THURSDAY, JULY 10, 1884

THE CHOLERA GERM

AT the present moment when the Continent has again become the battle-field between cholera and the human race, all questions concerning the cause, diffusion, and prevention of the cholera virus must take a prominent place in the deliberations on the best sanitary measures to be adopted in combating this insidious foe. Almost all practical preventive measures in this country and on the Continent as regards cholera and other infectious maladies are based on the assumption—supported by a good deal of evidence both theoretical and practical—that the virus is particulate, and, as indicated by its self-multiplication within the affected person, is a living organism. But the nature of this supposed organism of cholera has, until quite recently, been altogether mysterious. As is well known, Prof. Koch and colleagues, sent out last year by the German Government to investigate the cholera in Egypt and India, have ascertained that in the rice-water stools voided by patients suffering from the disease there are present, besides micrococci and bacilli common to the evacuations of other than cholera patients, peculiar curved bacteria, so-called "comma-shaped" bacilli, which Koch has not been able to discover in any cases of diarrhœa. These "comma-shaped" bacilli Koch has succeeded in isolating by artificial culture. Unfortunately cholera has hitherto not been found transmissible to the lower animals, and therefore the function of these "comma-shaped" bacilli must at present remain unknown. All we can therefore say is that Koch has shown that in cholera evacuations there exist, besides micrococci and straight bacilli, other organisms also characterised by this—that they are curved or comma-shaped. Whatever else has been said by Koch, his followers, and critics, scientific and daily papers, as to these "comma-shaped" bacilli being the cause of cholera, is simply and purely a supposition, which, as we shall presently show, is wanting in the most essential elements.

First and foremost, Koch has been unable to find anything of this "comma-shaped" bacillus in the blood or tissues in any stage of cholera. Now all experience on cholera teaches that, whatever its cause may be, the alimentary canal is not the only passage through which the cholera-poison enters the system, but that its entrance through the respiratory organs is also an established fact. For this reason it is necessary to assume that, as in other infectious diseases, it passes in the stage of incubation of the disease through the blood and system. The symptoms of cholera, the whole nature of the disease, shows that it is not a local distemper of the alimentary canal, but that the latter is merely a symptom of the malady, as much as in typhoid fever the distemper of the ileum and spleen, or in scarlatina that of the skin, throat, and kidney. Had Koch found the "comma-shaped" bacillus in the blood or the tissues, *e.g.* the blood-vessels of the alimentary canal, mesenteric glands and spleen, the nature of this "comma-shaped" bacillus would have been as obscure as ever, but still there would have been some sure element in the chain of surmises. Of course it might be argued, and as a matter of fact it is argued by Koch in the reports to his Government, that the bacillus, having found entrance into the cavity of the intestines, there multiplies, and produces some ferment, which, absorbed into the system, sets up the whole chain of appearances constituting the symptoms of cholera. This is quite possible, and to a certain limited extent is borne out by experience, notably in the case of putrid or pyæmic poisoning, where, owing to the presence of putrefaction in a wound, the products of putrefaction—the sepsin—absorbed in sufficient quantities into the system, create the above disease, often terminating fatally. In this case no specific organisms are detected in the blood or tissues; their presence is limited to the wound only, and their effect is merely this, that some ferment—ptomaïne or some other substance—produced by them is absorbed into the system.

That this should also be the case in cholera is, as we just said, possible, but it is not probable, for the simple reason that the cholera virus in a large percentage of cases enters the system by the respiratory organs, and therefore it must be assumed in these instances to pass into the general circulation, and consequently, if it is to be identified, must be identified in the blood or tissues.

The practical consequences of an assumption that the cholera-virus passes into the system exclusively by the alimentary canal, and that it has its breeding-ground in the latter only, are so great, that before acting on such an assumption the basis for it ought to be established, which it certainly is not.

Secondly, is it a well-established fact that this "comma-shaped" bacillus is present only in cholera evacuations? If it should be found that this bacillus is absent from the alimentary canal in all other diseases, then we could at best recognise it as pathognomonic, but it by no means follows that it is also pathogenetic.

I have lately had the opportunity of inspecting this "comma-shaped" bacillus in specimens prepared by Koch, from the rice-water evacuations, and also in artificial cultures, and I have fully convinced myself of its reality. But I possess prepared specimens of evacuations of patients suffering from severe diarrhœa (in an epidemic outbreak of diarrhœa in adults in Cornwall in the autumn of 1883, and investigated by Dr. Ballard, Inspector to the Local Government Board), in which specimens, besides micrococci and straight bacilli, there are undoubtedly present bacteria which, in shape and size and mode of staining, so closely resemble the "comma-shaped" bacilli of cholera that I am unable to discover a difference between them. I have, however, not made any artificial cultivation of them, and therefore cannot say whether there exist any differences between the two, notably as regards their mode of growth.

Here is one other point to which we wish to draw attention: as Cohn (*Beiträge zur Biologie der Pflanzen*, Heft ii.) has shown, and as is now generally accepted, a rod bacterium which is characterised by being curved is regarded not as a bacillus but as a vibrio; and it is not quite clear why, unless for the sake of novelty, Koch, generally accepting Cohn's terminology, should in the case of the cholera bacterium have deviated from it, and should not rather have spoken of it as a vibrio, because a vibrio, and particularly a *Vibrio rugula* (sp. Cohn), is the organism which he describes as a "comma-shaped" bacillus. E. K.

SULLY'S "OUTLINES OF PSYCHOLOGY"

Outlines of Psychology, with Special Reference to the Theory of Education. By James Sully, M.A. (London: Longmans, Green, and Co., 1884.)

AT the present time no one is so well qualified as Mr. Sully to write in the English language a text-book of psychology. Himself not committed to any of the systems of philosophy, he is unsurpassed in his knowledge of all, while we do not think it is too much to add that there is no one in this country who can be said to equal him in his acquaintance with the literature of pure psychology. Moreover, the weight of his information is ably balanced by that of his judgment, and therefore we were prepared to expect that in the often difficult task of drawing the lines between philosophy and psychology, he would furnish in this text-book and in this particular a brilliant example of scientific discrimination. After having carefully read his work with this consideration before our mind, we are glad to allow that our expectation has been fully realised, so that in no case can we say that we have found a philosophical theory doing duty for a psychological fact, or a psychological doctrine unduly coloured by the use of any philosophical spectacles. And this carefulness of method is the more creditable to the author, inasmuch as he nowhere avoids pointing out the relations in which this and that truth of psychology stands to this and that system of philosophy.

The work, which runs to about 700 pages, is conveniently arranged in large and small print paragraphs, with headings in large type, while copious foot-notes give references to all the more important literature on each point as it arises. "Outlines of Psychology" is thus a treatise well adapted to fulfil one of the most important functions of a text-book, viz. that of reference. But the main object which Mr. Sully has in view is that of supplying a text-book for educational purposes, and in order to further its usefulness in this respect he systematically travels beyond the "outlines of psychology" in seeking, as he says in the preface, "to give a practical turn to the exposition by bringing out the bearings of the subject on the conduct and cultivation of the mind. With this object I have ventured here and there to encroach on the territory of logic, æsthetics, and ethics, that is to say, the practical sciences which aim at the regulation of mental processes. Further, I have added special sections in a separate type dealing with the bearing of the science on education."

It will thus be seen that the work is designed to meet the wants of divers classes of readers—teachers as well as students, and professed psychologists as well as beginners. But, owing to the arrangement of the subject-matter and to the employment of different kinds of type, confusion between the several objects which the writer has in view is avoided, while each class of reader can immediately find what it is intended that he should read. For our own part we have found profit in not skipping anything; there is advantage to be gained by reviewing even the elementary truths of psychology when these are so clearly marshalled in logical order.

If we were asked to indicate in what one respect more than another the present text-book of psychology differs from its predecessors, we should say that it does so in giving prominence to the principles of development. Without expressly espousing the theory of evolution, Mr. Sully carries through his exposition a latent reference to it, and clearly shows that he considers one of the most important duties of the present-day psychologist to be that of tracing on the one hand the probable influences of heredity upon mental constitution, and on the other the historical order of events in the psychogenesis of the individual. This leads him to assign a prominent place to the literature which of late years has joined the philosopher to the sect of baby-worshippers; and it is evident, from the number of original observations which are scattered through the book, that Mr. Sully must himself have spent no small amount of time and devotion at the shrine. Here is one of his experiences, in which "a little girl of 4½ years once drove her mother to one of the most difficult problems of philosophy." On asking why a wasp could not hurt a window-pane with its sting, and on being told in answer, "Because the window-pane has no nerves and so is not able to feel," the child perplexed the learning of the household by asking—"Why do nerves feel?" We quote this little incident in order to cap it with one of a still more embarrassing kind, which we were told a short time ago. Another little girl of the same age was silently watching her father write his sermon, and after protracted observation put to him the somewhat difficult question—"Papa, does God tell you what to write in a sermon?" With some little hesitation our clerical friend replied in the affirmative, whereupon he was ignominiously nonplused by the further question—"Then, papa, why do you scratch it out again?"

Where so much work has been so well done, the function of criticism would be an ungracious one. Nor, indeed, is it an easy thing to pick, and still less to find, a hole in Mr. Sully's armour. The most important of the doctrines which we are disposed to question is the one which says, "In later life we rarely if ever judge without making a verbal statement or proposition externally or internally" (p. 392). This doctrine is no doubt one that is very generally accepted, but it appears to us, with as little doubt, absolutely untrue. Unless we limit the term Judgment to the very act of Predication (in which case the term is divested of all its distinctive meaning), it appears to us as obvious as anything can be that in order to form a judgment there is no need to frame a proposition. Thus, for instance, to adopt Mr. Sully's illustrations, whether by an immediate act of observation I judge "This rose is blighted," or conclude from certain signs in the sky that it is going to rain, in neither case is it necessary for me to clothe the judgment in words, "externally or internally" spoken. The *judgment* (as distinguished from the statement of it) is in both cases formed quite independently of speech, in the same manner as are the so-called "practical judgments" of infants and animals. But not only so. Even with respect to the more elaborated judgments which belong to what Lewes called "the logic of signs," we do not believe that, when once the needful structure of conception has been erected by the scaffolding of verbal signs, it is then always necessary to revert to this scaffolding every time that the conceptions are required for the purposes of a judgment. The finished conceptions are known to be standing, as it were, already built, and do not require to be mentally named, or newly reconstructed, in every act of thought. And similarly with respect to propositions, although we cannot doubt, from inquiries which we have made, that some eminent thinkers habitually employ the "*verbum mentale*" in the mechanism of their thinking much more than others equally eminent, yet we do not believe that any man who ever thought was in any large measure really dependent upon this *verbum*. Indeed it appears evident that in all cases that mental seizure of perceived relations, in which an act of judgment as such consists, must be prior to the statement of the act, whether internally or externally. No doubt the statement may serve in many cases to give clearness and precision to the judgment after it has been formed; but even here we are convinced that some thinkers are much less dependent upon this artificial assistance than others. In some minds whole trains of conscious reasoning upon matters of the most abstruse kind may pass without a single act of predication being performed, until the necessity arises for considering how these trains of reasoning may be expressed to other minds.

We have dwelt upon this point, because it is one to which we should like to see the attention of our psychological readers directed. But we may now conclude by saying that every one who desires to have his information on psychological matters brought up to date ought to procure this excellent text-book. It must have involved immense labour on the part of its author, and the result is one which deserves the substantial gratitude of the public. GEORGE J. ROMANES

OUR BOOK SHELF

Numerical Exercises in Chemistry. By T. Hands, M.A., Science Master in Carlisle Grammar School. (London: Sampson Low and Co., 1884.)

THERE are now several of these small books of questions in chemical arithmetic before the public, and although serving a very useful purpose, the tendency to run into purely arithmetical exercises with a flavour of chemical connection or application is apparent to a greater or lesser degree in all of them. This is to be regretted, as there is plenty of room for purely chemico-arithmetical problems and questions. And then again it is not desirable that more time than necessary should be taken up by the chemical student in solving arithmetical problems, seeing the immense amount of work to be done by the chemical student before he attains to a very moderate knowledge of the subject. We have an ever-increasing number of students who pass elementary and advanced examinations but who are completely fixed by problems in practical or theoretic chemistry whose solution demands only a knowledge of the fundamental properties of the elements and the effects of mass or temperature. The questions in this little book are varied and not too numerous in any one section, and should be useful as leading up to chemical *thinking*.

Chimie Elementara. Partea I. Metaloide. By Prof. Licherdopol. (Bucharest, 1884.)

THIS is a text-book in use in the technical school in Bucharest, and for an elementary work contains a very large amount of matter, and with the usual exception of having theoretical considerations in the early part of the book it is well arranged. The present part deals with the so-called non-metallic elements, which are arranged and treated in order of valency. At the end of each section are questions and problems. The appendix contains some good tables for the qualitative testing for acids and non-metallic substances and on rational formulæ, both for mineral and organic substances. The work has a decidedly practical stamp, and should be well adapted for a technical school of a general character.

Voyages of Discovery in the Arctic and Antarctic Seas and Round the World. By Deputy Inspector-General R. McCormick, R.N., F.R.C.S. Two vols. (London: Sampson Low and Co, 1884.)

IT seems rather late in the day for Dr. McCormick to tell the story of the various voyages in which he took part, in two handsome and richly illustrated volumes. He is certainly extremely diffuse, and has evidently no idea of perspective and proportion. However, we can pardon much in a venerable officer who has done good service to his country and to science in his day, especially since his volumes contain much that is really valuable. Dr. McCormick was with Sir Edward Parry in 1827 in the attempt of the latter to reach the Pole from Spitzbergen. But the greater portion of the first volume is occupied with the journal he kept when serving as surgeon in Ross's Antarctic Expedition of 1839-43; curiously he mentions only once or twice the name of Sir Joseph Hooker, whose classical Antarctic and other Floras were the result of his exertions during the same expedition. The second volume is occupied with the account of a boat voyage by Dr. McCormick in search of Sir John Franklin, and with his own exceedingly minute autobiography. The student of science will find much to interest him in these volumes; the very large-scale illustrations of the forms of ice seen during the Antarctic voyage are of special value.

