaps owing to the stock already having been interbred. Young larvæ hatched on the 14th instant, and are growing well. Food-plant, plum.

AILANTHUS SILK-MOTH (*Attacus Cynthia*).—This species commenced to emerge towards the end of the month, but only four specimens have yet appeared. It is usually the latest species of all.

PERNY'S SILK-MOTH (*Attacus Pernyi*).—Perfect insects of this species were on view throughout the month. Fertile eggs were obtained, which commenced to hatch on the 30th instant, and are doing well. Food-plant, oak.

TUSSEH SILK-MOTH (*Attacus mylitta*).—This species commenced to emerge on 28th instant, a beautiful male being bred; on the following day a male and female emerged. Eggs were obtained, which are probably fertile.

GREAT ATLAS MOTH (*Attacus Atlas*).—Throughout the latter half of the month specimens of this species have emerged, and many fine ones have been preserved. Eggs will probably be obtained later; there are many more still to come out.

INDIAN MOON-MOTH (*Actias selene*).—This first specimen of this species emerged on the last day of the month.

AMERICAN MOON-MOTH (*Actias luna*).—During the early part of the month specimens of this species emerged. Eggs have been obtained, but it is doubtful if they are fertilised.

PROMETHEAN SILK-MOTH (*Telea Promethea*).—The cocoons of this species have as yet only produced a large ichneumon fly (*Ophion*). Many visitors have evinced great interest on seeing these large parasites produced from externally perfectly-formed Lepidopterous cocoons and internally stout well-made oval cocoons of the Hymenoptera.

JAPANESE OAK SILK-MOTH (*Antheræa Yama-mai*).—The larvæ of this species produced from eggs have done fairly well; many are now nearly full fed and about to spin. Food-plant, oak.

Besides these fine silk-moths, which are in many cases likely to be of economical value, Mr. Watkins has succeeded in breeding during the past month examples of many of the finer European butterflies, such as the swallow-tail, orange-tip, black-veined white, and *Apatura ilia*, not to mention numerous Heterocera, Hymenoptera, and Neuroptera. During the present month also many additions have been made to the series.

A guide-book to the Insectarium is in preparation, not, as we are assured, with any idea of forcing visitors to buy it, as every object exhibited is fully and perfectly labelled, but rather for the purpose of making the Insectarium better known, and getting further contributions to it from foreign parts.

DR. BESSELS' ACCOUNT OF THE "POLARIS" EXPEDITION[1]

DR. EMIL BESSELS, as most of our readers will remember, was the chief of the scientific department on board the ill-fated *Polaris*, which was sent on her memorable North Pole Expedition by the United States Government in 1871. He finished the text of the present work in the summer of 1874, shortly after the return of the expedition, but postponed the publication until after the appearance of the official account of the voyage, which was edited by Rear-Admiral Davis. He had the misfortune to lose the greater part of his journal and many other papers in his luggage during a railway journey in Scotland.

The remarkable story of the *Polaris* Expedition is well known. Including Captain Hall, the commander of the expedition, the entire number of persons on board the *Polaris* was thirty-three. Of these eight were Esquimaux, consisting of two married couples and their four children, three little girls of ten, eight, and three years of age, and a boy of six. Another boy, who was named Polaris, was born during the voyage in Polaris Bay, on board the vessel. Two of those on board, besides Dr. Bessels, were scientific men, namely, Messrs. R. D. W. Bryan, astronomer, and Friedrich Meyer, meteorologist.

[1] "Die amerikanische Nordpol Expedition," von Emil Bessels. Leipzig: W. Engelmann, 1879.

The highest point reached by the *Polaris* was lat. 82° 26′ N. at the northern mouth of Robeson Channel. After being beset by ice and having been nipped sufficiently to render her extremely leaky, the ship was moored for the winter about forty miles south of this point in Thank God Harbour, on the east side of Robeson Channel, to the north of Petermann Fjörd. Several sledge expeditions were made from this point, but without reaching a higher latitude than that attained by the ship. Capt. Hall died on board on November 8. In the following summer attempts were made in vain to push further northward, and it was found the ship leaked so badly that it was necessary to return homewards. The ship became beset in the ice on August 16, and remained thus, drifting southwards with the field, suffering constantly from ice-pressure, until October 15, when it was in such jeopardy from the ice-movements that most of the provisions and stores of all kinds and all the boats were passed out on to the ice. The ice parted suddenly, and drifted away from the ship with nineteen persons upon it, including all the Esquimaux, whilst fourteen, and amongst them Dr. Bessels, remained on board. This took place at night. The castaways remained upon the ice 196 days, suffering terrible hardships, and having drifted to the coast of Labrador, were there picked up by a sealing-ship, even the children having survived. They saw the *Polaris* in shore at the commencement of their long journey, and wondered their comrades did not come to their assistance, not knowing that the ship was practically a wreck, and abandoned. Those left on the ship at

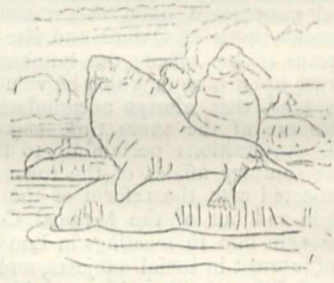

FIG. 1.—Walruses at rest on the ice.

the parting of the ice, keeping the leaking ship with difficulty afloat, and unable to see anything of those on the ice, got ashore near Cairn Point in the middle of Smith's Sound, and having wintered there in company with some Esquimaux families, built some boats from the wreck, and travelling south partly in these, partly on the drift-ice, were picked up in the west of Melville Bay by a whaler, the *Ravenscraig*, on June 23. Thus all engaged in the expedition, excepting Capt. Hall, got back in safety.

All this is related by Dr. Bessels in a most graphic and highly interesting style, and his book is filled besides with interesting accounts of the habits of animals met with, the condition of the vegetation of the region explored, the mode of life of the Esquimaux, meteorological and other scientific observations. We shall touch on a few of these. At Fiskernæs, on the south-west Greenland coast, the author turned over some of the kitchen middens of the Esquimaux, such as are now formed in front of each hut. In a very short time remains of all the eatable vertebrates of the Greenland fauna are to be found in them, and in many cases it would not be difficult to fix the season at which the deposits were made, for in places are found scarcely anything but bird-remains, in other places those of fish, in others those of mussels. Many good dogs' skulls and a number of marrow bones of seals broken for their marrow were found in the middens. At the same place one of the sailors of the *Polaris* nearly lost his life by attempting to perform the feat which most of the Esquimaux accomplish with such ease, of turning their kajak upside down without leaving

their seat, and then righting themselves from under water with a blow of their paddle.

Some interesting remarks are made on the calls used by various Esquimaux tribes whilst dog-driving. All the Esquimaux of that part of Greenland, which is under missionary influence, drive their dogs with the call *i! i! i!* and accompany the sound with a smack of the whip to the right or left when they wish to turn, whilst the dogs are

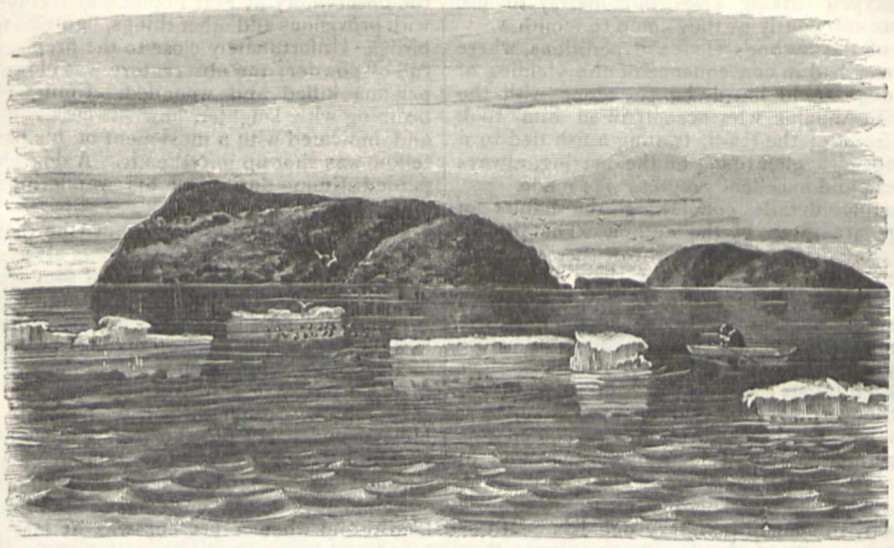

FIG. 2.—Littleton Island.

stopped by a short whistle. The Esquimaux tribe on the side of Smith Sound use similarly the sound hă! hă! hă! and as a halting signal a lengthened ōh! Those inhabiting the neighbourhood of Ponds Bay, as one of the Esquimaux on board the ship informed the author, use the call wōă-âh-hă-hă-hă! to turn their dogs to the

FIG. 3.—Group of Ita Esquimaux huts with *Polaris* House and the wreck in the distance.

right, and âh-wōă-wă-hă! to send them to the left; ōh! for halt. The calls used in Cumberland, a district of Baffin's Land, are somewhat similar sounds to the last; formerly they were more like them still, but have changed. The natives on the shores of the Hudson's Straits use only the call au! au! au! and those of King

William's Land only kgu! kgu! kgu! Amongst these two latter tribes the whip is almost unknown; the dogs are led or turned from side to side by means of a piece of wood which the driver throws out on the side from which they are to turn. The Esquimaux of Alaska appear to have no stereotyped driving cries, but merely to use various oaths promiscuously as they come to mouth.

During one of the author's sledge expeditions, where the going was very bad in consequence of the yielding of the snow, the dogs could hardly be got along with the whip, so two Esquimaux who accompanied him took turns to run in front of the team, trailing a fish tied to a string. The dogs struggled to get at the herring, always out of their reach, and excellent progress was made.

Some interesting details concerning the habits of Esquimaux dogs are given by the author. The instant halt is called by the driver the dogs throw themselves to the ground with their snouts between their forepaws; they rise again to stretch, and then lie down again at once. Two Newfoundland dogs which belonged to the *Polaris* pack gradually assumed similar habits; but before lying down they always turned round and round in their resting-place, like all dogs except the Esquimaux breed, for the author never saw an Esquimaux dog do this. Mr. Darwin, as will be remembered, has explained this habit of turning round before lying down, invariably to be observed in other domestic dogs, as a survival of the instinct of the wild ancestor, which leads him to form a bed in the grass by this means. Every one has heard of the extraordinary voracity of the Esquimaux dogs; they will even sometimes snap off a piece of their master's flesh if carelessly exposed. One day, on board the *Polaris*, the porcelain door-handle of one of the cabins fell off with the usual square rod of iron attached to it. Five or six of the dogs made a rush at it, there was a momentary struggle, the dogs were hastily driven away, but the door knob was already swallowed. The dog that ate it was none the worse, nor the handle either in the end. An Esquimaux told the author that the following were the points to be noticed in selecting a good dog:—a broad breast, short ears, strong legs, large feet, low loins, and a moderately long tail. The tail must not bend too near its root, as this shows the loins to be weak.

The descriptions of the Esquimaux and their habits throughout the work are worth reading. The most interesting are those relating to the Ita Esquimaux, inhabiting the north shore of the Foulke Fjörd, with whom the author and his companions spent their second winter. They consisted of nine men, three women, and eight children, who crowded at night the small house built by the shipwrecked party, and as there was no room for them usually to lie down, slept sitting with their backs against the walls. The floor measured only twenty-two feet by six, yet had to accommodate thirty-four persons, and once thirty-eight. It was no use erecting a tent for the visitors under the lee of the house; they preferred the close quarters inside.

The author's principal friend was Awatok, the priest of the tribe. He usually accompanied him when it was his watch, on his hourly rounds to the meteorological instruments. "We walked generally arm-in-arm, and when there was no snow drifting sang the tune of the spirited student's song, 'Was kommt dort von der Höh',' using bum—bum—bum instead of the words. After a little while he learnt to hum the tune fairly well." After some time the natives built snow huts near the *Polaris* house, and settled for the winter. The first to do this was one named Stokirssuk, but called "Jimmy" by the *Polaris* people. He was born near Cape Searle, about 650 miles south of Port Foulke. Whilst he was a youth he and his father left their home and wandered north and reached Cape Isabella, where they fell in with an Esquimaux tribe, of whose existence they had been ignorant. Here Jimmy married a wife with tattooed face, and five summers before the arrival of the *Polaris* had moved up thence to Ita, in a company consisting of a woman's boat and four kajaks. He had forgotten how many persons composed the expedition. They found Capt. Hayes' lifeboat on Littelton Island and destroyed it, and discovering the observatory at Port Foulke which Hayes had left filled with provisions and other things, lighted a fire there to cook birds. Unfortunately close to the fireplace was a canister full of powder; the observatory was blown up, and several persons killed and wounded. Jimmy related, his face beaming with laughter, how his father-in-law was killed, and indicated with a movement of his hand how the old fellow was shot up into the air. A dog which had accompanied Jimmy during all his wanderings was still fresh and strong.

Another noticeable native of the band was Majuk Kane's former companion; he was always hungry and a beggar. He named his youngest son, scarcely six weeks old, Dâkta-kè, which meant no more or less than Doctor Kane. This he did in order to flatter the *Polaris* people and ingratiate himself. Sometimes he brought a walrus liver or a few tongues, and got bread or tinned meat for them, at others a skin to get a harpoon for it. But in some moment, when unwatched, he would eat the tongues himself and carry off the liver again; but he did it so innocently that it was impossible to be angry with him. At one time during the winter the Esquimaux were nearly starving, yet one of them—Awatok—would not beg for his family, and when a present was at last sent to him of bread and bacon, had already killed five of his dogs to keep his wife and children alive. His strength of character and power of self-denial were remarkable.

The Ita people have no boats, and do not possess the bow and arrow, although words for these things still exist in their language. These facts show a very remarkable degradation, especially in a hunting people. Jimmy alone had a bow and three arrows. They had often been mended, and being very seldom used, were in a wretched condition, and Jimmy himself was a very bad shot.

One burial took place during the stay of the author. The corpse was wrapped in skins placed on a sledge, and buried in the snow with the face turned westwards. After the body was covered the sledge was turned over on top of it, and the hunting implements of the deceased laid by it. The men plugged their right nostril with hay, and the women their left, and these plugs were worn for several days, and only taken out when the wearers entered a hut. When it is possible a heap of stones is usually raised over the corpse. The nineteenth chapter is devoted to an ethnological sketch, in which the culture and characteristics of the various Esquimaux tribes are compared.

A good many musk-oxen were met with, and the author gives a valuable account of the habits of this animal. None of those killed by the *Polaris* people had a very marked musk smell. The author is uncertain whether this peculiarity is to be attributed to the very high latitude in which they were obtained, or to their having been killed out of the breeding season. No difficulty was found in distinguishing the tracks of these animals from those of reindeer, although some former observers have not found this easy. In all the herds there are from ten to twenty cows to one bull. Their voice is somewhat like the snorting of the walrus, and never resembles in the least the cry of the goat or the sheep. When danger approaches they never give signal with their voice, but only by stamping or striking their neighbour with their horns. They have dire combats with bears sometimes, and often come off victors.

A report, as will be remembered, was spread by newspapers at the time of the return of the expedition, that the *Polaris* had discovered walnut driftwood in the high north, and gave the author as an authority for the statement. Nothing however but coniferous wood was in reality

found. One of the most important matters contained in the book is the author's account of a Bathybius-like albuminous substance which he discovered in the mud composing the sea-bottom, at a depth of ninety or ninety-five fathoms north of Smith Sound. The specimens of mud were brought up in a water-bottle apparatus, about a large spoonful being obtained each time of sounding. This mud was very sticky, and showed itself under the microscope to consist of a yellowish gray mass with numerous opaque lime particles embedded in it. If some of the mud was left to rest in a hollowed out glass slip for some time the albuminous masses exhibited unmistakable amœboid movements, and took into their substance particles of larmine. The substance is named *Protobathybius*.

We cannot follow the author further. His book is well worth reading, and only escaped notice here sooner through accident. It is well illustrated throughout. He takes exception on the ground of priority to the name Palæocrystic Sea, which Sir George Nares conferred upon the expanse which the Americans had previously named Lincoln Sea. He states that, owing to the neglect of his work by an assistant, numerous serious errors occur in the official volume of scientific results of the *Polaris* expedition already published, especially in the meteorological department. These are corrected in the appendix to the present volume, which contains also much other scientific matter. He finds fault throughout his book with the conduct of the ice-master of the *Polaris*, S. O. Buddington, and considers that the ship might have reached higher latitudes if, on two occasions which he believes were favourable, a push had been made northward. He accuses Buddington of not even going up into the crow's-nest as often as he should have done to examine the state of the ice. Some official correspondence which passed on board the ship on these questions of the management of the expedition is given in the book. The manner in which the meteorological observations were kept up after the shipwreck, and the devotion with which Dr. Bessels attempted, though in vain, to sledge far north after the wreck from *Polaris* house are highly creditable.

The book is dedicated to the Arctic explorer, Capt. A. H. Markham, R.N., who with great kindness, and at very considerable inconvenience, shared his cabin on board the whaler *Arctic* with Dr. Bessels on the voyage to Dundee, the *Ravenscraig* having fallen in with the *Arctic* on the whaling-grounds. H. N. MOSELEY

THE COMET

THE comet which, so far as we are yet informed, was first astronomically observed in the southern hemisphere on May 29, is now well under observation in these latitudes, and as its position will become more and more favourable, it will be a mere question as to how long our telescopes will show it, what data may be obtained for an accurate determination of its orbit. The elements appear to have some resemblance to those of the great comet of 1807, to which reference was made in Dr. Gould's early telegram from the observatory at Cordoba, but the identity of the comets appears highly improbable after Bessel's classical memoir containing a rigorous investigation of the orbit of the comet of 1807, which he followed until the perturbations of the known planets had ceased to be sensible. We may briefly recall the circumstances attending the appearance of that body and one or two main results of Bessel's investigation. According to Piazzi it was first detected by an Augustine monk at Castro Giovanni in Sicily on September 9, but the first regular observation was made on the 22nd of the same month by Thulis at Marseilles. From this time the comet's positions were determined at every opportunity by Bessel, Olbers, Oriani, and others until the end of February, 1808, and on the 18th of the following month Wisniewsky, favoured by a very acute vision and the clear skies of St. Petersburg, observed the comet again, and succeeded in fixing its position until the 27th. In consequence of a notification from Olbers, that with powerful telescopes there might be a possibility of observing the comet again as the earth overtook it to some extent in October and November of the same year, Bessel, then working with Schroeter at Lilienthal, closely examined its track with reflectors of 15 and 20 feet focal length, and on November 9 did succeed in finding an extremely faint nebulosity near the computed place of the comet, which he could not find subsequently, but as the position differed 12′ from that assigned by an orbit which he considered very exact, he came to the conclusion that the object he observed was not the comet of 1807, but another one which happened to be in the vicinity, and which was not seen elsewhere. The discussion of the six months' observations of the comet appears in the masterly treatise to which we have referred, viz., "Untersuchungen über die scheinbare und wahre Bahn des im Jahre 1807 erschienen grossen Kometen," published at Königsberg in 1810. The method of determining the perturbations of a comet due to planetary attraction, which is detailed in this memoir, was long practised by the German astronomers in similar cases.

Bessel inferred from his researches that at the perihelion passage of the comet on September 22 it was moving in an ellipse, with a period of revolution of 1714 years, which was reduced to 1685 years at the date of Wisniewsky's last observation, and continuing his computation of the perturbations to March, 1815, when the effect of planetary attraction had become very small, he found the period further reduced to 1543 years.

The general aspect of the comet now visible as viewed in an excellent *Cometen-sucher*, reminds us of the appearance of the comet of June, 1845, discovered by Colla, which was observed under very similar circumstances, and it may be mentioned that Encke stated at the time that the comet of 1845 reminded him strongly of the great comet of 1819, which passed across the sun's disk on June 26.

The present comet appears to have been at its least distance from the earth about June 21, and should soon present a material diminution of brightness. In perigee its distance would be about 0·3.

[Since the above was in type we have received observations from Dr. Elkin, of the Royal Observatory, Cape of Good Hope: After a week of overcast sky the comet was found there on May 31. Mr. L. A. Eddie, F.R.A.S., of Graham's Town, saw it on May 27, and others claim to have seen it two days earlier. On June 4 the tail was 6° long, coma 20 minutes, and nucleus 20 seconds in diameter; the comet was as bright as *a* Columbæ.]

The following opinions of American astronomers have appeared in the *Daily News*. That paper, with wonderful journalistic enterprise, has not hesitated to telegraph nearly a column of matter from America on this subject:—

"Prof. Stone, of the Cincinnati Observatory, thinks it is not the comet of 1812, because of its not moving in a southerly direction, but that it may possibly be that of 1807. Professors Eastman and Skinner, at the Naval Observatory, succeeded in getting some fair observations of the comet on Friday night, although the night was not altogether favourable. Prof. Skinner describes the comet as having an extremely bright nucleus, which presented a very ruddy appearance. The observers did not know whether this appearance was normal, or was due to the prevailing atmospheric conditions. Prof. Skinner estimates the tail, which is fan-shaped, at about eight degrees in length. It was also ascertained that in twenty-two minutes the comet travelled three seconds in arc, and in an hour nine seconds, giving it a daily rate of travel northward of about three degrees thirty-six seconds. Computing its motion from its position when discovered,

Prof. Skinner found that in two days and a quarter the comet moved about ten degrees. On Saturday morning it became distinctly visible at 1·45, and could be seen until the sun rendered invisible all the stars except Venus. The astronomers at the observatory maintain their opinion that this comet is identical with the one recently observed by Dr. Gould in Buenos Ayres. Prof. Skinner describes it as a much finer comet than Coggia's, which appeared in 1874, and brighter than any since that which appeared in 1843.

"Prof. Newcomb said that as all the observations made on the comet of 1807 showed it to have a period of nearly 1700 years, it seems out of the question that under any circumstances the same comet could have returned in so short a time as seventy-four years, unless it has passed in the vicinity of some larger planets, which it could not have done. From Dr. Gould's telegram it may be inferred that the comet was very near the orbit of that of 1807 when he observed it. Prof. Newcomb is inclined to think that it is a case of two comets moving in nearly the same orbit, rather than the return of the same comet. One reason for this is that if it had been a periodical comet returning every seventy-four years, it could not have failed to have been observed on former occasions, because it would have returned in 1734 and in 1760. In neither of these years was any such comet observed. The position of its orbit is such that it could hardly have failed to be seen had it returned. Prof. Henry Draper has photographed the comet. To obtain such a photograph as he would like, he said, the plate ought to be exposed for at least an hour, but he had succeeded in getting an exposure of only seventeen minutes. The result, however, was satisfactory, in so far that it demonstrated the possibilities of photographing a comet. It showed the nucleus and the coma and part of the tail. He will try again to obtain a longer exposure. He wishes to take a larger photograph if possible, to examine more carefully the structure of the tail; but the larger the photograph, the more difficult it is to obtain, owing to the diffusion of the light. If he succeeds in obtaining two good photographs he will next turn his attention to its spectrum, which is much more difficult to photograph than the orb itself.