LETTERS TO THE EDITOR

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

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

Science and the Sandhurst and Woolwich Examinations

As one of a class of private tutors who, because they possess the secret of successfully preparing lads of moderate ability for the above examinations, are invidiously or ignorantly termed "crammers," I should like to say a few words on the subject of your excellent leader in NATURE of June 26 (p. 189).

With the opinions and suggestions therein propounded, I most cordially agree, and I believe they would be indorsed by every true friend of real education throughout the country. One or two of the facts connected with the table of percentages admit of an explanation founded on considerations besides those adduced by the writer, the exposition of which will, I think, tend to confirm still more the truth of the general conclusions arrived at. Thus the high percentage of success in French, both for Sandhurst and Woolwich, depends a good deal on the fact that it is compulsory for the preliminary examination in each case, a candidate naturally pursuing for his "further" examination, a subject which he has already partially acquired. It is, besides, *notorious* that this subject is highly marked.

Again, the percentage in the geography and geology for Sandhurst would not be so high were it not that a non-classical Sandhurst candidate generally pitches upon it as offering the easiest choice in the way of a fourth subject, because six questions in the paper are pure geography, a subject which is again obligatory for his "preliminary," while the geology, as the writer remarks, may perhaps be more readily crammed than any other scientific subject.

In the case of a Woolwich candidate who relies mainly on his mathematics, the necessity of a fourth subject is not so much felt, and, besides, his mathematical tastes would naturally incline him, of the two, to take up electricity rather than geology.

It is lamentable to think that this radical change, by which science is virtually shelved, is solely due, as the Duke of Cambridge said, to a desire on the part of the authorities to eliminate the "crammers," and get boys passed into Sandhurst and Woolwich direct from the public schools.

Now, however desirable the approximation to such an ideal may be to the authorities, or even the public schools, it is very questionable whether it will prove equally desirable for the service, unless indeed means are taken to insure that the schools will do their work more efficiently than heretofore. This is scarcely likely to be accomplished by cutting science or even English literature out of the scheme, under the pretence that such subjects admit of being "crammed." The truth is that in these points the authorities have simply pandered to the present inability of the schools to teach these subjects successfully. Nor is it likely that the schools will be any more successful in the teaching of French and German up to the new standard, than they have been up to the old. In this, as in everything else, the tutors by the new scheme are really left masters of the situation.

Why do not the authorities accept what the Marquess of Salisbury maintained was inevitable so long as competitive examinations existed, and instead of attempting the impossible task of uprooting the tutor, place him on a recognised official footing, give him in place of the prestige which efficiently insures the maintenance of discipline at the large public schools, the protecting ægis of a few simple rules which every tutor would be obliged to enforce, and the breach of which would render the offender liable to be denied entrance into the service? This would correct the evils which are prevalent at some of our larger army "coaching" establishments, and then there need be no reason for the pretence under which a candidate is supposed to be better fitted for life by a total ignorance of science and the literature of his own country, in lieu of which, like a parrot, he has been taught to chatter one or two foreign languages.

Tunbridge Wells, July 1 E. DOUGLAS ARCHIBALD

Animal Intelligence

HAVING noticed some time ago a number of letters in NATURE on the above subject, I venture to publish an instance, which came under my own observation last month, of extraordinary intelligence in a rat. I was standing in the doorway of a large shed, the further end of which had been partitioned off with bars to form a fowl-house, when I was attracted by a gnawing and scraping noise; turning round I saw a rat run from a large dog-biscuit which was lying on the floor, and pass through the bars. Being curious to watch if he would return, I kept quiet, and presently saw a well-grown specimen of the "common brown rat" (*Mus decumanus*) come cautiously forward, and after nibbling for a short time at the biscuit, drag it towa-d the bars, which are only two inches apart, and would not allow the biscuit to pass. After several unsuccessful attempts he left it, and in about five minutes returned with another rat, rather smaller than himself. He then came through the bars, and, pushing his nose under the biscuit, gradually tipped it on edge, rat number two pulling vigorously from the other side; by this means they finally succeeded in getting a four-inch biscuit through a two-inch aperture. Not feeling pleased that my dog's biscuits should be used as food for rats, I threw a hammer at them and picked up the biscuit.

I think the conduct of these animals showed a wonderful amount of intelligence; it was evident that the first rat saw that to get the biscuit through the bars it was necessary that it should be on its edge, and, not being able to tip it and pull at the same time, he gained the assistance of a friend.

The short space of time during which he was absent, and the concerted ac ion, show also that they must have some wonderfully facile means of communicating ideas. T. W. KIRK

Colonial Museum, Wellington, New Zealand, May

ABOUT twenty miles from this, in the town of Larne, there resides a gentleman in the possession of a cat, which is so great a favourite that every day a plate and chair are placed for her beside her master, whose repast she shares with supreme content.

One day for some reason the dinner was postponed, but the cat came in at the usual hour. She was evidently much disconcerted at seeing nothing going on, walked once or twice disconsolately round the table, then disappeared. Shortly afterwards she returned with a mouse, which she laid on her master's plate, then going away, she came back a second time with a mouse, which she put on her own plate. She postponed further proceedings until her master returned, when she immediately began to purr and rub herself against his legs, as much as to say, "See how nicely I have provided for you."

Between this town and the village of Holywood there is a country house which happened to take fire last week. The cat of the house, which had access to the servant-maid's apartments, ran up and pawed the young woman's face. Being very drowsy, the girl turned to sleep afresh. The cat, however, after some interval returned, and proceeded to scratch the girl's face to such purpose that she rose, and, smelling the fire, wakened the other members of the household, and the flames were extinguished.

A nephew of mine who is fond of cats generally keeps three or four, and by dint of pains and kindness teaches them a variety of tricks. I saw one of them sipping cream from a teaspoon, which it held between its two forepaws. I might relate quite a number of other particulars about cats, but do not like to trespass further on your space. The foregoing, along with the other details which I have already furnished, are perhaps not unworthy to be placed beside the interesting particulars narrated by the younger Cuvier and Mr. Romanes in reference to the intelligence of animals. HENRY MACCORMAC

Belfast

Butterflies as Botanists

THE caterpillars of Mechanitis, Dircenna, Ceratinia, and Ithonia feed on different species of Solanaceæ (Solanum, Cyphomandra, Bassovia, Cestrum), tho e of the allied genus Thyridia on Brunfelsia. Now this latter genus of plants had been placed unanimously among the Scrophularineæ, till quite recently it was transferred by Bentham and Hooker to the Solanaceæ. Thus it appears that butterflies had recognised the true affinity of Brunfelsia long before botanists did so.

There is yet another and more curious instance of our butterflies confirming the arrangement of plants in Bentham and Hooker's "Genera Plantarum." Ageronia and Didonis were formerly widely separated by lepidopterists, being even considered as constituting distinct families, but now they are to be found beside one another among the Nymphalinæ, and the structure of their caterpillars leaves no doubt about their close affinity. The caterpillars of Ageronia feed on Dalechampia, those of Didonis on Tragia. Now these two Euphorbiaceous genera were widely separated by Endlicher, who placed the former among the Euphorbieæ, the latter among the Acalypheæ; Bentham and Hooker, on the contrary, place them close together in the same sub-tribe of Plukenetieæ, and thus their close affinity, which had been duly appreciated by butterflies, has finally been recogni-ed by botanists also. FRITZ MÜLLER

Blumenau, Santa Catharina, Brazil, June 1

Christian Conrad Sprengel

WILL you allow me a short reply to Prof. Hagen's letter published in NATURE (vol. xxix. p. 572)? It is evident that Prof. Hagen's statements are very far from proving what he asserted in his former letter, viz. that between 1830 and 1840 Sprengel's discoveries were known to every student in Pru sia, and I think it would be easy to any one resident in Germany to prove the contrary by simply c nfronting what the manuals of botany published at that time -ay about the fertilisation of flowers. Thus, as I learn from Delpino's "Ulteriori Osservazioni" (p. 88), Link ("Elem. Philos. Bot.," ii. 1837, p. 222) and Treviranus ("Physiol. der Gew.," ii. 1838, p. 343), both of whom, according to Hagen, were entirely acquainted with Sprengel's discoveries, adopt Cassini's erroneous view of the fertilisation of Campanula being effected through the collecting-hairs of the style instead of through the stigmatic papillæ; and this must have been almost impossible for any one acquainted with Sprengel's excellent account of *Campanula rotundifolia* ("Entdeckte Geheimniss," p. 109). What Prof. Kunth, in his lectures at the Berlin University, taught about the fertilisation of flowers may be seen in his "Lehrbuch d-r Botanik" (1847, p. 422). Almost every line contains errors splendidly and convincingly refuted by Sprengel. Thus he considers as contrivances serving to aid the self-fertilisation of the flowers the collecting-hairs on the style of Campanulaceæ and Compositæ (see Sprengel, pp. 109 and 370), the pollen-masses of Orchideæ and Asclepiadeæ being fixed near the stigma (Sprengel, pp. 401 and 139), the movements of the stamens of Parnassia, Ruta, and Saxifraga (Sprengel, pp. 166, 236, and 242), as well as the movements of the stigmas of Nigella, Passiflora, and Epilobium (Sprengel, p. 280, 160, and 224). I do not know how to reconcile these errors with Prof. Hagen's statement that Kunth was "beyond doubt acquainted with the facts" discovered by Sprengel. He "beyond doubt" never read Sprengel's book, and I can explain those numerous and crass errors of one of the most celebrated botanists only by the assumption that at that time Sprengel had fallen into almost complete oblivion among German botanists, and remained so till, as Prof. Möbius justly remarks (NATURE, vol. xxix. p. 406), "the value of his treatise in its bearing on the theory of selection was first recognised by Charles Darwin." FRITZ MÜLLER

Blumenau, Santa Catharina, Brazil, May 25

Voracity of the Drosera

I AM not aware that the Drosera has been noticed to capture so large an insect as the dragon-fly, *Pyrrhosoma minium*. Passing a pond-side on a bright June morning, where this insect was flying plentifully, and near which *Drosera rotundifolia* was growing in abundance, I saw that many of these insects had fallen victims to the carnivorous propensities of the plant. On one spot about a foot square I counted six plants which had captured specimens of the dragon-fly, besides smaller insects. One plant had possessed itself of two of the dragon-flies, one being partially digested and the other freshly caught. The Drosera plants, being young, were in many instances less in expanse than the dragon-flies caught upon them, which measure about two inches across the wings, with a body about one inch and a half long. The dragon-flies appeared to be attracted to the plants by the reflected sunlight glistening upon the beads of fluid secreted from the leaves, and from which the plant receives its common name of "sun-dew." Those dragon-flies which I saw caught hovered over the plants about a second, at a distance of three or four feet, and then darted upon the plant, when they were instantly caught. A. BALDING

Wisbech, July 3

Lightning

AT this time of the year one commonly reads of persons being struck dead, blind, or senseless by lightning; some of the phenomena are very puzzling, especially in cases where persons are but slightly injured.

On June 6, 1881, I was in the open country near the sea between Gosport and Southampton, in a place where there was no shelter. Here I was suddenly overtaken by a violent storm of thunder, lightning, and rain. Before I had time to think of escape, the air became darkened by the pouring rain, and, to save myself from a drenching, I perhaps foolishly put up my umbrella; at the same instant I saw a blaze of fire on the right-hand side of my face; the thunder burst at the same moment, and a violent wrenching pain seized the fingers of my right hand (which held the umbrella), the pain instantly travelling to my elbow and shoulder, where it ceased. With the exception of a strong pain in the arm like rheumatism for the rest of the day, I felt no further ill effects.

There is a blind beggar sometimes seen about here who carries a label stating that his eyes were destroyed by lightning; there is no iris to either eye; both are quite white. One day lately I asked him how he lost his sight. He said that he was leaving a country public-house during a thunder-storm, and he received the blow from the lightning at the street-door, as he stood on the top of a short flight of stone steps. He could only remember seeing the blaze of the lightning, and being hurled to the ground down the steps into the street. On his senses returning, he was blind. He states that he had a little glimmering sight at the time of recovery, but first one eye and then the other soon became totally blind.

A few years ago several letters appeared in NATURE regarding the descent of balls of fire in thunder-storms. On July 5, 1881, whilst watching a storm from my windows at 11.30 p.m. I distinctly saw in the south a ball of fire drop from the clouds to the earth. The descent was rapid, but not comparable with lightning, and with an inclination to the east. The ball appeared large, and about one-half or one-third the apparent size of the moon. A carpenter who was working for me at the time, Mr. George Hebb, on calling upon me a few days after the storm, told me (I had not previously mentioned the matter to him) that he had seen the descent of the same ball of fire from Mildmay Park whilst he was walking towards the south. It is the only example I have seen. WORTHINGTON G. SMITH

Solar Halo

ON Friday, June 27, about 5 p.m. my attention was drawn to a solar halo which lasted for about two hours from that time; the circular part of the halo was white, and about the size of an ice halo, the sun apparently about four times its proper size and of badly-defined outline; all within the halo was darker than the rest of the sky, and vertically over the sun there was about an octant of another circle (?) touching the first one, but prismatically though not brilliantly coloured. On Saturday night there was a strong pink glow from 9 to 9.30 in the north-north-west, with a greener sky near the moon, which was itself also somewhat green. W. W. TAYLOR

INSECT PESTS IN THE UNITED STATES[1]

THIS volume is issued under the auspices of the Department of Agriculture, and relates entirely to five insect pests. The book is full of matter of general as well as of purely scientific interest, and abounds in suggestions for checking and exterminating the pests of which it treats.