"Prof. Bois, of Dudley Observatory, at Allebuy, secured a number of valuable observations. He says that at two o'clock on Saturday morning its appearance both to the naked eye and in a telescope was magnificent. The head of the comet was very bright, and the tail thirty or forty minutes broad, extending nearly 20° toward the North Star. The tail was very diffused and nebulous, spread out in fan-like form. Looking in the great telescope of thirteen inches aperture, a multitude of details became revealed which are not visible to the naked eye. The head was there seen to consist of a condensed nucleus, apparently about as large as Jupiter seen in a telescope, but of far greater intensity of light. A spray of brilliant rays spread out from the nucleus on the side nearest the sun, then, turning backward, mingled with the elements which form the tail. This resembled the jet of a fountain very closely in its general features. The tail itself extended in a direction diametrically opposite the sun. The whole field of the telescope was filled with glowing nebulosity. I am inclined to think that this comet has not been seen before this year, in modern times at least. It is probably the same comet as seen in South America. It is now certain that this is not the long-expected comet of 1882. It is almost equally certain that it is not the comet of 1807. The period of the comet of 1807 is about 1,700 years. Prof. Swift of Rochester says the comet grows smaller and brighter in nucleus, showing that it is approaching the sun. The head is active, and the tail does not obscure the stars. He thinks it will be visible several weeks. He cannot yet determine if the comet was ever before seen. Great activity is apparent in its head."

M. Janssen has presented to the Academy of Sciences, at its sitting of June 27, the *cliché* of a photogram of the comet, which was taken with the large telescope he described a few weeks ago, constructed for the purpose of astral photography. He obtained also a series of photograms of the nucleus, for which he varied the time of exposure. The results prove that the brightness is not more than that of a star of the fifth magnitude. On the photograph, which will be printed in NATURE, and which our correspondent has examined, the stars are visible through the tail. M. Faye delivered a speech praising the success realised by his colleague, and remarking that it was the first time that a comet had been photographed. The opinion that the tails of comets are merely an illusion, as professed by Seneca in his "Quæstiones Naturales," seems to gain ground, owing to the extraordinary transparency of these appendages.

WE have received the following communications :—

THE following positions which I obtained of the path of the comet may interest your readers :—I saw it first on Wednesday, June 22, at 10.55, during a break in the clouds for about a minute. It was then brighter than it was last night, the 27th, when I saw it well, the sky being clear. The colour is of an orange tinge, and the tail extends to about 10°, but can only be seen so far by sweeping across it. It has changed wonderfully since I first observed it, as will be seen by the drawings which I send you. The No. 1 Drawing shows a most singular appendage round the nucleus, in shape like a milkmaid's yoke, the nucleus occupying the hollow, which was black. From the nucleus two horns projected; they were as bright as the nucleus.

FIG. 1.

The first envelope on the preceding side took a sudden bend from the circular form to a straight line, while the outer envelope retained its parabolic form.

Last night, the 27th, I was surprised to find a great change had taken place—the yoke-shaped central luminosity appeared as if it had turned round in the nucleus

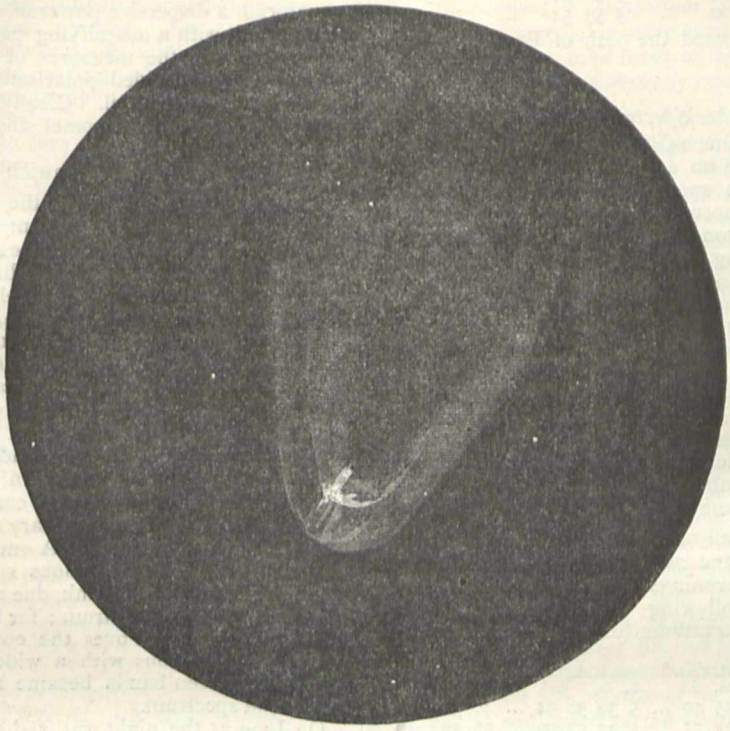

FIG. 2.

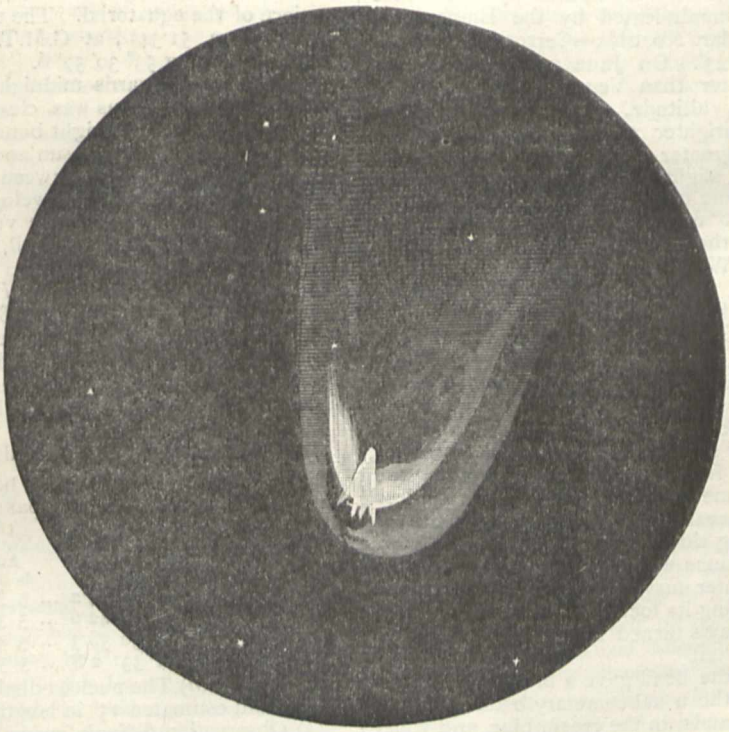

FIG. 3.

and occupied the usual position, while the nucleus itself had thrown out a bright tail, which gave it the appearance of a small comet lying across the bright envelope (Figs. 2, 3). The outer envelope on the following side was interrupted in its continuity, or seemed wanting.

The positions I got are as follows:—

	h. m.	R.A. h. m. s.	N.P.D. °
June 23 ...	11 0 ...	5 33 59 ...	44 55
25 ...	10 0 ...	5 41 41 ...	36 52
27 ...	10 0 ...	5 50 34 ...	29 50
27 ...	12 0 ...	5 55 54 ...	29 42

so that last night it crossed the path of Brorsen's comet of April 30, 1879. R. S. NEWALL

Ferndene, June 28

Photographic Spectrum of Comet

On Friday night (June 24) I obtained, with one hour's exposure, a photograph on a gelatine plate of the more refrangible part of the spectrum of the comet which is now visible. This photograph shows a pair of bright lines a little way beyond H in the ultra-violet region, which appear to belong to the spectrum of carbon (in some form) which I observed in the visible region of the spectra of telescopic comets in 1866 and 1868. There is also in the photograph a continuous spectrum in which the Fraunhofer lines can be seen. These show that this part of the comet's light was reflected solar light.

This photographic evidence supports the results I obtained in 1868, showing that comets shine partly by reflected solar light, and partly by their own light, the spectrum of which indicates the presence in the comet of carbon, possibly in combination with hydrogen.

Upper Tulse Hill, June 27 WILLIAM HUGGINS

COMET 1881 *b* was well observed at the Royal Observatory, Greenwich, on June 24 and 25. Its position was determined on both evenings with the altazimuth and transit-circle. The following are the places deduced from the meridian observations (uncorrected for parallax and aberration) :—

	G.M.T. h. m. s.	R.A. h. m. s.	N.P.D. ° ′ ″
1881 June 24 ...	11 25 40 ...	5 38 38·94 ...	40 36 39
25 ...	11 25 55 ...	5 42 51·06 ...	36 39 30

The observation on June 25 indicates the following corrections to the ephemeris computed by Mr. Lohse from the elements communicated by the Emperor of Brazil (Dunecht Circular, No. 21) :—Correction in R.A. + 9m., in Dec. + 6° 23′. On June 24 the head was estimated to be brighter than Vega or Arcturus, notwithstanding its low altitude, and on June 25 it appeared decidedly brighter than Arcturus, the star being at about 10° greater altitude than the comet. The tail, which was slightly curved (convex towards the preceding side), was traced to a distance of about 8° on June 24, and 10° or more on June 25, its general direction pointing to the star 2 Ursæ Minoris, about 3° east of Polaris. With the Sheepshanks equatorial (6¾ inches aperture) the head showed the want of symmetry that has been remarked in some other comets. On June 24 the preceding side was much the brighter, there being a strong brush or arc of light on that side, with a bright fan close to the nucleus and a much smaller arc on the following side, the two arcs appearing to spring from the nucleus on opposite sides, and higher up to interlace. A very remarkable feature was a straight wisp of light extending from the nucleus nearly along the axis of the tail. On June 25 this had become much less striking, and the appearance of the head had entirely changed. The following side was then much the brighter, and the general appearance was that of a parabolic envelope, with a much brighter unsymmetrical parabola placed within it, the latter having its focus on the following side of the nucleus, and its axis turned round in the direction *n p s f* from that of the tail.

The greater part of the head gave a bright continuous spectrum, obliterating the usual cometary bands, but one portion showed three bands, in the green, blue, and violet respectively. Measures of the principal band in the green showed that it coincides with the band in the first spectrum of carbon (blue base of flame) at 5165, and not with that of the second spectrum (vacuum-tube) at 5198. The bands in the blue and violet appeared to correspond, as nearly as could be estimated, with bands in the first spectrum of carbon. These observations were made with the half-prism spectroscope mounted on the 12¾-inch equatorial, a dispersive power of about 18½° from A to H being used, with a magnifying power of 14 on the view-telescope, as in the measures of star-motions in the line of sight. No decided polarisation was detected either in the head or the tail. Cloudy weather has prevented any observation of the comet since June 25.

W. H. M. CHRISTIE

Royal Observatory, Greenwich, June 28

IN a letter to the *Times* of the 25th inst., Mr. Ranyard says of Comet *b* 1881, at present visible in the northern heavens :—"In general brightness it decidedly outshone the star Capella. . . . With a direct-vision spectroscope of five prisms, and a 3½-inch telescope, its nucleus and head gave a continuous spectrum, on which I could not detect any bright bands." Last night, June 27, shortly before midnight, the brilliancy of the nucleus had considerably decreased, and yet with a five-prism direct-vision spectroscope I could see most clearly, along with the continuous spectrum, three green bands, not only in the nucleus, but also in the surrounding coma. Two of the bright lines were still strong in the neighbourhood of the nucleus, even where the continuous spectrum was very faint. I used an ordinary Browning spectroscope on an 8-inch achromatic. A small McClean's spectroscope gave only the continuous spectrum, as seen by Mr. Ranyard. This was, I think, due merely to the brightness of the continuous spectrum ; for in the Browning instrument the bright lines over the continuous spectrum were not very conspicuous with a wide slit, but on narrowing the slit the green bands became much brighter than the rest of the spectrum.

On June 25 the night was rather cloudy, but good observations for position were obtained by observing the transit of the comet and of δ Aurigæ over the wires of an eyepiece of the equatorial. The mean of four wires gave R.A. 5h. 42m. 51·34s., at G.M.T. 12h. 11m., the North Declination being 53° 30′ 57″·6.

On June 27, towards midnight, the double envelope surrounding the nucleus was clearly defined in the telescope, as was also the bright bundle of rays, which spread out in the direction of the sun and extended to a point in the coma about half way between the bounding lines of the inner and the outer envelopes. The direction of these bright rays, which were very vivid, was not quite opposite the direction of the tail, and the latter was very slightly curved.

A transit of the comet, *sub Polo*, was observed last night, June 27, at G.M.T. 11h. 38m., and this, combined with the corrected reading of the meridian circle, gives the following position :—R.A. 5h. 52m. 46·31s., North Declination 60° 13′ 40″·6. The length of the tail, clearly discernible to the naked eye, was last night about 9°.

S. J. PERRY

Stonyhurst Observatory, Whalley, June 28

THE following places have been obtained with the transit-circle when the comet passed *sub Polo* :—

Date.	Greenwich Mean Time of observation. h. m. s.	Observed Right Ascension. h. m. s.	Observed North Polar distance (uncorrected for parallax). ° ′ ″
(*a*) June 23 ...	11 31 54·2 ...	5 35 55·2 ...	44 53 20·6
(*b*) ,, 24 ...	11 30 42·6 ...	5 38 39·9 ...	40 35 33·7
(*c*) ,, 25 ...	11 30 58·3 ...	5 42 52·2 ...	36 38 27·4
(*d*) ,, 27 ...	11 33 2·8 ...	5 52 50·2 ...	29 46 5·8

Remarks.—(*a*) The nucleus distinct but nebulous. Tail bright, and estimated 15° in length. Observation good.

(*b*) Observation difficult, owing to cloud.

(*c*) Nucleus better defined than on June 23, but not so bright. Length of tail estimated at 15°. Observation good.

(*d*) Observation fair, very cloudy. Tail 12°-15° in length

Radcliffe Observatory, Oxford E. J. STONE

THE comet was examined spectroscopically here last night at 11·30. The nucleus gave a bright continuous spectrum, while the coma and brighter portions of the tail gave the three least refrangible hydrocarbon bands superposed on a faint continuous spectrum. On moving the slit of the spectroscope towards the fainter part of the tail the bands died out, leaving a faint continuous spectrum, which again gradually faded away as the end of the tail was approached. I have not measured the position of the bands, but they are sensibly the same as those from an alcohol flame. GEORGE M. SEABROOKE

Temple Observatory, Rugby, June 28

NOTES

THE Lords of the Committee of Council on Education, in reply to an application for aid to science teachers attending the classes of the Mason Science College two days a week, agree to pay three-fourths of the fees for the chemical and physical laboratories and for biology and histology, for a limited number of teachers, on condition that satisfactory terminal reports of their progress (ascertained by examination) and of their conduct be received at the end of the Michaelmas, Lent, and Easter terms. Applications for the privilege must be made to the Secretary, Science and Art Department, not later than August 31. The selection will rest with that Department. One-fourth of the fee for the whole session must be paid by the student on entrance; and the remaining three-fourths will be paid by the Department in equal instalments at the commencement of each term, if the reports are satisfactory.

THE fine library of the late M. Chasles is to be sold by public auction between June 28 and July 18. It contains no fewer than 3936 works, or about 15,000 volumes, and is one of the most complete libraries of mathematical works in existence. The precious manuscripts and various works of history and philology will doubtless be eagerly sought by amateurs. There is, among other works, a Geography of Ptolemy of Alexandria, printed at Rome in 1490, containing geographical maps which are the first engraved with copper plate (1478). The collection includes eighteen different editions of Archimedes, and the works on Euclid number sixty-six. The astronomical works of the sixteenth, seventeenth, and eighteenth centuries are fully represented, as also those on astrology, alchemy, &c.

THE programme of an excursion by the Geologists' Association to the Lake District, from Monday, July 18, to Saturday, July 23, has been issued. Keswick will be the centre of operations till Friday, when the Grasmere and Ambleside district will be visited. Saturday will be given to Windermere.

WE have also before us an attractive programme of a marine excursion to Oban and the West Highlands of Scotland by the Birmingham Natural History and Microscopical Society. The party leave Birmingham on the evening of July 1, and go direct by Greenock and the Kyles of Bute to Oban, which is made the centre for various excursions by sea or land, till July 12. Facilities for dredging will be afforded. The party will include some able naturalists.

IN a recent issue we gave some account of the Ben Nevis Observatory (so-called). The system has been in operation since June 1, and the daily observations by Mr. Wragge are published in the *Times*. This gentleman begins his magnanimous toil up the hill every morning at 5 o'clock. After spending about an hour on the top (9 to 10) in taking observations with the scanty stock of instruments fixed on stands protected by a stone screen, he gets home again by about 2 in the afternoon. In the early part of June the path up the mountain was often deep in snow and enveloped in mist, but Mr. Wragge has marked out the track with a succession of cairns. Anything more disgraceful to British science than this state of things, as representing our present achievement in the way of regular mountain-observations, it is difficult to conceive! A comparison with what has been accomplished in other countries, notably America, where well-equipped observatories are now to be found at vastly greater heights than the top of Ben Nevis, is sufficiently humiliating for us.

THE May number of *Naturen* gives the first of a series of papers, by Prof. Axel Blytt, on the "Theory of the Immigration of the Norwegian Flora at Different Earlier Geological Periods." In this paper the author, who is well known as the highest authority among Scandinavian botanists, describes the character of the flora, which, considered generally, is represented by only a small number of genera. At an elevation of 4000-4500 feet above the level of the sea the interior and southern districts exhibit dwarf forms of the willow and birch, with juniper; between 3000-3500 feet the first birch woods appear in the same districts, while firs and pines begin a few hundred feet lower. Here and there the high and barren fjalds of the interior near the glaciers are broken by the occurrence of blooming oases of plants of Arctic continental forms, which, after having lain buried for months under the snow, awaken to new life with the return of the summer sun. To the interior also belongs a boreal flora of small deciduous trees, including the oak, ash, alder, lime, &c., which penetrate as far as 2000 feet, and in the Inner Sogu district occur the only woods of elm and wild cherry to be found in Norway. The subboreal belt, including several Spiræas, *Fragaria collina*, *Artemidia campestris*, *Thymus chamadrys*, &c., is limited to the Lower Silurian formations in the eastern districts. The western coast-lands between Stavanger and Christiansund are the habitats of an Atlantic flora, including *Erica tetralix*, and several of the rarest Norwegian plants, but here Calluna, Sphagna, and Carices, with turf beds, constitute the principal forms. The most southern littoral belt near Christiansund presents a sub-Atlantic flora, while a number of sub-Arctic forms appear scattered over the whole of Norway. Prof. Blytt considers that the sporadic occurrence of the various continental and insular forms of the flora of Norway points to the conclusion that the climate has undergone various secular changes since the Glacial period, the continental forms having immigrated during the continuance of drought, when the peninsula was connected with neighbouring continents, while the appearance of the insular forms was contemporaneous with rainy periods.

THE decree appointing sixty-five French members of the Congrès d'Électricité has been signed by the President of the Republic, and will soon be published. Foreign Governments will appoint all their own members. Reporters and the public will not be admitted to the Congress; an official report will be published by the general Committee. Some French papers have already condemned such practice in strong terms. No jurymen will be appointed by the exhibitors, and the latter will have no direct influence on the verdicts. It is proposed to consult the Congress on certain measures of general interest, *e.g.* the adoption of electrical units. The electric railway station will be placed inside the building. For want of time, no viaduct will be constructed, and the rails will be laid on the common roads. The space allotted to English exhibitors on the ground-floor has been largely occupied. In addition to this space each of the British light exhibitors will have on the upper floor a special saloon to illuminate with his own system. The right of publishing and selling the French Catalogue has been purchased by the printers and publishers of *La Nature*, rue de Fleurus. The sale of scientific papers will be authorised, but will take place exclusively through their agency.

IN an old book—"Thomæ Bartolini Acta Media et Philosophica Hafniensa Anno 1674, 1675, et 1676," Herr Budde has

come upon a passage which bears on the history of the diving-bell. Bartolini there writes: "Singulare instrumentum invenit descripsitque Franziscus Kesler Wetzlariensis in secretis suis Oppenheimii editis 1616, capite VI., quod Wasserharnisch vocat, quo tuto ambulemus in fundo maris, legamus ibidem, scribamus, edamus, potemus, cantemus, sine periculo vitæ longiori tempore, omnia pergamus, thesauros eruamus et abscondamus," and so on. Of the two figures one represents the interior—a rough framework of wood, having straps with which the diver secures himself in the bell; the other (see *Wied. Ann.*, No. 5) shows the exterior, an inverted vessel of tumbler shape having five or six small circular windows at the top, while the man's legs project little below. According to Poggendorff (it is stated) the oldest book in which the diving-bell is mentioned is of 1664, and it refers to a work of Taisnier (as the source of information), the date of which Poggendorff does not give.

We learn from *L'Électricité* that there is being made near the Palais de l'Industrie a basin, 16 metres in diameter, which will be put at M. Trouvé's disposal for exhibition of his boat driven by electricity. In the centre will be an electric light on a pedestal. At various points within the Palais de l'Industrie will be placed (under the direction of MM. Ranvier, Berger, and Fontaine) models of statues as supports for the electric light in its various forms.

The Municipal Council of Philadelphia has granted to a Company the right to place 3000 kilometres of wire on posts for telephonic purposes. No tax is imposed, but a limit is set to the subscription. The fire-telephones in Berlin have proved so useful, that the municipal authorities are increasing the number. In Paris the development of telephonic lines amounted to 9121 kilometres, the extent of wire being double this.

An electromagnet of enormous dimensions has lately been made by Herren von Feilitzsch and Holtz for the University of Greifswald. The case is formed of twenty-eight iron plates bent into horseshoe shape, and connected by iron rings so as to form a cylinder 195 mm. in diameter. The height is 125 ctm.; the total weight 628 kilogr. The magnetising helix consists of insulated copper plates and wires having a total weight of 275 kilogr. (For further details see *Les Mondes* of June 23.) With fifty small Grove elements the magnet will fuse in two minutes 40 grammes of Wood's metal in the Foucault experiment. The plane of polarisation is rotated in flint glass after a single passage, &c. The core of the largest magnet hitherto known, that of Plücker, weighed 84 kilogr. and the wire 35 kilogr.

Mr. W. Mattieu Williams, F.R.A.S., F.C.S., author of "The Fuel of the Sun," "Through Norway with a Knapsack," &c., has been appointed to the management of the Royal Polytechnic Institution, Limited, and will commence his duties at once.

Mr. H. C. Russell, Government astronomer, has just sent home his report on the results of rain and river observations made in New South Wales during 1880. In regard to the latter part of the subject Mr. Russell remarks that it seems impossible to doubt that an unlimited supply of water passes away underground, more indeed than would suffice to make the western districts of the colony a well-watered country, and all that is wanted to make the supply available is a judicious use of the boring-rod. The report is illustrated by an interesting rainfall map of New South Wales, and another on which are given curves showing the height of the western rivers during the year.

Four shocks of earthquake occurred at Agram on the night of June 22-23; rather severe shocks were felt on June 22 at Bohyhad (10.20 p.m.) and Szegszard (11 p.m.) in Hungary.

A skeleton of an *Ursus spelæus* was found this week in a cave near Spanheim (Germany).

The arrangements for the International Medical and Sanitary Exhibition are now complete; the offices are removed from the Parkes Museum to the Exhibition Buildings at South Kensington. The Right Hon. Earl Spencer, Lord President of the Council, has accepted the office of president, and will be present at the opening ceremony on Saturday July 16. The Exhibition is to be complete on Wednesday, July 13, and the judges will make their examinations for the awards on the two days previous to the opening.

In consequence of the increasingly numerous cases of myopia developed in French schools through bad arrangement of seats and distribution of light, the Minister of Public Instruction has nominated a commission named De l'Hygiène de la Vue dans les Ecoles, whose object will be to study the influence of the material conditions of school arrangement on the progress of myopia, and to discover the means of counteracting the evil.