One rises from its perusal with a sense of thankfulness for our temperate climate, insularity, and moderate dimensions. These conditions are unfavourable to excessive multiplication of insect life; and hence we escape the locust, the canker-worm, and the palmer-worm, in their full devastating energy. The connection between solar activity and swarms of insects forms a special section; and the relation between sunspots and locust flights is drawn out in tabular form, showing a striking coincidence between special locust visitations and the minimum of sunspots. This is of course merely a scientific way of showing that hot summers breed insects. The Report deals with the Rocky Mountain Locust, the Western Cricket, the Army-Worm, Canker-Worm, and Hessian Fly, and the treatment of the subject is a full justification of the existence of such a Commission.

An Entomological Section of an Agricultural Department appears to be an absolute necessity in those vast regions, and the facts and phenomena are so startling as to be worthy of constant watchfulness, and this can only be secured by a special and permanent Commission. On the other hand, the powerlessness of man in dealing with the actual invading forces of the winged or creeping armies of Hexapoda is constantly exemplified. It is truly observed that the only effective method of dealing with insects is to study their habits, their structure, their weaknesses, their devolution. It is here that the entomologist shakes hands with the agriculturist. The cultivator is paralysed by the magnitude of the devastation, and the best he can do is to take such self-evident means as are at once available, such as burning, rolling, roping, or the like. The entomologist works less precipitately, but more surely, in studying the sexual and maternal habits of the *imago*, the conditions favourable to incubation, the hatching and development of the *larva*, the transformations to the *pupal* and perfect forms, and lastly, the food and habits of the mature insect.

All these and other matters are searched into by the State entomologist much upon the same principle as a Government section collects information as to the habits and resources of some nation with which it may at some time find itself at war. Thus the Entomological Commission

[1] "Third Report of the United States Entomological Commission. (Washington Government Printing Office, 1883.)

of the United States collects information which may serve a purpose in a war of extermination against the objects of its studies. The volume contains a vast amount of practical information, an extensive series of microscopic sections, chiefly relating to the embryology of insects, zoographical maps of North America, and appendixes bearing upon the subject-matter of the volume. Each destructive insect is very fully treated of with regard to its biological relations, its distribution, ravages, and methods of prevention, all of which are of great interest. A middle section of the volume is occupied with matter which may be described as pure embryology, and deals with the deepest questions which await the microscopist or the biologist. Thus the formation of the blastoderm, endoderm, mesoderm, and inner germinal cells, the phenomena of invagination, the evolution of the brain and ganglionic chain, the philosophy of metamorphosis, and the origin of wings. These matters appear scarcely germane to an Agricultural Department, and it is by no means easy to see how the discussion of such problems can throw the least little ray of light upon economic entomology. Viewed as a pursuit after pure knowledge, and a deep diving after the great mystery of life, these chapters may be considered as a contribution to our speculative knowledge. As a part of an agricultural report they are as relevant as would be a disquisition upon a fourth dimension or molecular movements in solids. At p. 295 is a Genealogy of Insects (Hexapoda), tracing from the Thysanura, followed by a detailed but highly speculative theory of the origin of the Coleoptera and other insect types. "The primitive form of beetle was probably a Staphylinus-like form, with a long narrow body, and rudimentary elytra, and carnivorous in habit." Such speculations probably are useful to their originator chiefly. We do not in fact deny their biological interest, but they are misleading in such a report as that before us. It is no doubt difficult to draw the line between what is useful and what is not, but in loading an economic report with such matter a door is opened which could scarcely be shut against any biological problem whatever. And yet some sop must be thrown to the scientific inquirer enlisted in the service of a Commission. He perchance would mope and pine if too rigidly confined to the economic side without being allowed to express his views upon deeper and wider problems. There is abundance of matter congenial to the agriculturist in these pages. It would not be just in the limits of one short article to attempt to review all the subjects of interest brought within the covers of this volume. We select as an example of the work done by the Commission that familiar enemy of our race, the locust; and we trust room will be found in these columns for a second notice of this work. "If you avoid the destruction of locusts, you will have to forget the welfare of the people: which do you think ought to be thought of first? Was not therefore Tao-choon wise and good when he said 'in killing insects one saves men?" Good Tao-choon flourished in the reign of Taï-Tzoon (dynasty Tan, from 627 ante till 649 post Christum), and he is still quoted in the Far West as an authority on locust destruction. So far back in point of time and so wide in point of distance do the Commission ransack for information, bringing all to bear upon this war. The Emperor Shen-Tzoon's orders would not perhaps commend themselves entirely to the independent voters of the free States. Thus, "whenever locusts leave desert places to go to populated ones, the local chiefs are obliged to hire poor people and have the eggs destroyed. If all of them should not be destroyed, and the locust therefrom reappear the next year, those commanders will be punished with 100 bamboo-rod blows." Again, "Once the locust appears there is no writing to be done for excuses of absence of chiefs, &c.—paper won't help—the commander-in-chief must be present." Evidently high position in the reign of Shen-Tzoon had its duties and responsibilities as well as its privileges. The practical and relentless measures recommended are thus described in the same document. "For the purpose of burning the locusts one digs a ditch 5 feet deep and 5 feet wide and twice as long. One empties the bags into the fire. As soon as the locust is in, it won't jump out. That's what the poetry means by 'delivering them over to the flames.' Even in old times they knew that if you bury a locust he will creep out again. Therefore the destruction of locusts by fire, as they did in ancient times, is the best."

The Rocky Mountain locust (*Caloptenus spretus*) is one out of about 200 species of this prolific family represented in North America. If we run our eyes over the map of North America and set aside all that portion contained between meridians 103° and 117° W. of Greenwich, and from the parallels of latitude 40° to 53°, we have the "permanent home" of this insect well before us. It is all considerably elevated, treeless, and arid, thus agreeing to some extent with the locust areas of Eastern Europe, Northern Africa, Asia, Australia, and Central and South America. It includes the greater part of Kansas, Nebraska, Colorado, Wyoming, Utah, Dakota, Montana, Oregon, Nevada, and extends far southward into Mexico. It is bounded on the north by the tree-bearing regions of British America, on the east by the great wheat-bearing regions of the Eastern States, and on the west by the higher ranges of the Rocky Mountains. This gigantic area comprises 300,000 square miles, and the annual rainfall is under twenty inches. It is all elevated, dry, and bracing, and is known physically as the arid region. It is not a wheat-growing area. Here the locust finds a permanent home, free from diseases, and suitable for breeding, and it is from these regions that, about once in eleven years, or at the minimum period of sun-spots, excursions are made and devastation is wrought. Still, while the whole of the permanent region is favourable to the locust, there are in reality but few portions of it that are adapted to its greatest increase. The largest and by far the most important of these specially favourable areas is that of Central Montana and portions of the British Possessions immediately to the north. The next in importance is that of which the Snake River Valley is the centre, while a third locality is that of Southern Utah and parts of adjoining States. We must not pause to consider the prodigious and terrible armies with their devastating effects, "darkening the sun," and "piled up in 'windrows' for miles in length." Such narrations are highly entertaining, but may be "taken as read" by most of the readers of NATURE. With reference to the treatment of this evil, it is hoped that cultivation will restrict the breeding area gradually but surely, and that the changes of climate which follow the husbandman and timber planter may also act advantageously. The active methods consist in digging trenches, sweeping the locusts into them, and burning them. This is best done when the creatures are in a torpid condition at or before sunrise. Harrowing the ground and processes of cultivation are useful in destroying eggs and larvæ. The noise of musketry and artillery prevents swarms from alighting, and is frequently employed for this purpose, as are also fires with damp weeds thrown upon them so as to cause dense clouds of smoke. Marching locusts may be arrested by strips of tin resting against posts or nailed to walls, as they cannot climb over such smooth surfaces. Other methods are referred to as having been published in previous reports of the Commission, but on the whole the means proposed and adopted are of that simple sort which would be suggested rather by common sense than by any profound knowledge of the creatures' habits.

In this respect the Commissioners have been more fortunate in their study of some of the other insect pests. One correspondent writes with regard to locusts:—"They marched uninterruptedly through the village of Colesberg (Cape Colony), over walls and houses, and destroyed every green thing. The plague lasted for weeks, and until the insects obtained wings, when the winds soon after wafted them away to devastate the lower country, and the ocean received them. Any opposition seemed so hopeless that none was attempted."

Among the most terrible of the insect scourges which affect the vast territories of the Western World, is the army-worm. The name arouses old associations, and one involuntarily recalls "the canker-worm, and the caterpillar, and the palmer-worm, my great army which I send among you." The army-worm well deserves his name, although like most familiar vernacular appellations it may have been wrongly employed. The cotton-worm (*Aletia xylina*), for example, has been so designated; but the true army-worm is *Leucania unipuncta*, known in the earlier chronicle as the "black worm," and is the larva of a Noctuid moth, named as above by Haworth. It is difficult to give an idea of the fearful character of this plague when in obedience to solar influence it begins its march. "Almost with a shudder (p. 145) one remembers that terrible invasion of Monmouth, when the potato fields were ruined as if by fire, and the waggon wheels reeked with green dripping gore as they entered our villages. . . . That beautiful lawn of Hollywood at Long Branch was invaded by them. The emerald sward was swept as if burnt. When any of the worms came against a tree they went up it, passed over the crotch, then descended at the other side. There is no 'turn back' to this singular worm, and when their path is intercepted by a stream, on they come, until, crowded forward, a compacted mass is urged into the water to serve as a living pontoon, over which the army passes to take possession of pastures new."

Another account states that the army-worm when travelling will scarcely turn aside for anything but water, and even shallow water-courses will not always change its progress. They avoid the rays of the sun, hence during the day they crawl under stones and sticks as closely as they can crowd themselves together, like the cut-worm. They come out towards sunset and continue their mighty march. If they come to a field of grass or young grain they devour the whole of it, down to the very roots; but if it is grown up to stalks they eat the leaves only, and then usually crawl to the top of the stalk and cut off the head and drop it to the ground.

They all keep together like an army of soldiers, and usually advance in a straight line, not swerving from their course to avoid hills, hollows, buildings, or any other obstacle. On coming to a brook, they crowd into it; millions of them are drowned, their dead bodies clogging and damming up the stream in places below, producing by their decay a stench in the atmosphere of the whole vicinity most noisome and intolerable.

Monmouth County was invaded in 1880, and the following graphic sentences from the *New York Sun* will help us to obtain an idea of this calamity:—

"Trenches were seen extending for miles along the roads close to the edges of the fields, but the crops for the most part were withered and lifeless, and it was evident that the precautions had been taken too late. Very often a trench ran across a wheat-field, showing where the farmer had abandoned one portion of his crops and tried to save the remainder. Occasionally a field was seen intersected by numerous trenches, indicating that the proprietor had fought manfully against his persecutors, and disputed the ground with them foot by foot. In many places the road was literally covered with the worms, all in motion, and all moving towards the fields on either side. Thousands and tens of thousands were crushed beneath the waggon wheels and under the horses' feet, but the rest passed on. And at intervals spots were passed where an imaginary line seemed to be drawn across the road beyond which the army-worms could not pass. For a certain space beyond, sometimes for a distance of two or three miles, not only the roads, but the adjoining country was free from the pest. Not a worm was to be seen until, the clear space passed, the waggon was again rolling over millions of them." The remedies suggested partake of the general character of the means proposed by entomologists, and are probably mostly learnt by the entomologists from the farmers and peasants. They consist in rolling, fencing, ditching, burning, coal-tarring, poisoning, "drawing the rope," which is done by two men drawing the rope in a direction at right angles to its own length.

Another pest of different habits and less widespread destructiveness is the Canker-worm (*Anisopteryx pometaria* and *æscularia*), an insect which feeds on the leaves of apple-trees, and completely ruins orchards. Entomological science has conferred a boon by suggesting methods of getting rid of this creature by taking advantage of its peculiarities. The female, like our glow-worm, is wingless, and therefore cannot rapidly spread beyond the locality where it exists. She hibernates in the earth near the roots of trees, and on the first return of spring she ascends the trunk, depositing her eggs between the leaflets of the expanding buds, sometimes even close to the ground, but oftenest under loose scales of bark. It is this peculiarity of the female which enables the fruit-grower to grapple with the difficulty. One of the best means is what is known as "hanging the band." This contrivance consists essentially of a band or ring of tin a few inches outside the trunk of the tree, and held there by a circle of muslin attached to the tin at its edge, and drawn with a cord at the top, so as to fit the tree closely and prevent the insects from going over the tin, which is coated with a mixture of castor-oil and kerosene: as soon as they touch this they drop to the ground. Troughs of oil arranged closely around the tree, or the complete isolation of the tree by fitted boarding lined on the outside by smooth tin and also fitted with shallow troughs for oil are also used. Another ingenious plan is to use a cylinder of sheet tin upon a band of line or cord. The cord forms a firm boss around the tree, and the hollow cylinder surrounds it and extends them at four inches above and below it. The female finds this an effective barrier, and it is said if she even succeeds in passing upwards to the top of the cylinder she will never *descend* in the inside so as to again reach the tree.

A good deal of interesting evidence is adduced upon the effects of "jarring and burning," or the jarring of the affected trees, after spreading a light coating of dry straw on the ground below, which is then fired without injury to the trees. A table-spoonful of Paris-green in twelve quarts of water applied to the tree with a large syringe, when, as nearly as can be judged, the worms are all hatched, is a second method. "Fall-ploughing" is a third plan, which appears to have been very successful; and, lastly, attention has been very properly drawn to the balance of power in nature by encouraging birds and parasitic insects that live upon the canker-worm. A valuable distinction has also been pointed out by the Commission between the "fall" canker-worm, and the spring species, from which it differs in many important respects, as may be gathered from its name. There are many other interesting chapters in the volume which we should have liked to at least have mentioned, but it is not our object to do more than give a good general idea as to the work of the Commission and the manner in which it is prosecuted. We therefore leave the consideration of the Hessian fly and the Rocky Mountain cricket, with a hearty recommendation to those who are interested in economic entomology to obtain this Report. J. W.