A careful study of the chief methods in use for the chemical examination of potable water, so far as organic matter is concerned, has been undertaken by order of the U.S. National Board of Health. Medical men throughout the country, and others interested in sanitary matters, have been requested to report to Dr. Mallet of Virginia University any well-marked case of disease from impurities in drinking-water, and to forward samples of such water.

The additions to the Zoological Society's Gardens during the past week include two Red-handed Tamarins (*Midas rufimanus*) from Demerara, presented by Mr. John Pequē; a Stanley Crane (*Tetrapteryx paradisea*) from South Africa, a Common Chameleon (*Chameleon vulgaris*) from North Africa, presented by Mr. J. Sexton; two Laughing Kingfishers (*Dacelo gigantea*) from Australia, presented by Sir Hubert Sandford; a Lead-beater's Cockatoo (*Cacatua leadbeateri*) from Australia, presented by Mr. Martin Smith; a Marsh Harrier (*Circus æruginosus*) from Malta, presented by Mr. J. Wolfe Murray; a Lesser Kestrel (*Tinnunculus cenchris*), South European, presented by Mr. William Brodrick; an Undulated Grass Parrakeet (*Melopsittacus undulatus*) from Australia, presented by the Countess of Ellesmere; two Gerbillus (*Gerbillus*, sp. inc.) from Algeria, presented by M. Alphonse Milne-Edwards; a Long-headed Snake (*Xenedon rhabdocephalus*), a d'Orbigny's Snake (*Heterodon d'Orbignyi*) from South America, presented by Dr. A. Stradling, C.M.Z.S.; a Red-throated Amazon (*Chrysotis collaria*) from South America, deposited; three Moustache Monkeys (*Cercopithecus cephus*), a Diana Monkey (*Cercopithecus diana*), a Talapoin Monkey (*Cercopithecus talapoin*), two Green Monkeys (*Cercopithecus callitrichus*), a White-collared Mangabey (*Cercocebus collaris*), a Grey-cheeked Monkey (*Cercocebus albigena*), two Water Chevrotains (*Hyomoschus aquaticus*), a Crested Guinea Fowl (*Numida cristata*) from West Africa, a Tamandua Anteater (*Tamandua tetradactyla*), a Peba Armadillo (*Tatusia peba*), a Red-billed Toucan (*Ramphastos erythorhynchus*) from Brazil; a Hawk's-billed Turtle (*Chelone imbricata*) from the East Indies, a Puff Adder (*Viper arietans*) from Africa, purchased; a Horned Tragopan (*Ceriornis satyra*), an Impeyan Pheasant (*Lophophorus impeyanus*), bred in the Gardens.

BIOLOGICAL NOTES

Rhythmic Contraction of Voluntary Muscles.—It has been recently observed by Herr W. Biedermann (Vienna Acad. *Sitzungsberichte*) that if the sartorius muscle of a curare-poisoned frog, prepared at a low temperature, be put in a solution of 5 gr. $NaCl$, 2 gr. Na_2HPO_4, and 0·4 to 0·5 gr. $NaCO_3$ in 1 litre water, it shows, after a longer or shorter time of rest, *rhythmic* contractions, which continue regular a certain time for each part of the immersed muscle. Then occur periods of rhythmic contractions, separated by longer or shorter pauses, and often varying in character. These phenomena last a long time; with a coo[1]

external temperature for days. The author saw preparations still pulsating strongly and regularly on the fourth day. (The liquid, in that case, must be often renewed.) These rhythmic contractions of a voluntary striped muscle, indicating chemical stimulus, awaken special interest, through their similarity to the long-known contractions of the apex of the heart, separated and without ganglia, in blood-serum. The heart-muscles, it is known, are also striped.

THE GORILLA AND THE CHIMPANZEE.—Mr. H. von Koppenfels, who is now engaged in explorations in the Gaboon district of Western Africa, in a letter published in the last number of the *American Naturalist*, states that he has good evidence of the existence of crosses between the male gorilla and the female chimpanzee. "This," he says, "settles all the questions about the gorilla, chimpanzee, Kooloo-Kamba, N'schigo, M'bouvé, the Sokos, Baboots, &c." Herr v. Koppenfels observes that the "French *savants* seem to have a special predilection for creating new species from variations in the form of the skull, such as often occur in this group of animals. There is but one district which forms the range of the gorilla, and this is situated in the western part of Equatorial Africa, and here it exhibits no varieties, while the chimpanzee is found all over Tropical Africa, and naturally exhibits considerable variation. The chimpanzee of Northern Guinea differs essentially from that of the southern portion of the same country, and, according to Livingstone, the 'Soko' differs from both, but is still a chimpanzee. Du Chaillu's Kooloo-Kamba, N'schigo, and M'bouvé are *not* distinct species, and this traveller, who is certainly a man of merit, but is too credulous, has been imposed upon by the mendacity of the natives, which beggars description. The names N'schigo, M'bouvé, Koola, Baboo, Soko, Quia, and Kooloo-Kamba are only different designations of the chimpanzee by different tribes. The mongrel progeny of the male gorilla and female chimpanzee discovered by me is found but in individual cases, and as such deserves no special name."

SALIVARY GLOBULES.—Prof. Stricker of Vienna, by examination of salivary globules under high-power lenses (obj. No. X. of Krafft and Seivert), has obtained the following results:—He cannot accept the supposition of a so-called Brownian (molecular) movement in salivary corpuscles. He has found the globules to consist of a complete, distinctly visible network. The granules, which have been seen under low powers of the microscope, appear on close inspection and carefully focussing to be thickened points of intersection of the threads forming the reticulum. There is a permanent fluctuation of the threads during the life of the corpuscle. By the action of concentrated salt-solutions the fluctuation ceases gradually and the reticular arrangement disappears.

FISH MORTALITY IN THE GULF OF MEXICO.—From time to time since 1844 a widespread destruction of all sorts of marine creatures has occurred along certain well-marked-out tracts in the Gulf of Mexico. In 1854 the fishes suffered all along the southern shore; in 1878 there was again an excessive mortality; in 1879 the plague again appeared; while in 1880, we learn from the recently-published report of Inspector Ingersall to Prof. S. F. Baird, it has been very intense. The poisoned waters occur in streaks or patches, sometimes near to one another, at other times many yards apart. These seem to drift with the flow of the tide, and ultimately become diluted. The most probable solution of this strange phenomenon is to suppose that eruptions of noxious volcanic gases arise through the bottom of the sea; certain it is that the marine life on the sea-bottom suffers first. Sponges, sea-anemones, mollusks, and the ground fish die in mass, and apparently at once. Upwards the deadly pestilence mounts, and the small fish swimming at or near the surface are killed by thousands, and float lifeless on the water. The large surface fish would seem to escape, and rarely is a mullet to be found destroyed. Fishing in such districts has to be abandoned, even although in the pure streaks the fish abounded, for should a smack fill its well with the results of a successful catch it had to run the gauntlet of the broad patches of the poisoned waters, and if any of these were encountered, and entered the well, a few moments would suffice to bring about the death of every fish in the cargo. The keeper of the Egmont Lighthouse writes on February 21 in this year: "As the tide came in on October 17, 1880, there were thousands of small fish floating on the water, most of them quite dead. The next day the fish were dying all along the shore; between October 25 and November 10 the stench was so horrible that it was impossible to go on the beach. Sending my family to Manatee, the assistant-keeper and myself shut ourselves up in our rooms, and kept tar, coffee, &c., burning day and night in order to stand it. The peculiar smell was like bilge-water. The fish I noticed dying acted as if crazy, darting around in every direction, then giving up and floating ashore. After a very heavy gale from the south-west the bad and good waters got mixed up, and soon all the fish caught were fat and nice." As the cause of this strange phenomenon is still problematical, some discarding the idea of the evolution of subterranean gases, believing it to be the result of a poisoning of the waters by an excess of rain-water discharged into the Gulf by the rivers, others that it is owing to the water being saturated with the tannin derived from decomposing roots and stems of palmetto, sumach, oak, &c., it would seem highly desirable that Prof. Baird should institute a series of observations as to the chemical constituents at different times of the waters of these districts.

ON THE NECTAR-SECRETING GLANDS IN SPECIES OF MELAMPYRUM.—The cow-wheats are a familiar group of plants, of which several species are to be found native. E. Ráthay, while investing the subject of the secretion of sugar by plants, was attracted by the appearance of swarms of ants evidently collecting some sweet material from the little dark puncta on the bracts of *Melampyrum arvense* (purple cow-wheat). These puncta, even under a hand-lens, are seen to be little round disk-shaped bodies, which proved to secrete a sugary secretion for which the ants came. In a memoir on this subject these gland-like disks are described and figured as they occur in *M. arvense*, *M. nemorosum*, *M. pratense*, and *M. barbatum*. These bodies have long since been observed by the systematic botanists; they form part of the trichomic development of the epidermal system of the bracts, and may be described as consisting of a short foot-cell, attached to the centre of which is a circular disk. This latter is composed of a single layer of seven-sided cells. According to their function these structures in the species of Melampyrum mentioned belong to the epidermal glands of De Barry, since they secrete upon the upper side of their disk, between the cuticle and cell-membranes of the seven-sided cells, a liquid which, through the bursting of the cuticle, gets out, and is sought by the ants and eaten. The secreted fluid contains at least 2 per cent. of a kind of sugar which is not reducible by oxide of copper. The history of the development of these structures is practically the same as that of other similar formations. The purpose which they serve to the Melampyrum would seem neither to be explained by the hypothesis of Belt and Delpino as to the meaning of the extra floral nectaries, nor according to the hypothesis of Kerner concerning the same. Ráthay further adds that the moistness which almost always appears over these structures is quickly, on removal, renewed; that this moistness increases so much as to form drops when the plants are protected from the approach of ants, &c.; and that this drop-formation is repeated several times if the drops are from time to time removed (Vienna Academy *Proceedings*, vol. lxxxi. 1880).

CHEMICAL NOTES

M. RAOULT states in *Compt. rend.* that the oxides of barium, strontium, and calcium rapidly absorb carbon dioxide at a high temperature: much heat is evolved in the reaction, the temperature of the mass in the case of barium oxide being as high as 1200°, according to a pyrometric determination.

MM. CAILLETET AND HAUTEFEUILLE have determined the densities of liquid oxygen, nitrogen, and hydrogen (*Compt. rend.*) by liquefying these gases mixed with carbonic anhydride and with nitrous oxide, and basing their calculations on the assumption that the mixed liquids are without action on one another. The density of liquid oxygen at $-23°$ (pressure $=300$ atmos.) was found to be 0·89 from experiments with carbonic anhydride, and 0·94 from experiments with nitrous oxide: at 0° the numbers obtained were 0·58 and 0·65 respectively. Liquid nitrogen at $-23°$ gave numbers corresponding with the density 0·44, while at 0° the density was 0·37. The density of liquid hydrogen was 0·033 at $-23°$, and 0·025 at 0°. Dividing the atomic weights of the three elements by the densities at $-23°$, the *atomic volume* of oxygen is found to be 17, of nitrogen 31·8, and of hydrogen 30·3.

HERR O. LÖW describes experiments with fluorspar from Wölsendorf (*Berliner Berichte*), which seem to show that the liquid contained in the cavities of this mineral consists of free

fluorine. When the mineral is broken up, a strong chlorine-like odour is perceptible; when heated with sulphur, an odour resembling that of sulphur chloride is evolved; the liquid in the mineral decomposes sodium chloride and iodide, with formation of chlorine and iodine respectively. On addition of dilute potash it yields a solution which instantly decolorises indigo solution. When the mineral is moistened with ammonia water, powdered, the liquid filtered off, neutralised with sodium carbonate and evaporated, a residue is obtained which, on addition of sulphuric acid, evolves hydrofluoric acid. Herr Löw thinks that the fluorine is produced by dissociation of cerium fluoride in the mineral.

THE application of potassium oxalate as a precipitant for many heavy metals, both in qualitative and quantitative analysis, is described by Herr von Reis in the *Berichte* of the German Chemical Society; the quantitative results obtained are very accurate.