THE FORESTRY EXHIBITION

IN last week's NATURE (p. 222) we briefly noticed the remarks of the Marquess of Lothian in declaring the International Forestry Exhibition at Edinburgh open. For several reasons it has not been in the power of some foreign Governments to be represented at the Exhibition. And in more than one case, notably that of Chili, an unforeseen accident occurred to prevent others who intended to be present. Where direct participation, in so far as exhibits are concerned, has been impossible, official maps and publications bearing on the forest service or literature of the country have been forwarded, or a representative has been commissioned officially to attend, or the efforts of private individuals have been exerted to supply the omission. The Exhibition has thus been inaugurated by the co-operation of many of the foreign and colonial Governments, and by the good wishes of all.

In the arrangement of the articles exhibited the geographical principle has been adopted, the goods of each country being together.

A scientific arrangement was very desirable, and the "classification" issued by the Executive Committee was prepared with that intention, but it was found impossible to arrange the Catalogue in accordance with it, from the imperfect details given in many of the schedules of exhibitors, and the tardy arrival of the consignments. Great latitude has been allowed to the admission of goods, which have been largely received during the week since the opening, and we believe that the very large and interesting collection from Japan will be in its place in a few days.

The Catalogue contains much valuable information, especially the portion relating to India and the Scottish Arboricultural Society, which together cover eighty pages; but it is not yet complete with respect to several colonies and foreign Governments, notably Japan. A new edition is promised, more easy of reference, where the theoretical classification of the articles on paper will agree with the actual distribution in the building.

The ground on which the buildings are erected is 5 acres in extent. The main building is 650 feet long by 55 feet broad, with three annexes, each 150 feet long by 55 feet broad, with a high central dome in each annexe.

The design of the buildings is similar to the main galleries in the Health Exhibition, Kensington. Additional annexes, 500 feet long and 25 feet broad, similar in design to the main buildings, were erected at a later stage in consequence of the large demands for space by the Japanese Government, &c.; the exhibiting area thus became one-third larger than its original extent. It is a handsome light building which produces a very agreeable effect on entrance.

The Electric Railway runs along two sides of the building, and is about 650 yards in length. On the west side of Donaldson's Hospital grounds a field 7 acres in extent was inclosed for the purpose of exhibiting woodworking machinery in motion, nurserymen's exhibits, greenhouses, iron houses, wire fencing, gates, &c. Here will be found various huts and châlets, including one from Balmoral; also the Manitoba Settler's Farm, and many varieties of models of gates, fencing materials, &c., exhibited by the Commissioner of Her Majesty's Woods and Forests, all having a connection with the wide subject of forestry.

The Indian collection occupies the south central transept, and several bays on each side; it is very large and interesting; the catalogue has a historical preface by Sir George Birdwood. The arrangement is admirable, Col Michael and his assistant having had experience in the Paris, Vienna, and Amsterdam Exhibitions.

The Index Collection of Timbers sent by the Government of India, comprises 800 specimens, with their commercial uses and habitats, and illustrates arboreal vegetation from Thibet to Cape Comorin; each specimen is carefully labelled.

In the Indian Court may be specially noticed the very valuable series of maps and diagrams executed by the Forest Survey Department under Major Bailey, R.E., who has himself arranged them in an instructive manner. The excellence of these topographical surveys can scarcely be overrated in connection with the demarcation and management of the reserved forests divided into blocks or compartments, and in the case of boundary disputes their value is undeniable. For students of forestry this is a most important feature of the Exhibition, and shows the silent progress of the great work which has been carried on by Dr. Brandon and his assistants during the past twenty-five years.

The only other country which exhibits maps showing in detail the general distribution of forests is Denmark. There are three sheets displaying the occurrence of the forests of conifers and of broad-leaved trees, also the extent of newly-planted areas and the geological formations on which they grow. There are also maps of the forest district of Kronborg which resemble those made in Germany, and are very neatly executed.

It would have been very desirable that sets of these illustrative maps had been furnished as far as possible by various Governments to assist in determining the rates of growth of indigenous trees in different countries. For instance these diagrams give the mean height from 20 to 120 years, and show that in Germany the height of beech and spruce is greater than in Denmark; but the average diameter of the latter exceeds that of the former.

In the Indian collection an interesting contribution from Col. Yule has found a temporary resting place. Marco Polo, who tells us of the existence of the roc, a bird of wonderful dimensions, further tells how the feather or quill of the roc was brought back by envoys to Madagascar or East Africa, and presented to the Great Khan. Col. Yule and Sir John Kirk seem now to have brought to light the true roc's quill in the frond of the leaf of the *Raphia* palm, which is largely used on the coast near Zanzibar for making stages, ladders, rafters, and doors. The hard ligneous frond, stripped of its leaflets, somewhat resembles a stripped feather; the largest is twenty-five feet four inches long, and twelve inches in girth at the base.

TECHNICAL SCHOOL EDUCATION AT THE HEALTH EXHIBITION[1]

In last week's issue some account was given of the appliances, methods, and results of primary school education to be seen at the Health Exhibition, and we ventured to express the hope that this remarkable and probably unprecedented collection would be carefully inspected by as many as possible of our schoolmasters and mistresses, as well as by school managers and others. In the present article it is proposed to deal similarly with technical handicrafts and science teaching as practised not merely in England, but in those foreign countries and organisations which, as previously stated, have brought together such excellent collective exhibits.

The increased attention now being devoted to the whole subject of infant training, and the enlarged sympathy and interest with which the best modern teachers are studying the methods of Fröbel (some of the developments of which are at the basis of all so-called technical training), have justified the appropriation of a considerable space to illustrations of the Kindergarten system. The British and Foreign School Society have devoted the whole of the room at their disposal to this purpose, in order to make the display as complete as possible, and here will be found a practical answer to those who allege that "Kindergarten work is all play," for the manner in which it leads up to various trades is distinctly shown. In the Belgian Court there is also a very complete and effective Kindergarten exhibit, though it contains nothing specially new, and the

[1] Continued from p. 220

same remark applies to that of the city of Antwerp. In the gallery of the Albert Hall (No. 1374) is an admirable exhibit, in which all Fröbel's occupations are grouped round a given object in nature, illustrating the Pestalozzian system of Kindergarten teaching, as carried out in Berlin.

The subject of domestic economy, and other forms of technical and industrial occupation for girls, is illustrated in a very thorough manner by the Minister of Public Instruction in Belgium, and to a less extent by the corresponding official in France. A notice appended to the Belgian Illustrative Museum states that mere oral lessons have been found to produce no good results, and hence that this subject is taught in a "decided, intuitive, and demonstrative" manner, which has necessitated the formation of illustrative collections in each school. These will be found to be most complete, every stage in the manufacture of clothing and food, from the raw material to the finished product, being illustrated, as well as the more important points in house sanitation. No similar exhibit is to be found in the English section. The embroidery and other work of the "École professionelle de jeunes filles" will repay careful inspection. With regard to needlework generally, we are informed that some lady experts in this matter have a very high opinion of what is shown in the Belgian and French Courts, as well as of that sent by the Birmingham School Board, which appears to be the best English needlework. In this connection also a word may be said in support of the efforts now being made by the Scientific Dress-cutting Association, who show interesting demonstrations of their methods.

Turning now to the more general question of scientific and technical instruction as illustrated at the Health Exhibition, it will be remembered that one of the results of a comparison of English and foreign primary school methods was stated to be, that elementary scientific instruction formed a much more prominent feature in French and Belgian primary schools than in English. We notice with great pleasure that, in opening a higher-grade school at Manchester on Monday last, Mr. Mundella pointed out that one objection to English education was its too exclusively literary character. The practice of the Liverpool and Birmingham School Boards, and to a less extent of the London School Board (which in its exhibit endeavours to illustrate its whole system, and not merely certain features of it, as is done by the Birmingham authorities), is however a pleasing exception to this general statement. It cannot be denied, however, that a very much better foundation is laid in primary schools abroad than at home for that technical education the importance of which is now becoming so generally recognised, as evidenced by the extraordinary demand for copies of the recently published Report of the Royal Commission on the subject, and by the noble building in which the chief educational exhibits are temporarily housed.

It may be convenient, as in the former case, to notice first the foreign appliances for, and results of, technical education, the collection of which in point of interest and size is not so large, when compared with the corresponding English exhibits, as is the case with the primary schools. In the Belgian Court the collections of the Ministry of Public Instruction and of the Carlsbourg School are specially noticeable; the technological collections to illustrate the various industries are most complete, and are arranged under such heads as vegetable fibre, minerals, the animal kingdom, &c., while under the head of botany is an admirable series of specimens illustrative not merely of agriculture but of arboriculture, the various methods of grafting, for example, being clearly shown. There is also an interesting collective exhibit "des écoles industrielles et professionelles," and there are no less than three societies whose sole object is the technical and professional training of women in various trades, such as artificial flower-making, dress-making, embroidery, &c. This appears to be a new departure, which might be advantageously followed in our own country.

In reviewing the recent progress of educational legislation in France, we find that in March 1882 laws were passed which rendered obligatory (1) the teaching of the elementary physical sciences in primary schools, and (2) the performance therein of a certain amount of manual work. Accordingly, under the first of these heads we find exhibited by the Minister of Public Instruction the authorised collections of objects and apparatus used in this teaching, as well as models of simple and cheap instruments such as could be fabricated by the pupils themselves. The second law alluded to has called into existence the "École normale de travail manuel," a school probably unique of its kind, whose whole course of instruction is well illustrated by a series of photographs and specimens, and by a detailed programme. It comprises the systematic teaching of carpentry, the use of the lathe, the chemical and physical laboratory, the smith's forge, and the "fitting" shop. The whole instruction is gratuitous, and admission is obtained after a competitive examination in the lower grade schools. Fuller details about this school, as well as about the present system of education in France as a whole, will be found in the ten pages of the special educational catalogue devoted to an introduction to the French exhibits. Closely associated with this is a capital collection of work from the École des Arts et Métiers of Aix (Bouches-du-Rhone), which, together with the results of various apprenticeship and art schools, is exhibited by the Ministry of Commerce, Paris. The handicraft work of the primary schools of Vierzon and of Voiron (Isère), as well as of the technical schools at Evreux and Nantes, deserves careful examination, while in the department of agricultural industry, the work of a school at Lille is much to be commended and worthy of imitation. Among the private exhibits in the French section the most noticeable features are:—the admirable collection of objects of natural history and of science diagrams, all for school use, shown by M. Émile Deyrolle, and the wonderful collection of botanical and physiological models shown by Mme. Veuve Auzoux and M. Montaudon. Part of this is a series of anatomical models (probably the best of their kind) composed of solid pieces, which can be easily adjusted or separated, and removed piece by piece as in actual dissection. Somewhat similar models are shown by Mme. Lemercier. It is greatly to be regretted that the very high price of these excellent models is an effectual bar to anything beyond a very limited use of them.

The collection of educational appliances as used in Norway, and shown by Mr. Mallings in the gallery of the Albert Hall, deserves warm commendation. It is characterised by the same importance as attached to objective and practical teaching (as distinguished from book-information) which we noticed in the French and Belgian schools. This publishing house is one of the sights of Christiania.

Prominent among the illustrations of technical education in England, the preparations for which, as we have before stated, have not yet reached down to our primary schools to any appreciable extent, are the three rooms devoted to illustrations of the work at the Finsbury Technical School. These are specially remarkable as showing the admirable methods which characterise the whole of the work there, and which, we venture to think, deserve careful study. A room is devoted to the mechanical laboratory and appliances, and a large amount of space to the department of electrical engineering, while a special feature in the display is the printed explanatory paper of notes attached to each piece of apparatus. Another good example of English technical education is the collection of drawings and models relating to coach and carriage building, to which three organisations contribute, illustrating the alterations that occur in the conditions of locomotion. There is a very good collection of excellent specimens of school work done in the Allan Glen's Institution of Glasgow, in which the object of a two years' technical course is to prepare boys to learn trades whose mastery implies a considerable amount of scientific knowledge. University College, Nottingham, exhibits some work done in the recently established technical school attached to it, and the Engineering Department of University College, London, illustrates its work mainly by photographs and plans. The nearest approach to the handicraft school teaching as practised on the Continent, is to be found in the admirable technical work of the Central Higher School of the Sheffield School Board, in which an attempt is made to provide the proper connection between the theoretical instruction in the class-room and the practical instruction in the workshop. The Manchester Technical School, the Oldham School of Science and Art, the Clerkenwell Technical Drawing School, and the School of Art Wood carving all show praiseworthy results of technical training. Attention may here be called too to the admirable specimens of work done in the four trades-departments of the National Industrial Home for Crippled Boys; the pupils vary in age from twelve to eighteen, and having chosen a trade on entering the school, follow it for three years.

Among the results of the work of individual exhibitors, the exhibit of Mr. Robins calls for special notice, consisting as it does of a series of drawings illustrative of the general arrangements and fittings required for applied science educational buildings; these are so placed that comparisons are readily made between the arrangements adopted in various noted colleges, &c. Mr. Millis shows some excellent results of instruction in trades classes, specially models in wood and metal-plate work. Mr. James Rigg exhibits more than a hundred mechanical models specially arranged for instruction in four or five of the subjects in which the Science and Art Department examines pupils, and a smaller collection of the same kind is shown by Messrs. Gilkes and Co. Lathes of different patterns, and other mechanical tools and apparatus, are exhibited by Messrs. Holtzapffel and Co., Messrs. Melhuish and Sons, Mr. Syer, Mr. Evans, and others.

In neither of these articles has any reference been made to the appliances for elementary art instruction, nor to the special methods and apparatus used in educating the blind, and the deaf and dumb, all of which, however, are very fully illustrated. The seven classes of exhibits which come under "Group IV.—The School" (to quote the official phraseology) are also unnoticed. These comprise such important subjects as everything relating to the structural arrangements of school buildings, school kitchens, sanatoria, and infirmaries, and lastly, though by no means least in importance, the gymnastic and other apparatus for physical training in schools. Enough however has, we hope, been said to give some idea of the vast scope of this exhibition of educational appliances, and to justify the assertion made at the beginning of the first article, that probably no such extensive and valuable a collection of school appliances, methods, and results has ever been brought together before. Such an opportunity for study is not likely to occur again for some years, and we conclude by reiterating an earnest hope that it will not be lost by those most vitally interested in it.

WM. LANT CARPENTER

CHEMICAL RESEARCH IN ENGLAND

THE address of Dr. Perkin, F.R.S., to the Chemical Society at its anniversary meeting contains some sadly true statements respecting the state or rather the absolute want of state of research in chemical science in this country. After drawing attention to some interesting points in the work done during the past year, Dr. Perkin goes on in the first place to refer to the very small number of original papers contributed to the Society during the past year (a point to which attention was called in these columns a few months ago), and then compares foreign sources of research work and the probable causes of this disparity. But this portion of the address will speak better for itself than in a mere abstract, and the facts therein stated demand the most serious attention of the authorities at our seats of learning.

Last year, Dr. Perkin went on to say, my predecessor, in his address, referred to the increasing number of chemical laboratories in the United Kingdom and the greater facilities which are now afforded for the prosecution of research. After considering the number of papers which have been read before this Society during the past few years, it appeared to me that it might be useful to make some remarks as to the influence these greater facilities have had on the development of chemical science.

The first thing that attracts attention is the startling and anomalous fact that the number of papers read before the Society (and I think this may be taken as a good criterion, especially as but few have been brought before the Royal Society) is declining year by year. The largest number we ever had was in the session 1880–81, when there were 113 communications brought before us; but in 1881–82 they declined to 87, in 1882–83 to 70, and this last session to the lamentably low number of 67, or about the number we had nine years ago. And this, not only with increased laboratory accommodation, but also with the assistance offered to investigators by our Research Fund and the Government Grant. This state of things causes us to look around and see where research *is* and where it *is not* being carried on in the United Kingdom.

If we look to the laboratories of our Universities, from many of these we never hear of a research emanating, and from the rest, taken as a whole, we get but driblets at intervals. How different from the German Universities, from which there is such an incessant flow of work!

If we turn to the other laboratories connected with our colleges, hospitals, &c., with how few exceptions do we find any appreciable amount of work being carried on for the extension of the boundaries of our science; in fact, speaking in a general way, the work of our laboratories consists mainly in the students carrying out the ordinary course of qualitative and quantitative analysis, and attending one or two courses of lectures.

It is scarcely necessary to say that this is not sufficient, however well taught, to make a student a chemist; it is but a preliminary part of the training, which, being carried on as it usually is, by tables, and carefully laid down directions, gives but little scope for independent thought and action. The subsequent prosecution of scientific research, under proper supervision, however, is quite another thing, and calls out all the faculties of the student, requiring, as it does, independent thought and independent methods of working, and, moreover, gives him an insight and vivid interest in his science that nothing else will do. The preparation of chemical products, before the commencement of research, is no doubt also a very useful training if sufficiently diversified; but research is the most important of all.

The degree of Doctor of Philosophy has undoubtedly done a good deal to further chemistry in Germany, necessitating, as it does, the prosecution of original work, and now that degrees are so much thought of in this country (though why a chemist with one of our ordinary University degrees should be preferred to one who has fully given his mind to his science, and therefore has not got such a degree, it is difficult to understand), it is believed that if something analogous to the Ph.D. could be inaugurated in this country, it would help to further chemical science here also. A step in this direction has been taken at the Owens College, Manchester, but hitherto the degree has not found favour with students. It is not surprising, however, while there are so many different degrees not requiring original work as a *sine quâ non*, that such a degree should not be sought after. This difficulty, however, might be overcome by modifying the requirements for the present degrees, and requiring that original research should be substituted for book knowledge. At the London University original work is recognised, but not required.

The past neglect of research will, it is to be feared, have a more lasting influence on the progress of chemistry in this country than may appear at first sight, and in this way. Those who have been students in laboratories where the importance of this kind of work is not recognised, advance in their positions, becoming assistant demonstrators, &c., and eventually professors, and as they have not learnt to practically realise the value of research by being in the habit of conducting it themselves, or of seeing others do so, when they become professors they will naturally not encourage students to undertake it in their laboratories, and it is to be feared that we are already suffering in this way, and that this is one of the causes why the new laboratories which have been opened are doing so little to add to our store of fresh knowledge.

It is said that students cannot be induced to stay longer than is necessary to go through the ordinary course of qualitative and quantitative analysis, and can this be wondered at when they do not see anything else going on of sufficient interest to make them feel it would be a great advantage for them to do so? Would it be the case if higher work were being enthusiastically carried on? The fact that many of our students are found to leave this country and go to Germany, where research is carried on with so much zeal, I think gives an answer to this question.

In all chemical laboratories there are without doubt different classes of students: some who have no right to be there, having no care for science; those who have not sufficient capacity to proceed with its study beyond an elementary stage; and those who are capable of becoming efficient chemists. Of course it would be but waste of time to attempt to make the first two classes remain and engage in research. It is to be feared, however, that some are not unfrequently thought to belong to the second class who really, if sufficiently interested in their science by the example of others, would be found to be possessed of no mean ability. When a young man is made to realise that he may be the discoverer of new facts, or does discover new facts, he gets a new impulse, which alters the whole current of his thoughts and actions.

There can be no doubt that when a professor, his assistants, and advanced pupils are enthusiastically engaged with research, their influence is found to act even on beginners, who, if they possess any scientific spirit at all, will realise that the ordinary course of analysis is but a preliminary thing, and will thus be induced to use their best energies to master it that they also may try their hand at original work.

That this condition of things is calculated to fill laboratories with students is seen from the fact that on the Continent, where the greatest scientific activity prevails, the laboratories are the most crowded, and this is the kind of activity we want in this country, where our students pre-eminently possess all the faculties for original work, but as they are not cultivated these are not developed.

There is also another class of students who study chemistry, but the fruit of their study is so extremely small, that it is difficult to realise that it possesses any practical value. I refer to medical students; yet there are good teachers and good laboratories employed in the work, in fact a very large amount of valuable power is used for it; but it seems almost like the employment of a large amount of power to raise a weight to a certain distance and then let it fall again, and year after year to continue the same thing, never raising it sufficiently high that it may be placed in a useful position. The present condition of things cannot but be disheartening both to students and to teachers. Medical students have so much to learn that it it is sad they should have to waste their time in studying chemistry in the way they do. If there is any value in chemical products as curative agents, if there is any value in physiological chemistry, or any importance in toxicology, surely medical students should have a sound knowledge of chemical science, and not simply learn to detect an acid and a base in a mixture, an operation which is of no value except as an intermediate exercise, to be followed by more advanced work.

The only cure for the evil appears to be either that their term of study should be lengthened, or that other subjects which are of less importance should be withdrawn from the curriculum, so as to enable them to work at this science sufficiently. Unfortunately medical men have as a rule acquired so imperfect a knowledge of chemistry themselves that they have found it to be of little value, and therefore do not sufficiently see how important its proper study would be to students. It is evidently high time that some steps were taken to economise the present waste of time and power, and that we should hear of some good work proceeding from the numerous, and in many cases well-appointed, chemical laboratories connected with our hospitals.

Of late years much attention has been given to the subject of technical or applied chemistry, and it is to be hoped that this movement will be so judiciously carried on that much will be done for perfecting and developing the chemical manufactures in this country; but it appears that there is an idea in the public mind that there are two kinds of chemistry in existence, one suitable for the manufacturer, and the other suitable for the scientific man; and unless this idea can be successfully eradicated, it is to be feared that much of the value of this movement will be lost, and we shall be left in the position of followers instead of leaders; copyists of what others are doing, instead of being originators of new processes and industries.

In the present state of things students who are to be manufacturers are supposed to know enough chemistry when they have acquired a knowledge of ordinary analytical methods, and the result is that we have but very few efficient chemists in our works. On the Continent, however, we find a very different state of things: first of all, in their chemical works they usually have a much larger staff of chemists than we do, and secondly, their chemists are efficient men.

The chemists preferred in Germany are those who have had a thorough training, and taken their degree of Doctor of Philosophy, and shown their power as chemists by conducting original research, and in many cases have been for some time assistants to the professors in their research laboratories. Those from the Polytechnics are not so much valued, except in relation to their knowledge of engineering, mechanics, &c.

What do we see as the result of the employment of high-class chemists in Germany? First, we notice that chemical industries are developing and increasing there more than in any other country; and secondly, that the manufacturers are able to make their products in a very economical manner, and as a consequence supply them at a low price. Men who have studied chemistry sufficiently to do analysis and look after existing processes which are well known are certainly useful in their way; but we want more than this; we want men who have had their minds so trained by carrying on research that they may be imbued with a spirit of investigation, and be able to improve or entirely change processes in use, and to keep up their knowledge of chemical science, so as to be able to grasp the importance of new scientific facts, and make them subservient to the industries they are engaged in.

The chemists from the German Universities, when entering chemical works, naturally have but little knowledge of technical processes. This they have to acquire, but unfortunately they then only are likely to see those operations which are carried on in the particular industry with which they become connected. Those who study in the Polytechnics have a certain advantage in this particular, inasmuch as they can become acquainted with processes carried on in a variety of manufactures; and what is wanted nowadays is something like what would result from a fusion of the work of the Universities and the Polytechnics, *i.e.* scientific training similar to that in the former, with a general knowledge of engineering, mechanics, &c., and the methods adopted in carrying on processes on the large scale, this latter not being confined to one industry only, but also to industries in general, so that great breadth of knowledge may be acquired. With men so trained we might expect to see our chemical industries flourish, and keep at least abreast of those on the Continent.

It is to be hoped that some such standard of training will be undertaken at the Central Institute of the City and Guilds of London. It wou'd be a sad thing to find the munificence of the City Companies resulting only in perpetuating the present kind of imperfectly trained chemists, who are incapable of advancing the chemical industries of this country, so that our manufacturers not unfrequently find it necessary to send to the Continent for more competent men.

In this retrospect of the work which is being carried on in relation to chemistry, it may be thought by some that an undue weight has been given to that which is going on in Germany, and too little to that which is being carried on in this country; but I think if any one will impartially compare one with the other, this will not be found to be the case. Science, however, has no nationality, and as chemists we cannot but be thankful that it is being actively studied, whether abroad or in our own country; but we must feel that it is our duty to do our part, especially when we see, from the work which has been and is being done in this country, that nationally we have the characteristics which qualify us to take a prominent position in work of this nature.

But from the point of view of our national progress we are bound to be active workers in this field of science. There is no doubt we do not hold the position we did as chemical manufacturers, and unless our chemical industries keep pace with chemical discovery fully as well as they do on the Continent, our position must further decline, and moreover, unless we make chemical discoveries ourselves, we must wait until we hear of the discoveries of others, which will mean, in cases where they are susceptible of practical application, that we are placed at a great disadvantage.

The bearing which the progress of chemistry in this country has upon this the oldest Chemical Society in existence is so obvious that it is superfluous to make any observation on the subject, except to express the hope that it will continue to be active, and found doing its part for the advancement of our science, and as a consequence be an important factor in the welfare of our country.

ON THE EVOLUTION OF FORMS OF ORNAMENT[1]

THE statement that modern culture can be understood only through a study of all its stages of development is equally true of its several branches.

Let us assume that decorative art is one of these. It contains in itself, like language and writing, elements of ancient and even of prehistoric forms, but it must, like these other expressions of culture, which are for ever undergoing changes, adapt itself to the new demands which are made upon it, not excepting the very arbitrary ones of fashion; and it is owing to this cause that, sometimes even in the early stages of its development, little or nothing of its original form is recognisable.

Investigations the object of which is to clear up this process of development as far as possible are likely to be of some service: a person is more likely to recognise the beauties in the details of ornamental works of art if he has an acquaintance with the leading styles, and the artist who is freed from the bondage of absolute tradition will be put into a better position to discriminate between accidental and arbitrary and organic and legitimate forms, and will thus have his work in the creation of new ones made more easy for him.

Hence I venture to claim some measure of indulgence in communicating the results of the following somewhat theoretical investigations, as they are not altogether without a practical importance. I must ask the reader to follow me into a modern drawing-room, not into one that will dazzle us with its cold elegance, but into one whose comfort invites us to remain in it.

The simple stucco ceiling presents a central rosette, which passes over by light conventional floral forms into the general pattern of the ceiling. The frieze also, which is made of the same material, presents a similar but somewhat more compact floral pattern as its chief motive. Neither of these, though they belong to an old and never extinct species, has as yet attained the dignity of a special name.

The walls are covered with a paper the ornamentation of which is based upon the designs of the splendid textile fabrics of the Middle Ages, and represents a floral pattern of spirals and climbing plants, and bears evident traces of the influence of Eastern culture. It is called a pomegranate or pine-apple pattern, although in this case neither pomegranates nor pine-apples are recognisable.

Similarly with respect to the pattern of the coverings of the chairs and sofas and of the stove-tiles; these, however, show the influence of Eastern culture more distinctly.