THE reaction of bleaching powder on alcohol, which results in the formation of chloroform, is not thoroughly understood. M. Béchamp details experiments (*Annales Chim. et Phys.*), according to which no oxygen is evolved during the change, but only after the primary change is complete, and a secondary change begins when the reacting bodies have acquired a high temperature. The formation of chloroform is represented by M. Béchamp by the following equation, $2C_2H_6O + 4Ca(OCl)_2 = CaCl_2 + 2H_2O + 2Ca(OH)_2 + (HCO_2)_2Ca + 2CHCl_3$.

IN *Annali di Chimica* Signor Chiappe states that he has found spots of minium (Pb_3O_4) on various marble monuments, on parts of which bands of lead have been fastened. He supposes that by the action of the air and rain lead carbonate is produced, this is absorbed by the marble, and when exposed in places to the sun's rays it is decomposed with production of minium.

A VARIETY of coal, said to be the most highly-carbonised member of the coal series hitherto described, has been found near Schunga, on the western shores of Lake Onega (*Jahrbuch für Mineralogie*); it contains about 91 per cent. carbon, 7 or 8 per cent. water, and 1 per cent. ash. This coal is extremely hard and dense, has an adamantine lustre, is a good conductor of electricity, and has a high specific heat (0·1922). Although containing as much carbon as the best graphites from Ceylon, it is not a true graphite, inasmuch as it is not oxidised by potassium chlorate and nitric acid, but behaves towards those reagents like an amorphous coal.

FEDER AND VOIT have carefully repeated the experiments of Hallervorden on the effect of feeding with ammonium carbonate (*Zeitschrift für Biologie*). The results confirm the statement of the last-named author, that in dogs ammonium carbonate is converted into urea, and also show that ammonium acetate undergoes a similar change.

IT has been asserted that the employment of sodium nitrate in manures facilitates the solution and removal from the soil of plant-foods: Herr Fiedler has recently examined this subject experimentally, and he thinks himself justified in concluding that nitrates do not dissolve out any considerable quantities of plant-foods from the soil; that, within certain limits, absorption of phosphoric acid is favoured and absorption of potash slightly impeded by sodium nitrate; and that the same salt exerts a solvent action on *dibasic* phosphates of calcium, iron, and aluminium, but not on the *tribasic* phosphates of these metals.

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society on Monday last, Lieut.-Col. C. E. Stewart, of the Bengal Staff Corps, read some portions of a paper which he had prepared on the country of the Tekke Turkomans and the Tejend and Murghab Rivers. Col. Stewart, it may be remembered, is one of the officers who was accused, in a recent official despatch from St. Petersburg, of "haunting the oases" in the Turkoman country: this paper was consequently looked forward to with much interest. He left Constantinople in April of last year, and proceeded in the first instance to Ispahan, where he spent two months and a half in the Armenian quarter of Julfa, making preparations for his journey, as he had determined to travel in the disguise of an Armenian horse-dealer. On September 30 he went to Ardakan, where he assumed his disguise, and travelled in a north-easterly direction along the edge of the salt desert to Meshed, afterwards crossing the mountains to Mahomedabad. The account of this part of his journey, with its numerous adventures, Col. Stewart was unfortunately obliged to omit, owing to the length of his paper. Deregez, in which Mahomedabad is situated, is in the most northern part of North-east Persia beyond the mountains, and is some sixty-five miles long and forty broad; as it projects into the Turkoman country, it is a most favourable position for collecting information respecting the neighbouring country to the Caspian on one side, and to Merv on the other. Col. Stewart made Mohamedabad his head-quarters from November 25 to January 15, and during this time moved about in Deregez, but never crossing the Persian frontier, and obtained much interesting information by diligent inquiry among the Persian officials and the Turkomans whom he met. This particularly applies to the Merv district—for he denies the existence of a town of Merv—and the Murghab River. Col. Stewart also explained very clearly the Russian line of advance, and the present and future position of the railway question. It may be interesting to add that his disguise was completely successful, and entirely deceived even the Persian servant of Mr. O'Donovan, the enterprising correspondent of the *Daily News*, who is now detained in the Merv district.

THE fiftieth and last volume of the Geographical Society's *Journal* is chiefly occupied with Mr. C. R. Markham's history of the fifty years' work of the Society, which is at once valuable and entertaining. In it will be found detailed the actual circumstances attending the establishment of the Society, about which some misapprehension has hitherto prevailed. This took place in July, 1830, and the Society is therefore now fifty-one years old: after passing through many vicissitudes, which at one time threatened its very existence, it now numbers 3394 ordinary Fellows, and is the largest and wealthiest institution of the kind in the world. Mr. Markham, we may add, has been able to reproduce its first list of 460 Fellows, dated August 4, 1830. In a voluminous appendix, equal in length to the history, he furnishes complete lists of officers from the commencement, references to obituary notices of distinguished men, lists of explorers and geographers who have received medals, grants in aid of their work, &c., and of the papers and maps published by the Society. Lastly there is some interesting information respecting the Hakluyt Society. The few remaining pages of the volume contain notes on two maps of the Andaman Islands by Mr. E. H. Man and Lieut. R. C. Temple, and on the history and origin of the word "Typhoon," by Dr. F. Hirth, tables of altitudes in East Central Africa computed from 317 observations taken by Mr. Joseph Thomson during his recent East African expedition, and a narrative of a journey overland from Amoy to Hankow by Mr. E. F. Creagh. From a brief prefatory notice we learn that the issue of the *Journal* is to be discontinued, and that in future "elaborate papers of more than ordinary length and great value" will be published as supplements to the monthly *Proceedings*.

FROM the *Colonies and India*'s Queensland notes we learn that Mr. Watson, in command of the Transcontinental Railway Survey, had crossed the Worna and Workingham Creeks in safety, and reported the soil magnificent and the grass splendid. The floods had however "sadly hampered the expedition," and this fully bears out the remarks made in NATURE, vol. xxiv. p. 114, as to the route for the line laid down on the Government map. It has lately been announced that General Fielding and Mr. J. Robinson, C.E., have gone out to make what is presumably an independent survey for a line, and we hope they may be able to find a more suitable route. The arrival of Mr. Watson's party at Point Parker, on the southern shore of the Gulf of Carpentaria, has since been announced by telegraph.

THE new *Bulletin* of the Bordeaux Society of Commercial Geography contains an address recently delivered before it by Capt. Gallieni, on his expedition, chiefly for surveying purposes, from the Senegal to the Niger. It is accompanied by a sketch-map of the region, on which the routes of the expedition are laid down.

PROF. ROWLAND'S NEW THEORY OF MAGNETIC ACTION

PROF. ROWLAND has lately published in the *American Journal of Mathematics* (vol. ii., No. 4; vol. iii., Nos. 1 and 2) a series of papers on "The General Equations of Electromagnetic Action with application to a New Theory of Mag-

netic Attractions, and to the Theory of the Magnetic Rotation of the Plane of Polarisation of Light." The papers, in addition to what is stated in their title, contain the mathematical consideration of that action of magnetism on electric currents which was lately discovered by Mr. Hall, and it is proved in them that, if Maxwell's theory of light be true, this action will explain the magnetic rotation of the plane of polarisation of light. These papers will no doubt be very extensively read, both on account of the interest of their contents and the great reputation of their author, and a brief discussion of them may therefore not prove uninteresting to the readers of NATURE.

We shall commence with the "New Theory of Magnetic Attractions." This theory is of the simplest kind, and obviously suggested by the mathematics of the subject. Since the magnetic induction is related to the distribution of the vector potential of magnetic induction in exactly the same way as the angular rotation of an element of fluid is to the distribution of velocity in the fluid, Prof. Rowland suggests that the magnetic field consists of a perfect fluid, whose velocity at any point is represented in magnitude and direction by the magnetic vector potential at the point, the vortex lines in this fluid are the lines of magnetic induction, and the velocity of angular rotation, is proportional to the magnitude of the magnetic force. Again, since 4π times the electric current is related to magnetic induction in the same way as magnetic induction to the vector potential, Prof. Rowland considers that an electric current consists of, as it were, vortices of vortices, or in other words, that certain irregular distributions of the vortices constitutes currents.

Maxwell has proved that the forces existing in the magnetic field could be produced by a certain distribution of stress in a medium filling the field. This stress in the simplest case consists of a tension along the lines of force equal to $\frac{H^2}{8\pi}$, along with a pressure at right angles to the lines of force equal also to $\frac{H^2}{8\pi}$, H being the intensity of the magnetic force.

Prof. Rowland goes on to show that this state of stress exists in the medium, which, according to his theory, fills the magnetic field; his proof is as follows:—"Conceive the fluid in a tube to be rotating around the axis with a certain velocity, and suppose the ends of the tube to be closed with movable pistons. Then, if the pistons are left free, there will be a centrifugal force against the sides of the tube proportional to the square of the velocity of angular rotation. If the walls are flexible and the piston immovable, then there will be a force tending to press the pistons in, and proportional also to the square of the velocity. According to our theory the magnetic force is the velocity of rotation, and so we have in the medium a tension along the lines of force and a pressure at right angles to them." Prof. Rowland does not seem to have noticed that this explanation requires the vortices to be of a finite size. It is easy to prove that in a cylindrical vortex of radius a, density ρ and angular rotation ω, the intensity of pressure on the circumference of the cylinder is greater than the mean intensity of pressure on the ends by $\frac{\rho\omega^2a^2}{4}$; but if this is to explain the magnetic attractions the difference must be $\frac{H^2}{4\pi}$. Hence if $H = c\omega$, where c is a constant, we must have $\pi\rho a^2 = c^2$, $a = \frac{c}{\sqrt{\pi\rho}}$; we thus get a definite value for a, and the vortices must not be capable of division into bundles of smaller radius than a. Thus the fluid by which Prof. Rowland explains magnetic action cannot be the indefinitely divisible fluid treated of in theoretical hydrodynamics. It is worthy of remark that in the theory of magnetism put forth by Maxwell in the *Phil. Mag.* for 1861-62, and which agrees with the theory we are considering in explaining magnetic force by the angular rotation of a fluid, the vortices have a finite size, being done up as it were into cells, the space between the cells being filled with particles whose motion, according to Maxwell, constitutes electric currents.

Let us now go on to the explanation Prof. Rowland gives of the production of the magnetic field. He says: "Let the nature of electromotive force be such that it tends to form vortex-rings immediately round itself, not by action at a distance, but by direct action on the fluid in the immediate vicinity. The first ring will then move forward, another one will form, and so on until the whole space is filled with them, when there will be equilibrium." The consequences of this explanation, vague as it is, are somewhat startling. In the first place it is clear, from the properties of vortex motion, that every chain of particles of the fluid which possess rotation at any time must at some previous time have been in the immediate vicinity of the electromotive force; and since according to the theory there is rotation of the fluid at every point in the magnetic field, it follows that in the time taken to set up the field every particle of fluid in it has been in the immediate neighbourhood of the electromotive force. But magnetic disturbance is propagated, according to Maxwell's "Theory of Light" (which Prof. Rowland accepts), with the velocity of light; hence the streams of the fluid must be flowing with the velocity of light, and in addition every particle of fluid in the field must have rushed through the small space occupied by the seat of the electromotive force in the short time it takes to establish the magnetic field. Another difficulty which Prof. Rowland does not explain is the following: If we take a small element of electromotive force we know that to agree with the distribution of magnetic force all the vortex-rings must have the same sense of rotation; but if vortex-rings have the same sense of rotation they move through the fluid in the same direction, so that these vortex-rings when produced would all move off in the same direction, and thus leave one half of the field without rings, *i.e.*, without magnetic force. Again, the way in which these rings spread out so as to fill the field would seem to be in contradiction to the laws of vortex-motion; but as the author says he is investigating the dynamics of the subject, we may leave further comment on this point till the result of his investigation appears.