The carpet also, which is not a true Oriental one, fails to rivet the attention, but gives a quiet satisfaction to the eye which, as it were, casually glances over it, by its simple pattern, which is derived from Persian-Indian archetypes (Cashmere pattern, Indian palmettas), and which is ever rhythmically repeating itself (see Fig. 1).

The floral pattern on the dressing-gown of the master of the house, as well as on the light woollen shawl that is thrown round the shoulders of his wife, and even the brightly coloured glass knickknacks on the mantel-piece, manufactured in Silesia after the Indian patterns of the Reuleaux collection, again show the same motive; in the one case, in the more geometrical linear arrangement, in the other, in the more freely entwined spirals.

Now you will perhaps permit me to denominate these three groups of patterns that occur in our new home fabrics as modern patterns. Whether we shall in the next season be able, in the widest sense of the word, to call these patterns modern naturally depends on the ruling fashion of the day, which of course cannot be calculated upon (Fig. 2).

I beg to be allowed to postpone the nearer definition of the forms that occur in the three groups, which, however,

Fig. 1.

on a closer examination all present a good deal that they have in common. Taking them in a general way, they all show a leaf-form inclosing an inflorescence in the form of an ear, or thistle; or at other times a fruit or a fruit-form. In the same way with the stucco ornaments and the wall-paper pattern.

The Cashmere pattern also essentially consists of a leaf with its apex laterally expanded: it incloses an ear-shaped flower-stem, set with small florets, which in exceptional cases protrude beyond the outline of the leaf; the whole is treated rigorously as an absolute flat ornament, and hence its recognition is rendered somewhat more difficult. The blank expansion of the leaf is not quite unrelieved by ornament, but is set off with small points, spots, and blossoms. This will be thought less strange if we reflect on the Eastern representations of animals, in the portrayal of which the flat expanses produced by the muscle-layers are often treated from a purely decorative point of view, which strikes us as an exaggeration of convention.

[1] From a paper by Prof. Jacobsthal in the *Transactions* of the Archæological Society of Berlin.

One cannot go wrong in taking for granted that plant-forms were the archetypes of all these patterns. Now we know that it holds good, as a general principle in the history of civilisation, that the tiller of the ground supplants the shepherd, as the shepherd supplants the hunter: and the like holds also in the history of the branch of art we are discussing,—representations of animals are the first to make their appearance, and they are at this period remarkable for a wonderful sharpness of characterisation. At a later stage man first begins to exhibit a preference for plant-forms as subjects for representation, and above all for such as can in any way be useful or hurtful to him. We, however, meet such plant-forms used in ornament in the oldest extant monuments of art in Egypt, side by side with representations of animals; but the previous history of this very developed culture is unknown. In such cases as afford us an opportunity of studying more primitive though not equally ancient stages of culture, as for instance among the Greeks, we find the above dictum confirmed, at any rate in cases where we have to deal with the representation of the indigenous flora as contradistinguished from such representations of plants as were imported from foreign civilisations. In the case that is now to occupy us we have not to go back so very far in the history of the world.

FIG. 2.

The ornamental representations of plants are of two kinds. Where we have to deal with a simple pictorial reproduction of plants as symbols (laurel branches, boughs of olive and fir, and branches of ivy), *i.e.* with a mere characteristic decoration of a technical structure, stress is laid upon the most faithful reproduction of the object possible,—the artist is again and again referred to the study of Nature in order to imitate her. Hence, as a general rule, there is less difficulty in the explanation of these forms, because even the minute details of the natural object now and then offer points that one can fasten upon. It is quite another thing when we have to deal with actual decoration which does not aim at anything further than at employing the structural laws of organisms in order to organise the unwieldy substance, to endow the stone with a higher vitality. These latter forms depart, even at the time when they originate, very considerably from the natural objects. The successors of the originators soon still further modify them by adapting them to particular purposes, combining and fusing them with other forms so as to produce particular individual forms which have each their own history (*e.g.* the Acanthus ornament, which, in its developed form, differs very greatly from the Acanthus plant itself); and in a wider sense we may here enumerate all such forms as have been raised by art to the dignity of perfectly viable beings, *e.g.* griffins, sphinxes, dragons, and angels.

FIG. 3.

FIG. 4.

The deciphering and derivation of such forms as these is naturally enough more difficult; in the case of most of them we are not even in possession of the most necessary preliminaries to the investigation, and in the case of others there are very important links missing (*e.g.* for the well-known Greek palmettas). In proportion as the representation of the plant was a secondary object, the travesty has been more and more complete. As in the case of language, where the root is hardly recognisable in the later word, so in decorative art the original form is indistinguishable in the ornament. The migration of races and the early commercial intercourse between distant lands have done much to bring about the fusion of types; but again in contrast to this we find, in the case of extensive tracts of country, notably in the Asiatic continent, a fixity, throughout centuries, of forms that have once been introduced, which occasions a confusion between ancient and modern works of art, and renders investigations much more difficult. An old French traveller writes:—"J'ai vu dans le trésor d'Ispahan les vêtements de Tamerlan; ils ne diffèrent en rien de ceux d'aujourd'hui." Ethnology, the natural sciences, and last, but not least, the history of technical art are here set face to face with great problems.

FIG. 5.

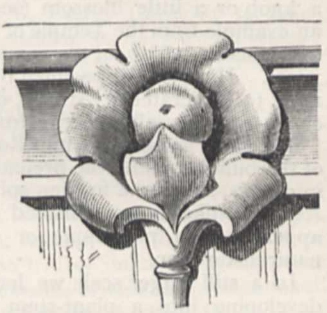

FIG. 6.

FIG. 7.

FIG. 8.

In the case in point, the study of the first group of artistic forms that have been elaborated by Western art leads to definite results, because the execution of the forms in stone can be followed on monuments that are relatively not very old, that are dated, and of which the remains are still extant. In order to follow the development, I ask your permission to go back at once to the very oldest of the known forms. They come down to us from the golden era of Greek decorative art—from the fourth or fifth century B.C.,—when the older simple styles of architecture were supplanted by styles characterised by a greater richness of structure and more developed ornament. A number of flowers from capitals in Priene, Miletus, Eleusis, Athens (monument of Lysicrates), and Pergamon; also flowers from the calathos of a Greek caryatid in the Villa Albani near Rome, upon many Greek sepulchral wreaths, upon the magnificent gold helmet of a Grecian warrior (in the Museum of St. Petersburg),—these show us the simplest type of the pattern in question, a folded leaf, that has been bulged out, inclosing a knob or a little blossom (see Figs. 3 and 4). This is an example from the Temple of Apollo at Miletus, one that was constructed about ten years ago, for educational purposes. Here is the specimen of the flower of the monument to Lysicrates at Athens, of which the central part consists of a small flower or fruits (Figs. 5 and 6).

The form passes over into Roman art. The larger scale of the buildings, and the pretensions to a greater richness in details, lead to a further splitting up of the leaf into Acanthus-like forms. Instead of a fruit-form a fir-cone appears, or a pine-apple or other fruit in an almost naturalistic form.

In a still larger scale we have the club-shaped knob developing into a plant-stem branching off something after the fashion of a candelabra, and the lower part of

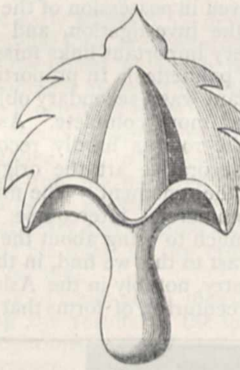

FIG. 9.

the leaf, where it is folded together in a somewhat bell-shaped fashion, becomes in the true sense of the word a campanulum, out of which an absolute vessel-shaped form, as *e.g.* is to be seen in the frieze of the Basilica Ulpia in Rome, becomes developed.

Such remains of pictorial representation as are still extant present us with an equally perfect series of developments. The splendid Græco-Italian vessels, the richly ornamented Apulian vases, show flowers in the spirals of the ornaments, and even in the foreground of the pictorial representations, which correspond exactly to the above-mentioned Greek relief representations. [The lecturer sent round, among other illustrations, a small photograph of a celebrated vase in Naples (representing the funeral rites of Patroclus), in which the flower in question appears in the foreground, and is perhaps also employed as ornament (Figs. 7 and 8).]

The Pompeian paintings and mosaics, and the Roman paintings, of which unfortunately very few specimens have come down to us, show that the further developments of this form were most manifold, and indeed they form in conjunction with the Roman achievements in plastic art the highest point that this form reached in its development, a point that the Renaissance, which followed hard upon it, did not get beyond.

Thus the work of Raphael from the loggias follows in unbroken succession upon the forms from the Thermæ of Titus. It is only afterwards that a freer handling of the traditional pattern arose, characterised by the substitution of, for instance, maple, or whitethorn, for the Acanthus-like forms. Often even the central part falls away completely, or is replaced by overlapping leaves. In the forms of this century we have the same process repeated. Schinkel and Bötticher began with the Greek form, and have put it to various uses; Stüler, Strack, Gropius, and others followed in their wake until the more close resemblance to the forms of the period of the Renaissance in regard to Roman art which characterises the present day was attained (Fig. 9).

Now what plant suggested this almost indispensable form of ornament, which ranks along with the Acanthus and Palmetta, and which has also become so important by a certain fusion with the structural laws of both?

We meet with the organism of the form in the family of the Araceæ or Aroid plants. An enveloping leaf (bract), called the spathe, which is often brilliantly coloured, surrounds the florets, or fruits, that are disposed upon a spadix. Even the older writers—Theophrastus, Dioscorides, Galen, and Pliny—devote a considerable amount of attention to several species of this interesting family,

FIG. 10.

FIG. 11.

especially to the value of their swollen stems as a food-stuff, to their uses in medicine, &c. Some species of Arum were eaten, and even nowadays the value of the swollen stems of some species of the family causes them to be cultivated, as, for instance, in Egypt and India, &c. (the so-called Portland sago, Portland Island arrowroot, is prepared from the swollen stems of *Arum maculatum*). In contrast with the smooth or softly undulating outlines of the spathe of Mediterranean Araceæ, one species stands out in relief, in which the sharply-marked fold of the spathe almost corresponds to the forms of the ornaments which we are discussing. It is *Dracunculus vulgaris*, and derives its name from its stem, which is spotted like a snake. This plant, which is pretty widely distributed in olive-woods and in the river-valleys of the countries bordering on the Mediterranean, was employed to a considerable extent in medicine by the ancients (and is so still nowadays, according to von Heldreich, in Greece). It was, besides, the object of particular regard, because it was said not only to heal snake-bite, but the mere fact of having it about one was supposed to keep away snakes, who were said altogether to avoid the places where it grew. But, apart from this, the striking appearance of this plant, which often grows to an enormous size, would be sufficient to suggest its employment in art. According to measurements of Dr. Julius Schmidt, who is not long since dead, and was the director of the Observatory at Athens, a number of these plants grow in the Valley of Cephisus, and attain a height of as much as two metres, the spathe alone measuring nearly one metre. [The lecturer here exhibited a drawing (natural size) of this species, drawn to the measurements above referred to.]

Dr. Sintenis, the botanist, who last year travelled through Asia Minor and Greece, tells me that he saw beautiful specimens of the plant in many places, *e.g.* in Assos, in the neighbourhood of the Dardanelles, under the cypresses of the Turkish cemeteries.

The inflorescence corresponds almost exactly to the ornament, but the multipartite leaf has also had a particular influence upon its development and upon that of several collateral forms which I cannot now discuss. The shape of the leaf accounts for several as yet unexplained extraordinary forms in the ancient plane-ornament, and in the Renaissance forms that have been thence developed. It first suggested the idea to me of studying the plant attentively after having had the opportunity five years ago of seeing the leaves in the Botanic Gardens at Pisa. It was only afterwards that I succeeded in growing some flowers which fully confirmed the expectations that I had of them (Figs. 10 and 11).