The explanation of the stress in the medium which we have referred to before is the only application of the theory worked out by Prof. Rowland. He does not explain by it any of the phenomena of induction, nor does he get from it any connection between statical and current electricity; yet he does not hesitate to speak of his theory "as one link in the chain, the first three links of which have been added by Thomson, Helmholtz, and Maxwell."

We must now leave this part of the subject and pass on to that portion of the paper which treats of the general equations of the electro-magnetic field. The mathematics of this is merely an application of the theory of the vector-potential to currents. The most important feature in the treatment of the subject is that Prof. Rowland always writes the product of the conductivity into the electromotive force instead of the intensity of the current, and claims that this is an important advance; but if there is any difference either Ohm's law must not be true, or Prof. Rowland must mean by electromotive force something different from that meant by ordinary users of the term. Prof. Rowland asserts that in an unlimited medium the action is not between magnets and currents, but between magnets and electromotive forces; he bases this assertion on the theorem that in an unlimited medium unclosed electric currents have no magnetic action. It is hard to see how this proposition can be true, for the current through any area is measured by the line integral of the magnetic force round the boundary of the area; but if the magnetic force is everywhere zero, then the line integral of it round any curve must vanish, and thus the current at any point must vanish. The proposition is based on reasoning of the following kind: the force between an electric point (by an electric point he means a point from which electricity is streaming, in fact what is usually called a source) and a magnetic pole must by symmetry be along the line joining them. But a magnetic pole of any size is always accompanied by one of the opposite sign, and the two form a vector quantity; and we think from the relation that one pole necessarily bears to another, it is not safe to reason about it as if it were a purely scalar quantity. Prof. Rowland himself acknowledges what is equivalent to this, for after saying that the force due to the unclosed currents on each pole of the magnet is zero, yet he says there is probably a force on the magnet as a whole tending to place it across the currents.

Although we think that the reasoning given for the assertion that the action is not between magnets and currents, but between magnets and electromotive forces, is unsatisfactory; yet we think that, understood in a certain sense, the proposition is mathematically true. For we can prove directly from the ordinary expressions for the magnetic action of currents, that if we have a source and a sink of equal intensities ($4\pi m$) placed close together, the magnetic action of the currents produced is

the same as that due to a current of strength m flowing along the short line joining the source to the sink. Now the current at any point produced by a source and sink placed close together at a distance ds, is exactly the same as the magnetic force at the same point produced by a magnet joining the source and sink, whose moment is mds, and direction of magnetisation along the line joining the source and sink. Hence if we have any system of currents in the field, and find by the application of the methods given by Sir W. Thomson in his paper on "Inverse Problems" the distribution of magnetism which would produce a magnetic field such that the magnetic force at any point was equal in magnitude and direction to the current at the point, the magnetic action of the system of currents will by the proposition just stated be the same as that due to currents whose intensity and direction coincide with the intensity and direction of the magnetisation producing the said magnetic field. Thus instead of currents occupying the whole of the medium, we have only to consider currents occupying a limited portion of it. This is, we think, all that can be fairly stated about this point, and it will be seen that, to say the least, Prof. Rowland's statement that "the action in such a medium reduces itself to an action between magnets and electromotive forces instead of between magnets and currents," is not a clear way of putting it. Prof. Rowland in this part of the subject introduces a new term, viz., magneto-motive force; this is a force supposed to exist between two magnetic poles so as to cause the same number of lines of induction to pass between the points as to flow out of either of them; it is proportional to the magnetisation, and seems only introduced for the sake of making more evident the fact that currents are related to electromotive forces like lines of induction to magnetisation, or with the new terminology to magneto-motive forces. This was pointed out by Maxwell in his paper on "Faraday's Lines of Force" published in the Cambridge *Transactions* for 1856.

The last part of the paper, which is also the most interesting, contains the explanation, by means of the new action discovered by Mr. Hall, of the magnetic rotation of the plane of polarisation of light. By adding to the old expression of the electromotive force a term representing the force discovered by Mr. Hall, Prof. Rowland obtains an expression for the rotation of the plane of polarisation of exactly the same form as the one given by Maxwell in § 829 of the "Electricity and Magnetism."

J. J. THOMSON

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The report of the Botanic Garden Syndicate states that during the past year valuable additions have been made to the collections of ferns and orchids, and many choice stove and greenhouse plants have been received. The collection of hardy, herbaceous, and alpine plants has been much increased, and the rockery furnished with many rare alpine species. The genera Iris, Narcissus, and Helleborus have received special attention. During the year, 1594 labels have been written in large letters. The curator, Mr. Lynch, has extended the correspondence of the Gardens with botanic gardens, nurserymen, and private cultivators: 2600 plants have been received, and 1285 packets of seeds.

In consequence of the decision of the Duke of Devonshire in favour of the legality of the recent vote of the Senate admitting women to the Previous and the Tripos Examinations, the first lists in which the names of women who have passed the Previous and any Tripos Examination, have appeared in the University *Reporter*. In the Natural Sciences Tripos, Part I, Class 2, is the name of Miss Anelay of Girton. In the Previous Examination twelve Girton students and two Newnham students have passed in one or more parts of the examination.

LOCAL LECTURES.—In spite of the removal of several important districts from the scope of these lectures by the establishment of local colleges, the numbers attending lectures during the past winter have been 4369 as against 5009 in the preceding winter; and the reduction in numbers is due to the absence of the South Wales centre from the lists, the Syndicate having been unable to make adequate arrangements for this district, owing to their engagements elsewhere. South Wales is again to be vigorously worked in the coming session. Dr. R. D. Roberts of Clare College has been appointed Assistant Secretary for the purposes of the local lectures. The courses of lectures on physical science subjects in the past winter have included Mr. Teall's on Early Man in Western Europe, and the Origin of Rocks and Scenery of the British Isles at Nottingham and Derby, Mr. J. E. Marr's on Geology at Carlisle and Penrith, Mr. E. Carpenter's on the Science and History of Music at Nottingham, and on Light at Chesterfield, Mr. Carr Robinson on Gases and on Chemistry at Hull, and by Mr. H. N. Read on Botany at the Crystal Palace.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, June.—The flight of birds and the mechanical principles involved, by A. C. Campbell.—Recent advances in photography, negative and positive, by J. Carbutt.

Journal de Physique, June.—On registering apparatus for atmospheric electricity and terrestrial magnetism, by M. Mascart.—On radiophony (third memoir), by M. Mercadier.—On the contraction of galvanic deposits and its relation to Peltier's phenomenon, by M. Bouty.—Projection of the Lissajous figures with differences of phase variable at will, by M. Crova.—Production of electric currents in any system of fixed conducting wires, by M. Brillouin.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti. Vol. xiv. fasc. viii.-ix.—On the question whether American vines may be imported from phylloxerised or suspected districts without risk, by Count Trevisan.—Difference of longitude between the observatories of Genoa, Milan, Naples, and Padua, by Prof. Celoria.—On the stocking of Italian lakes with fishes, by Prof. Pavesi and Dr. Sulzer.—Toradelphia of a scorpion, by Prof. Pavesi.—Monstrosity of a fresh-water Crustacean (*Astacus fluviatilis*), by Prof. Maggi.—Cremation and legal medicine, by Dr. Biffi.

Rivista Scientifico-Industriale, No. 9, May 15.—Two new applications of the electric light, by Prof. Ferrini.—Mercury air-pump, by S. Serravalle.—New method of qualitative chemical analysis, by L. Mauri.

Atti della R. Accademia dei Lincei, vol. v. fasc. 12.—Description of a terrestrial *trombe* which occurred in 1456, by S. Blaserna.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 16.—"On the Reversal of the Lines of Metallic Vapours. No. VIII. (Iron, Titanium, Chromium, and Aluminium.)" By Professors Liveing and Dewar.

In their last communication on this subject the authors observed that iron introduced as metal or as chloride into the electric arc in a lime crucible in the way which had proved successful in the case of many other metals, gave no reversals. They succeeded however in reversing some ten of the brightest lines of iron, mostly in the blue and violet, by passing an iron wire through one of the carbons, so as to keep up a constant supply of iron in the arc. Considering the great number of iron lines, and that so many of them are strongly represented amongst the Fraunhofer lines, it seemed somewhat surprising that it should be difficult to obtain a reversing layer of iron vapour in the arc inclosed in an intensely heated crucible. A like remark might be made respecting titanium, which is almost as well represented as iron in the Fraunhofer lines, but has heretofore given no reversals. Almost the same might be said of chromium, except that the number of chromium lines is so much less than that of either of the other two metals.

They have since found that most, if not all, of the strong lines of these three metals may be reversed by proper management of the atmosphere and supply of metal in the crucible. Indeed with regard to iron the method employed with other metals was successful so far as the ultra-violet rays were concerned, though it failed for less refrangible rays. When iron has been put into the crucible through which the arc of a Siemens' dynamo-electric machine is passing, and then fragments of magnesium dropped in from time to time, most of the strong ultra violet lines of iron are reversed. The magnesium seems to supply a highly reducing atmosphere, and to some extent carry with it the iron vapour. It also produces a good deal of continuous spectrum, at least in certain regions, and against this the iron lines are often depicted on the photographic plates sharply reversed. In this way the authors have observed the reversal of the strong

iron lines about the solar lines L and M, four strong lines below N, the line O, all the strong lines from S_2 to U inclusive, and two strong groups still more refrangible.

Potassium ferrocyanide introduced into the arc instead of magnesium gives a reversal of the same lines as are mentioned in the foregoing paragraph.

Iron wire fed in through a perforated pole gives reversals of the highest group (wave-length 2492 to 2480), but with the lines so much expanded as to form broad absorption-bands instead of lines.

With a vertical arrangement of the carbons and a stout iron wire in the axis of the lower (positive) carbon, many more lines in the visible part of the spectrum are seen expanded and reversed. This effect is sometimes enhanced by leading into the crucible through the upper carbons, which is perforated for the purpose, a very gentle stream of hydrogen gas; the stream must be no more than is just sufficient to give a tiny flame at the the mouth of the crucible; a stronger stream diminishes the amount of metallic vapour, probably by its cooling action, and lessens the effect. By this treatment some of the strongest lines of iron remain reversed for some time, the weaker lines are seen to expand and be reversed for a few seconds at a time, when, from a change in the intensity of the current, or some other reason, a larger amount of metal is volatilised and shows itself by burning in brilliant scintillations at the mouth of the crucible.

A list of the iron lines reversed, 136 in number, designated by their approximate wave-lengths, is given in the paper.

When the perforation of the lower carbon is filled with titanium cyanide instead of the iron wire the titanium lines come out very brilliantly and steadily, and many of them, especially in the green and blue parts of the spectrum, are expanded and reversed. A list of twenty-nine lines observed to be reversed is given in the paper.

In the case of chromium, introduced into the crucible either as oxide or as bichromate of ammonia, there were no reversals until a gentle current of hydrogen or of coal gas was led in through the perforated carbon. This brought out the triplet in the green, wave-lengths 5207, 5205, 5203, sharply and steadily reversed, and likewise the three strong lines in the indigo, wave-lengths 4289, 4274, 4253; also a triplet near N at wave-lengths about 3578, 3593, 3606, apparently coincident with strong lines in Cornu's map of that part of the solar spectrum, and a rather strong double line just below O at about wave-length 3446. The reversal of another chromium line at about wave-length 3217 is doubtful. A triplet at wave-lengths 2799·8, 2797, 2794, is more easily reversed than any other of the chromium lines. This triplet is generally strongly developed whenever a compound of chromium is introduced into the crucible, so that the authors conclude that it is due to that metal, but it is sometimes visible in the photographs when other chromium lines are not seen. A still more refrangible chromium line, wave-length about 2779·6, is also frequently reversed by a gentle current of hydrogen.

The two aluminium lines near S are frequently reversed when a fragment of the metal is dropped into the crucible, the less refrangible line, wave-length 3091·5, being more strongly reversed, and continuing reversed for a longer time than that at wave-length 3080·5.