(*To be continued.*)

NOTES

THE International Conference on Education in connection with the International Health Exhibition will be opened on Monday, August 4, at 11 a.m., and will continue throughout the week. The arrangements as yet are not quite complete, but it is announced that the following papers, among others, will be read:—(1) Conditions of Healthy Education:—On the structure, fitting, and equipments of a school, by the Rev. Canon Holland, Canterbury, and Rev. E. F. M. MacCarthy, King Edward's School, Birmingham; on gymnastics and other physical exercises, by Captain Burney, R.N., Royal Hospital School, Greenwich, and H. J. Wilson, J.P., Sheffield; on the right apportionment of time to different subjects of instruction in schools of various classes, by H. W. Eve, University College School, London. (2) Infant Training and Teaching:—What Fröbel did for young children, by Miss Manning; on the relations of the Kindergarten to the various industries of a country, by Fräulein E. Heerwart; on the main work to be accomplished by Kindergartens for the people, and on the methods of training teachers in such institutions, by Madame Schrader, Berlin. (3) Technical Teaching—(*a*) Science, (*b*) Art, (*c*) Handicrafts, (*d*) Agriculture, (*e*) Domestic Economy:—On the methods of teaching the different branches of physical and of natural science, by Henry E. Armstrong, Ph.D., F.R.S.; the teaching of science in public elementary schools, by W. J. Harrison, Birmingham; science teaching in training colleges, by H. A. Reatchlous, Westminster Training College; on the teaching of drawing and colouring as a preparation for designing and decorative work, by John Sparkes, Science and Art Department, A. F. Brophy, Finsbury Technical College, and T. R. Ablett, London School Board; on technical teaching, by Prof. Garnett, University College, Nottingham, and E. M. Dixon, Allen Glen Institute, Glasgow; on technical teaching in Board schools, by J. F. Moss, Sheffield School Board; on manual training schools, by Prof. Woodward, St. Louis, U.S.; (*d*) the teaching of agricultural science in elementary, in intermediate, and higher schools, in evening science classes, in special colleges, and in the Universities, methods of teaching, &c., by the Rev. J. M'Clellan, Royal Agricultural College, Cirencester, J. Wrightson, Wiltshire Agricultural College, and others; on school farms and farm schools, by H. M. Jenkins, Royal Agricultural Society; on methods of teaching cookery in schools, by Miss Fanny Calder, Hon. Sec. Northern Union of Schools of Cookery. (4) Teaching of Music in Schools. (5) Museums, Libraries, and other Subsidiary Aids to Instruction in Connection with Schools:—On school museums, by Dr. Jex Blake, Rugby. (6) Training of Teachers:—By G. B. Davis, Birmingham, and C. Mansford, Wesleyan Training College, Westminster; on some of the differences which exist between the training, position, and duties of elementary teachers in Great Britain and on the Continent, by the Rev. Canon Cromwell, St. Mark's College, Chelsea; Universities and their relations to the training of teachers, by the Rev. R. H. Quick, Sedbergh; professorships and lectureships on education, by Prof. S. Laurie, University of Edinburgh, and Prof. J. M. D. Meiklejohn, St. Andrew's University; on diplomas and certificates and the registration of teachers, by F. Storr; on training colleges in Scotland, by the Rev. J. Morrison, D.D., Glasgow. (7) Inspection and Examination of Schools:—(*a*) By the State, by W. Kennedy, Glasgow; (*b*) by the Universities—on the University local examinations, by the Rev. G. F. Browne, B.D.; on the University extension movement, by Albert J. Grey, M.P., and E. T. Cook; by other public bodies, by the Rev. H. L. Thompson, Iron Acton. (8) Organisation of Elementary Education:—By Sir U. Kay Shuttleworth, Bart., and T. E. Heller; on the English system of elementary education—its growth and present condition, by the Rev. H. F. Roe, Sherborne. (9) Organisation of Intermediate and Higher Education:—On the requirements of a truly national system of higher education and the proper relation of the old Universities to such a system, by R. D. Roberts, Clare College, Cambridge; on the comparative advantages and disadvantages of arranging the course of study in the various school classes on lines of subjects appointed for local University or other general examinations, by the Rev. R. B. Poole, Bedford Modern School; on the advantages and disadvantages of providing for intermediate and higher education by means of a rate, as is done in the case of elementary education, by the Rev. Canon Daniel, and Hon. E. Lyulph Stanley, M.P.; on the organisation of higher education for girls, by Miss Beale, Cheltenham; on the curriculum of a girls' high school, by Mrs. Bryant, B.Sc. (10) Organisation of University Education:—On the proper relation between the teaching and examining bodies in a University, by Sir George Young, Bart.; on scientific teaching in a University, by Prof. Fleeming Jenkin; on the University education of women, by Mrs. H. Sidgwick; on the relation of a University to the colleges, by G. W. Hemming; on the relation of provincial colleges to a University, by E. Johnson, Nottingham; on the duties of the Universities to our Indian Empire, by Prof. Monier Williams.

HER MAJESTY has been pleased to confer a baronetcy upon Mr. Bernhard Samuelson, M.P., and a knighthood upon Prof. Roscoe, in consideration of the services rendered by them in connection with the Technical Education Commission. Sir Bernhard Samuelson well deserves the honour which has been conferred upon him; the services which he has rendered to science and to scientific education both in and out of Parliament, by his insisting for so many years on the importance of science to our national industries, is well known to all our readers.

"A NATURALIST," in a letter to the *Times* of yesterday, again draws attention to the scheme for a Marine Biological Laboratory, showing the practical utility of such an institution by quoting the report of Prof. Brooks on the researches on oysters carried out in the Marine Biological Laboratory founded by the Johns Hopkins University. In a leading article the *Times* very heartily supports the appeal of "A Naturalist" for subscriptions to the Marine Biological Association, an appeal which we hope will be liberally responded to.

IN a communication to us dated Helsingfors, June 23, Prof. Selim Lemström states that, having seen in NATURE that Dr. Sophus Tromholt has entirely failed in producing the artificial aurora borealis in Iceland with one of the "utströmnings" apparatus invented by the Professor, he ascribes this chiefly to the unusually adverse winter, heavy snowfall, and great moisture having frustrated nearly every attempt to produce the aurora in Sodankylä. It is remarkable, the Professor adds, that these circumstances have in no way affected the terrestrial currents, the measurements of which have been highly satisfactory.

THE second number of *La Nuova Scienza* fully maintains the promise of the first, lately noticed in NATURE. The editor, Prof. Enrico Caporali, who contributes most of the papers, continues to deal chiefly with the borderland between physics and metaphysics. His avowed object is to establish a new philosophy based on the reconciliation of idealism and the material order. Hence he revives the speculative doctrines of Campanella, Giordano, Bruno, and Vico, proclaims himself a follower of Kant, in so far as he accepts the Absolute as lying behind the relative, and denounces not only the French materialists but even the modern English Agnostic school. Thought, life, liberty, *la cernita*, that is, "selection" in the Darwinian sense, pervade all nature, the so-called material or inorganic as well as the organic world. Even crystals are "living beings, possessing not the turbulent fiery life of organised species, but a calm and stable life, feeling its harmony and unity, and ever seeking to adapt itself to the environment." And again: "Free selection has done everything in nature. The harmony of beings is the outcome of a long, persistent, unflagging work of fruitful selections inspired by Unity," that is, by the Absolute. In the present number the leading papers are:—"Modern Italian Thought," "The Pythagoric Formula of Cosmic Evolution," and "The German compared with the Italian Anti-clerical Movement."

DR. GLASENAP continues to give in the *Novoye Vremya* further details concerning Russian private observatories. Dr. Endrzeewitsch's observatory at Plonsk is provided with two equatorials, the objectives of which have respectively 162 and 140 mm. diameter; an equatorial telescope, the objective of which is 108 mm.; a transit instrument, three spectroscopes, a Secchi solar eye-piece, and a rich collection of meteorological and physical instruments. Although engaged in the medical profession, Dr. Endrzeewitsch displays a rare energy in the observations of comets, minor planets, Jupiter's satellites, and double stars. His observations of double stars are considered by astronomers as most accurate. General Mayevsky's observatory at Pervino, close to Torjok, is provided with a 6-inch refractor with parallactic motion, and with a transit instrument. Although M. Mayevsky makes observations only during the summer months, his measurements of some double stars and of stars situated in that part of the sky where the moon will be during the next total eclipse of October 4, are worthy of notice. His scientific work is usually described in the Annual Reports of the Pulkowa Observatory.

A DISEASED coffee leaf from Natal has been transmitted to Kew by Prof. Macowan, Director of the Botanic Garden, Cape Town. It has been examined by Mr. H. Marshall Ward, lately employed by the Government in the investigation of the coffee disease in Ceylon, and he finds it attacked with a typical form of the fungus *Hemileia vastatrix*, to which the well-known leaf-disease of that colony is due. This is the farthest westward extension of the disease at present. Eastward it has long maintained a position in Fiji.

PROF. BONNEY asks us to state that the paper which he has promised to the Montreal meeting of the British Association is not, as inadvertently stated in NATURE (p. 218), "On the Archæan Rocks of Canada, &c.," but "On the Archæan Rocks of Britain." Prof. Bonney has not yet visited Canada or examined many of its rocks.

ACCORDING to the *Times* Paris Correspondent, M. Pasteur's experiments with the virus of hydrophobia are going on with unbroken success. He has thus far experimented on 57 dogs, 19 of them mad and 38 bitten by them under uniform conditions. Out of these 38 half had been previously inoculated, the other half not. The latter, without a single exception, died with unmistakable signs of hydrophobia, whereas the 19 others are about and as well as ever. They will be watched for a year by veterinary doctors to see whether the inoculation holds good permanently or only temporarily.

As to chemical *research* in England we print Dr. Perkin's address in another column. As to chemistry as a *trade* we are requested to state that a petition, signed by Prof. Odling, M.A., F.R.S., &c., Professor of Chemistry in the University of Oxford, and others, has been presented to Her Majesty in Council praying for the grant of a charter of incorporation, under the title of the Institute of Chemistry of Great Britain and Ireland. The petition has been referred to a Committee of the Privy Council. The trade seems distinctly to have the best of it!

MR. STANLEY is reported at St. Paul de Loanda to have sailed for England on June 8.

THE city of Rouen has organised in connection with the Concours Regional an exhibition of electricity for the whole of France, and a special exhibition of Algerian products. The number of electrical lamps, regulator and incandescent, is very large, about 400 Swan, some Maxim, 30 Breguet regulators, about 30 Jablokhoff, and 5 or 6 sun lamps. One of the most interesting features is the special exhibit by the Association des Propriétaires of steam-engines of Normandy, who have collected a large number of boilers which have exploded, with labels indicating the causes of explosion.

DR. GULDBERG writes to us with reference to his recent article on the North Cape Whale (vol. xxx. p. 148), that he stated that one of these species of whale was taken at Pampeluna (an inland town); what he meant to have stated was that it was taken at San Sebastian, and brought to Pampeluna. He also finds that Taranto was given as Toronto. Dr. Guldberg informs us that one specimen more of the North Cape Whale has been captured, viz. at Guetaria, not far from San Sebastian, on February 11, 1878; the omission was due to the fact that his article was written during his stay at Liége, where all his books of reference were wanting.

THE additions to the Zoological Society's Gardens during the past week include two Diana Monkeys (*Cercopithecus diana* ♂ ♀) from West Africa, presented by Mr. J. H. Cheetham, F.Z.S.; a Bonnet Monkey (*Macacus sinicus* ♂) from India, presented by Mrs. Norman Yonge; a Razorbill (*Alca torda*), British, presented by Lady Hayter; four Snow Birds (*Junco hyemalis*), an American Coot (*Fulica americana*) from North America, presented by Mr. F. J. Thompson; a Hutchins's Goose (*Bernicla hutchinsi*) from Arctic America, a King Vulture (*Gypagus papa*) from South America, presented by Mr. W. A. Conklin, C.M.Z.S.; a Barn Owl (*Strix flammea*), British, presented by Mr. M. B. Windus; two Angulated Tortoises (*Chersina angulata*), two Areolated Tortoises (*Homopus areolatus*) from South Africa, two Geometric Tortoises (*Testudo geometrica*) from Little Namaqualand, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; two Ceylonese Terrapins (*Clemmys trijuga*) from the Island of Diego, Garcia, presented by Commander the Hon. Foley C. P. Vereker, R.N.; a Pale-headed Tree Boa (*Epicrates angulifer*), an Antillean Snake (*Dromicus antillensis*), two Maculated Snakes (*Ungalia maculata*) from the Island of New Providence, Bahamas, presented by Mrs. Blake; a Tuatera Lizard (*Sphenodon punctatus*) from New Zealand, presented by Surgeon-Major

G. Henderson; a Spotted Cavy (*Cœlogenys paca*), a Blue and Yellow Macaw (*Ara ararauna*) from South America, deposited; a Blue Crested Tanager (*Stephanophorus leucocephalus* ♂) from Brazil, two Cape Doves (*Œna capensis*) from South Africa three Hardwicke's Spur Fowl (*Galloperdix lunulata* ♂ ♀ ♀), two Rufous Spur Fowl (*Galloperdix spadicea*), two Rain Quails (*Coturnix coromandelica*) from India, three Blackish Sternotheres (*Sternothærus subniger*) from West Africa, purchased; a Heloderm (*Heloderma suspectum*) from Mexico, received in exchange; a Burrhel Wild Sheep (*Ovis burrhel* ♂), a Red Deer (*Cervus elaphus*), six Upland Geese (*Bernicla magellanica*), five Long-fronted Gerbilles (*Gerbillus longifrons*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

MINIMA OF ALGOL.—In the calculation of the following Greenwich times of geocentric *minima* of Algol, the later observations of Schmidt have been brought to bear:—

		h.	m.			h.	m.
August	12 ...	14	35	September	24 ..	14	43
	15 ...	11	23		27 ...	11	31
	18 ...	8	12		30 ...	8	20
September	1 ...	16	14	October	14 ...	16	23
	4 ...	13	3		17 ...	13	12
	7 ...	9	51		20 ...	10	0
	12 ...	17	54		23 ..	6	49

It is much to be desired that the observation of this star should be taken up in a systematic manner by one or more observers. We have been indebted to the late indefatigable astronomer at Athens for nearly all the published determinations of *minima* during the last ten years.

THE COMET 1858 III.—Herr Spitaler, of the Observatory at Vienna, who has been searching for some time past for this comet with the 27-inch refractor along the track defined by the calculations of M. Schulhof, remarked on May 26 three small, faint, uncatalogued nebulæ, of which, owing to rapidly-advancing clouds, he was only able to secure the following approximate places:—

		h. m. s.		° ′
1.	Right Ascension ...	17 40 50 ...	Declination ...	+ 35 33
2.	,,	17 42 0 ...	,, ...	+ 35 33
3.	,,	17 42 10 ..	,, ...	+ 35 33

A period of almost unexampled bad weather followed, and it was not till June 17 that observations could be repeated: the first of the three nebulæ was then missing, and its disappearance from the position where it had been observed on May 26 was confirmed with the same instrument on the night of June 20. Its place is close upon that given in M. Schulhof's ephemeris if the comet's mean anomaly is assumed to have been 8° 33′ at midnight on May 26.