Chemical Society, July 16.—Prof. Roscoe, president, in the chair.—The following papers were read:—On the isomeric acids obtained from coumarin and the ethers of salicylic aldehyde, by W. H. Perkin. The author has studied the action of various agents on these bodies. The α body (from coumarin) is converted into the β body by heat or light. In general the effect of chemical action on the α acid is to convert it into the same compound as that yielded by the β body. Bromine forms an exception, and two isomeric dibromides were obtained. The author concludes that as the α body has a lower boiling-point, density, refractive index, and is less stable than the β acid, it is probable that its molecules are farther apart and that the difference of distance is probably between the radical and the hydroxyl. The derivatives from propionic and butyric coumarin were studied.—Notes on naphthalene derivative, by H. E. Armstrong and G. Lowe. The authors have continued their investigations as to the action of sulphuric acid on naphthalene, and confirm their previous statement that three and not two disulphonic acids may be obtained. An isomeric β naphtholsulphonic acid was prepared by dissolving β naphthol in cold concentrated sulphuric acid.—On the synthesis of ammonia, by G. S. Johnson. The author reasserts that pure nitrogen, free from nitric oxide, when passed with hydrogen over spongy platinum, forms ammonia. If however the nitrogen be previously passed through red hot asbestos no ammonia is formed. This indicates the existence of an active allotropic nitrogen analogous to ozone.—On the alkaloids of nux vomica, by W. A. Shenstone. The author has prepared pure brucine, but concludes that the so-called Igasurin has no existence.—Notes on photographs of the ultra-violet emission spectra of certain elements, by W. N. Hartley.—On the sulphates of aluminium, by S. U. Pickering.—On two new oxides of bismuth, by M. M. P. Muir, Bi_2O_7 and Bi_4O_7, prepared by the action of aqueous potassium cyanide on a hot nitric acid solution of bismuth nitrate.

Royal Microscopical Society, June 8.—The president, Prof. P. Martin Duncan, F.R.S., in the chair.—Eleven new Fellows were elected and proposed.—Prof. Paul Reinsch attended the meeting and exhibited specimens of the vegetable forms found by him in the Coal measures.—The president read a paper on some remarkable enlargements of the axial canal in sponge spicula and their causes, accompanied by drawings on the blackboard. Nearly all the spicula obtained from specimens of very deep soundings off Japan were found to have the normal axial canal enlarged in a moniliform or conoidal manner, producing very elegant results. The spicula were of seven or eight kinds, and were mature. The enlargement was found to be invariably accompanied by an open condition of the axial canal or by penetrations, cylindrical in outline, from without, down to the canal. The penetrations were shown to be connected with an organic body resembling the zoospores of an *Achlya*, and granules, organic in nature, were observed within the enlarged canals. Thinning and solution of the spicula, the result of these organisms, were considered, and admitting the influence of great pressure, the president stated that he had never seen anything which led him to believe that there was free carbonic acid gas in the ocean.—A note was read by Dr. Savage calling attention to the changes which took place in nervous tissues in the process of hardening.—Mr. Holmes read a paper on a new British Alga, specimens of which were exhibited.—Discussions also took place on the value of swinging sub-stages on the motion of diatoms.—Dr. Maddox exhibited some micro-photographs of diatoms, and Mr. Powell demonstrated the aperture of his $\frac{1}{8}$-inch oil-immersion objective = 1·47 num. ap., the largest hitherto made.

Physical Society, June 25.—Prof. Fuller in the chair.—Señor Olympio de Barcelos was elected a member.—Mr. Grant exhibited an apparatus for showing the position and direction of the curve of zero electro-dynamic induction. It consisted of two coils of insulated wire mounted on stands, one being fixed while the other was free to revolve round it at a fixed distance.—Prof. W. E. Ayrton explained the determination of the refractive index of ebonite made by himself and Prof. Perry. The result for oxy-hydrogen light was 1·7, but at the suggestion of Prof. Fitzgerald of Dublin this was checked by measuring the polarising angle of ebonite by reflected light. Sunlight was employed in these experiments, and different pieces of ebonite. The result was 1·611. Professors Ayrton and Perry had repeated their former experiments, using the electric light and a battery of 70 volts E.M.F. The result confirmed the one first obtained. They had also determined the index of refraction in the ordinary way from the red rays, which they observed to pass through the prism of ebonite. Result for the least refrangible rays 1·66. Mr. Boys remarked that one could see better through thin ebonite if it was varnished or wetted than when untreated.—A letter was read by the chairman from a sub-committee of the British Association inviting the members of the Society to send exhibits to the jubilee meeting of the British Association at York.—Dr. James Moser read a paper on the microphonic action of selenium cells, in which he argued that the action of the selenium cell in the photophone was that of a microphonic contact or bad joint between the metal electrodes or metal plates of the cell and the selenium. The heat rays of the photophonic beam caused the joint to expand and contract; hence the variation in the current passing through the receiving telephone. Dr. Moser also exhibited a piece of selenium which increased, not diminished, in electric resistance when light fell upon it. He further showed a standard Daniell cell of the gravity type, which consisted of a glass vessel containing the copper plate at the bottom immersed in sulphate of copper solution, and the zinc plate at the top immersed in sulphate of zinc solution, and a clear line of demarcation between these solutions was produced by suspending an independent piece of zinc midway between the plates, so as to decompose all the sulphate of copper which diffused upward to that point.

Prof. Mcleod said that he had produced the same result by surrounding the zinc plate with a cage of copper wire connected to the copper plate. Copper deposited on the cage and the cell was in constant use. Dr. Lodge said that arrangement would not however serve as a standard of electromotive force, because all the copper plate should be in the copper solution. In his cell the copper and solution are both in a test-tube immersed in the zinc solution, and diffusion has to take place up this test-tube and down the cell so as to enter a second tube, open at the bottom, in which the zinc is placed.—Dr. Guthrie showed a new experiment to the effect that when a magnet is suspended over a disk of copper and the disk is rotated the magnet is repelled upwards. The experiment was shown by suspending a horse-shoe magnet from one end of a scale beam, counterweighted. As a possible explanation he suggested that the vertically-resolved force of the induction-current before the magnet might be greater than that behind the magnet.—The Secretary read a paper by Prof. Balfour Stewart and Mr. W. Strode, on results obtained by a modification of Bunsen's calorimeter described to the Society in January last year. With a new instrument made by Casella they have determined the mean specific heat of iron to be 0·1118, and that of sulphur 0·1756, the true values being given as 0·1138 and 0·1776. The advantage of the method is its simplicity, and the fact that very small quantities of the substance may be used.—Dr. Lodge then explained experiments by Mr. Sutherland, showing that a Daniell cell keeps its E.M.F. very constant when heated, because the thermo-electric effect at the junction of the zinc with the solution is balanced by that at the junction of the copper with the solution. After remarks by Dr. Moser and Prof. Perry, the Society separated until November next.

PARIS

Academy of Sciences, June 20.—M. Wurtz in the chair.—The following papers were read:—Observations on the simultaneous reduction of two bilinear forms, by M. Jordan.—On the preparation of aldol, by M. Wurtz.—Fresh discovery of native sulphur in the soil of Paris, by M. Daubrée. This occurred during the laying of drains in the rue Meslay. The case seems very similar to that previously recorded.—On a new thermograph, by M. Mercadier. The instrument consists of a cylindrical brass reservoir prolonged into a capillary tube of red copper, which opens into a Bourdon tube. The whole is filled with oil, and closed. The dilatation or contraction of the oil with varying temperature affects the curvature of the Bourdon tube, and thereby a recording lever. Two such instruments may be used simultaneously to give the curves for a deep and a peripheric part of the body. It is proved that in vaso-motor disorders the animal temperature undergoes variations in opposite directions in the central and peripheric parts. Inanition cools both the centre and periphery, while certain maladies seem to increase the production of heat, for they heat both parts.—On M. Roudaire's project of the interior sea; reply to M. Cosson, by M. de Lesseps.—On osseous grafts, by M. Ollier. He calls attention to Mr. MacEwen's success (in Glasgow) in reconstituting a portion of the humeral diaphysis by means of six cuneiform bony fragments taken from the tibias of young children having rachitic incurvations. The osseous tissue was transplanted complete. The antiseptic method was employed. (A note by Mr. MacEwen describes his mode of procedure).—Microscopic phenomena of muscular contraction; transversal striation of smooth fibres, by M. Rouget. It is demonstrated that this striation (which occurs only in the state of contraction) is due to the fibre when it contracts getting folded on itself, and then presenting alternate projections and depressions. The fibre-cells in polarised light are uniformly bi-refringent in the smooth state, but in the state of contraction they show in the dark field an alternation of bright and dark bands. It is shown from smooth fibres of the adductor-muscle of the valves in a cephalous molluscs killed by heat, that a fibre which has lost all contractility may still acquire all the peculiarities of structure and optical characters of striated fibres, if any cause produce in it fine and regular folds.—On the thermal laws of the excitative spark of condensers, by M. Villari. The heat developed by this spark (which is that produced against the exciter) is proportional to the quantity of electricity multiplied by the electric thickness, or it is proportional to the quantity of electricity for the fall of potential.—On the heat of formation of oxychloride of calcium, by M. André.—Action of protoxide of lead on alkaline iodides, by M. Ditte.—On the basic carbonates of lime, by M. Raoult. The property of hardening in contact with water is observed in all basic carbonates obtained by heating any lime, pure or not, in carbonic acid, and it is this that chiefly characterises that class of compounds.—Influence of concentration of hydrochloric acid on the dissolution of chloride of silver, by MM. Ruyssen and Varenne. The decrease of solubility as the acid is diluted is rapid and regular. The insolubility seems approximately to be tripled as the titre of the acid is halved.—Action of arsenic and phosphoric acids on tungstates of soda, by M. Lefort.—Researches on tertiary monamines; action of heat on bromide of allyltriethylammonium, by M. Reboul.—On the microzymas of chalk; reply to MM. Chamberland and Roux, by M. Béchamp.—Studies on the coal-formation of Commentry; its formation attributed to transport in a deep lake, by M. Fayol. He here criticises adversely the theory of primitive horizontality of the deposits with general subsidences of the ground. The natural explanation is transport without subsidence. Important industrial interests depend on arriving at an exact theory of formation of coal strata.—M. Daubrée presented the first volume of *Annals* of the School of Mines of Ouro-Preto, sent by the Emperor of Brazil in name of M. Gorceix. This describes some of the mineral riches of Brazil.—M. Tabourin communicated a project for the electric light: he would place in the pedestal supporting the carbons a small magneto-electric machine driven by the force of water in pipes, or by compressed air, or by descent of a weight.

VIENNA

Imperial Academy of Sciences, June 17.—L. T. Fitzinger in the chair.—T. Exner, examinations into the localisation in the cortex cerebri of man.—A. Rollett, on the action of salts and sugar on the red-blood corpuscles.—L. Boltzmann, contributions to the theory of viscosity of gases.—On some theorems relating to heat-equilibrium, by the same.—Ign. Klemencic, on the deadening vibrations of solid bodies in liquids.—Dr. K. Friesach, on the transits of Mercury and Venus in 1881 and 1882.—G. Haberlandt, on the collateral vessels in the leaves of ferns.—T. Herzig, contributions to the knowledge of trigenic acid.—A note on cyanuric biuret, by the same.—H. Fürth, on berberonic acid and the products of its decomposition.—G. Goldschmidt, on some new aromatic hydrocarbons.—C. Senhofer, on the direct action of carboxyl groups on phenols and aromatic acids.—C. Senhofer and F. Salay, on the action of hydroquinone on potassium dicarbonate.—C. Brunner, on the action of tolu-hydroquinone on potassium dicarbonate.—T. Zehenter, on some derivates of α-dioxybenzoic acid.—D. T. Woldrich, second report on the diluvial fauna of Zuzlawitz near Winterberg (Bohemia).—T. Pernter, on the daily and yearly course of atmospheric pressure on mountain-summits and in Alpine valleys.

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