It is not clear from what elements the positions assigned in the sweeping-ephemeris have been derived. In M. Schulhof's most probable orbit the period of revolution is 6·61 years. If we assume four revolutions to have taken place between 1858 and 1884, we find a period of 6·478 years, and reducing by the factors for $d\mu$ in *Astron. Nach.* No. 2592, in the most probable ellipse, and bringing up the longitudes to May 26, 1884, we have the following constants for the comet's equatorial co-ordinates:—

$$x = r \,.\, [9{\cdot}99985] \,.\, \sin(v + 291^\circ\ 27'{\cdot}5)$$
$$y = r \,.\, [9{\cdot}99890] \,.\, \sin(v + 201\ \ 33{\cdot}8)$$
$$z = r \,.\, [8{\cdot}87720] \,.\, \sin(v + 181\ \ 14{\cdot}6)$$

If the true anomaly, May 26·5 G.M.T., be assumed to be 49° 36′·6, we find that the calculated right ascension agrees with that observed, but the calculated declination is 3° 34′ too small. And M. Schulhof's definitive orbit for 1858 shows a similar discordance in declination, when the computed and observed right ascensions are made to agree. A comparison (made as a check) with the observed longitude and latitude leads to the same inference. It will be of interest to learn upon what elements M. Schulhof has founded his predictions.

If the comet's mean period between 1858 and 1884 were about 6·478 years, it might have approached the planet Jupiter in the middle of September 1880, within 0·97 of the earth's mean distance from the sun, a sufficiently near approach to cause a sensible, though not very important effect upon the elements defining the position of the plane of the orbit.

The intervention of unfavourable weather at Vienna after May 26 was particularly unfortunate, as the comet in the observed position would be receding from both earth and sun, and consequently the intensity of light would be rapidly diminishing, thus rendering a further observation after June 17 almost hopeless. It will remain for M. Schulhof to decide whether the object observed and missed at Vienna was really the comet the return of which he had led astronomers to expect, or another body. Possibly the discordance noticed above may be explained by error in the orbit as printed.

THE PHYSIOLOGICAL BEARING OF ELECTRICITY ON HEALTH[1]

THE reader of the paper commenced by stating that electricity as at present used is at once a source of danger, a possible cause of sickness, and a remedy.

In all these cases it has been insufficiently studied, and continues to be ill understood. This condition of affairs is probably due to the fact that from the great subdivision of modern science, a competent knowledge of physics as well as of physiology is rarely acquired by the same person, whereas, for accurate work it is essential that so powerful an agent should be measured by accepted units. What little has been done by the physiologists is marred by considerable errors as to the force actually in use. Indeed much of it requires total revision in the light of modern discoveries.

1. Dangers to sight were very briefly considered. It was noted that the incandescent and the arc light subjected the eyes to two totally different risks, the former from heat rays at the less refrangible, and the latter from actinic and chemical action at the more refrangible, end of the spectrum. To obtain a sufficient protection in both cases, a pair of eye-protectors, made for the speaker by Mr. Baker of High Holborn, was shown, in which the front glass was blue, and the side "blinker" deep red. The former could be used alone for incandescent lamps, to remove glare, and lessen irritation; while the side glass could be turned down over the blue when powerful arc lights had to be gazed at. If the two tints were well selected and combined by means of the spectroscope, a very handy and simple appliance was obtained, clearly conducive to health. 2. Dangers to life and health were more minutely adverted to. Causes of death may be:—(1) By catalytic action; (2) by thrombosis of the larger vessels; (3) by shock and syncope, due to action on the cardiac nervous system. It was admitted that, considering the enormously increased power of our modern sources of electricity, accidents had been singularly few; and indeed it was abundantly proved that a large steady current, even of considerable magnitude, was comparatively harmless to the human economy. Rapid fluctuations, especially at the starting or breaking of the circuit, were much more dangerous; and still more so if by accident, or by the impregnation of the skin with conducting saline solutions, the resistance of the body was reduced to a minimum. In reviewing the recorded accidents, at the Birmingham Music Hall, in Paris, at Hatfield, and on board the Russian yacht, it was obvious that they were not all to be classified under the third heading given; inasmuch as life in some cases had been prolonged for three-quarters of an hour after the accident. Probably thrombosis in some form would account for them; but more precise information was much needed. Dr. Stone then proceeded to consider certain remedial and physiological points. 1. Several common errors were corrected, especially that of imperfect contact. 2. Any approximate determination of the electrical resistance of the human body to low and high tension currents respectively was described. 3. Use of the telephone and meter-bridge for measuring this resistance demonstrated; and 4. Measurements of E.M.F. of high tension alternating currents by dynanometer and quadrant electrometer were given. Much of this had already appeared in the pages of NATURE on June 14 and September 13, 1883, and on April 3 of the present year. The great need for an electrical testing establishment open to observers at large, like that at Kew, was insisted on, and might well be undertaken by the Society. Lastly, a few suggestions were thrown out as to the therapeutical uses to which electricity, administered, not as now, haphazard, but quantitatively and scientifically, might be put. These were classified as (1) muscular, (2) sensory, (3) neurotic, (4) eliminative, (5) vaso-motorial.

[1] Abstract of a paper by W. H. Stone, M.A., M.B. Oxon, F.R.C.P., Member, at the Conference of the Society of Telegraph Engineers at the Health Exhibition, July 4.

THE MOVEMENTS OF THE EARTH[1]

V.

WE last appealed to those branches of physical science which are connected with the determination of the velocity of light, in order to see whether we could get any help in that direction on a most interesting question, a question which, like another to which attention has been drawn, might have been considered as an open one, unless one had gone beyond the range of ordinary astronomical observation with regard to it. It has now been seen that by investigating the facts connected with the velocity of light, first, that we could determine that velocity by two different methods with a wonderful agreement between them; and secondly, that, by taking the velocity of light and dealing with it in the way we then did, a perfect demonstration was obtained of the fact that the earth revolves in an orbit round the sun. It was further seen that using this velocity of light, and also this fact of the earth's revolution which it enabled us to demonstrate, we were able to say that the distance of the earth from the sun was, roughly speaking, 92½ millions of miles.

We will now go more into detail with regard to the precise form of the earth's orbit, and consider some of the conditions under which the earth's movement in that orbit takes place. In proceeding to do this let us first suppose the orbit of the earth to to be in the form of a circle with the sun in its centre, then it is perfectly clear that the earth will always be at exactly the same distance from the sun, and that consequently the sun as seen from the earth will always appear of the same size; but on the other hand if the earth does not move in a truly circular orbit round the sun, then, unless she moves with great irregularity—and we shall see subsequently that she does not, the only other possible course for her to take is an elliptical one, because if she took an orbit of any other form—that of a parabola or an hyperbola for instance—she would not revolve about the sun at all, she would not have a succession of years each of 365¼ days' duration, but one year, a year of infinite length; she would in fact go off at a tangent into infinite space.

Let us then consider what will happen if the earth instead of moving in a circular, travelled in an elliptical, orbit, with the sun in one of its foci, and not in the centre of figure; then it is perfectly clear that the distance of the earth from the sun will vary, that she is nearer the sun at some points of her orbit than at others. So much for supposition. Let us consider the facts. We know that it is the duty of the astronomers at Greenwich to make daily observations, when possible, of the transit of the sun, by means of one of those transit instruments to which reference has been made. Now if the sun, as seen from the earth, had always the same apparent diameter, it is obvious it would always take exactly the same time to cross the central wire of the transit instrument; but when we turn to the record of the observations made at Greenwich we find this:—Take the year 1878. On January 9 in that year the apparent diameter of the sun was 33′ 33″·50 of arc, whereas on July 13 of the same year it was 31′ 30″·24; the apparent diameter was less, so that if these observations are to be depended on—and I know of none better—we were nearer the sun in January 1878 than we were in July. If that be so, then there should be two intermediate points when the diameter of the sun was the same, with an interval of six months between them. This is what was observed on two such dates in this same year, on April 5 an apparent diameter of 31′ 58″·16, and on October 5 an apparent diameter of 32′ 5″·17. In this latter case we have a difference only of 7″·01; in the former case a difference of over 2′, so that the Greenwich observations quite justify the supposition that the earth moves, not in a circle, but in an ellipse; because, the greater the distance of the sun from the earth, the smaller it must appear. While we are on this subject of the ellipticity of the earth's orbit, I am anxious to draw your attention to the two diagrams, so that the matter may be as clear as possible. Let us consider the diagram, Fig. 43. We have drawn there an ellipse, and the earth is assumed to move in the direction of the arrow round the sun placed in one of its foci, S.

Now by the construction of an ellipse we know that S B, which represents the mean distance between the earth and the sun, is exactly the same as the distance A O or P O, which represents what is known as the semi-axis major of the ellipse; further, the eccentricity of any ellipse is defined by the ratio of O S to O A; when the distance O S is very large as compared with O A, then the ellipse is a very flattened one, and the shorter the distance O S as compared with O A the less flattened will be the ellipse and the more nearly will it approach a circle. It will now be clear why the two points are marked A and P, for if S be taken to represent the focus of the ellipse actually occupied by the sun, the point P will represent the place occupied by the earth when it is nearest the sun, which is called by a Greek word, "perihelion," whilst this other point A will mark that point in the orbit of the earth when it is farthest removed from the sun, this being called by another Greek word, "aphelion." This aphelion distance represents the semi-axis major plus the eccentricity, and the perihelion distance of the earth from the sun is obtained by a subtraction of the value of the eccentricity from that of the semi-axis major. These statements are general with regard to ellipses, and in order to make the point quite clear, we have shown them on the very flattened ellipse of Fig. 43, but the true form of the earth's orbit very nearly approaches a circle. If we want to find the greatest distance and the least distance of the earth from the sun at the opposite points of the orbit, we take the best value we can get of the mean distance S B, or O A, which is the same thing, and it is found that the eccentricity comes out about 1½ millions of miles, so that the greatest distance of the earth is less than 94½ millions, whilst its distance at perihelion is a little more than 91¼. So much then for the facts with regard to the varying distances at which the earth is found from the sun at different periods of the year.

The next point is this: if the earth moves in this elliptic path round the sun, does she always move with the same velocity, does she go more quickly at some times than at others, or does she travel always with a steady, constant pace? Now here again the question can easily be answered by an appeal to the

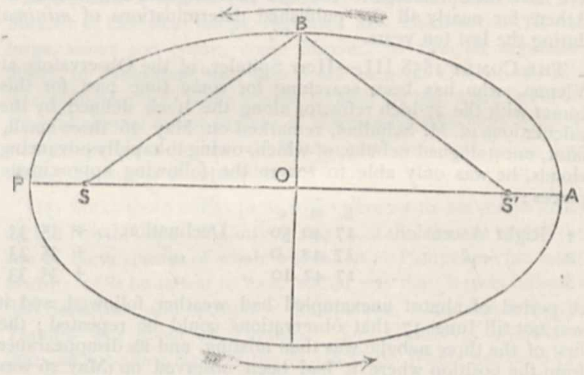

FIG. 43.

useful transit instrument. Our sidereal clock gives us a method, of determining the interval, true to the hundredth part of a second, between one transit of the sun over the central wire of the instrument and another, and so enables us to determine the number of degrees, minutes, seconds, tenths of seconds, and hundredths of seconds of arc passed over by the sun in that time. If the earth, therefore, in her revolution round the sun moves with an equal unchanging motion then it is clear that the number of degrees, minutes, and seconds of arc passed over in any given time will be always the same. Let us again consider the facts according to the Greenwich record. On December 27, 1877, the transit of the sun's centre occurred at 18h. 25m. 44·9s. sidereal time, but on the day before it took place at 18h. 21m. 18·5s. If this second quantity be subtracted from the first, the difference comes out as 4m. 26·4s., that being the amount of arc passed over by the earth in that interval. Now on June 29 of the same year we get 0h. 33m. 51·7s., whereas on the 28th the time was 0h. 29m. 43·3s., a difference of 4m. 8·4s. It is thus obvious that the motion of the earth is not uniform, and that being so, the question arises, Is this want of uniformity constant, or is it irregular? Is there, in short, any law governing it? It will be seen that there is a most perfect law about it; that when the sun looks biggest, that is to say, when we are nearest the sun, the earth moves most quickly, and that when the sun looks smallest from the earth, when the earth is at its greatest distance from the sun, it moves with its least velocity. This fact brings us face to face with a most fundamental law of astronomy—that law which is known as the second law of Kepler. This can be gathered from Fig. 44. Here S represents the sun in one focus of the ellipse

[1] Continued from p. 113.

representing the orbit of the earth, and we have P, P^1, P^2, P^3, P^4, and P^5 representing different positions of the earth at different times of the year, the distance between these points P and P^1, P^2 and P^3, and P^4 and P^5 representing the portions of the orbit passed over by the earth in equal intervals of time. This law is known as the Law of Areas. It states that in equal intervals of time the radius vector or line joining the earth and sun passes over equal areas in its revolution. Thus the area of the triangle $S\ P\ P^1$ is equal to the area of the triangle $S\ P^2\ P^3$, and is also equal to the area of the triangle $S\ P^4\ P^5$, and these areas of the orbit are passed over by the radius vector in equal intervals of time. When the earth is nearest to the sun she travels most quickly; when she is at her greatest distance from the sun she

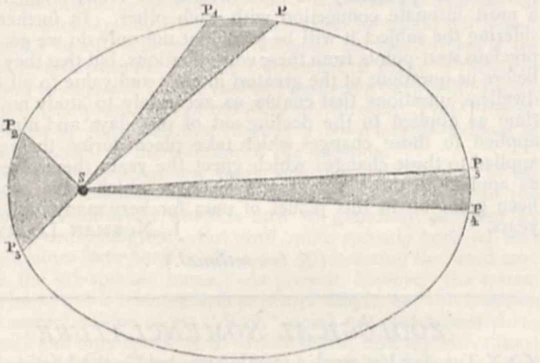

FIG. 44.—Explanation of Kepler's second law.

travels most slowly; and thus she keeps the figures inclosed by the radii vectores always of equal area during equal times. Let us be quite clear on this point: the law is not that the earth moves through equal distances in equal times, but that the areas of the spaces swept over by the radius vector are the same for equal intervals of time.

We come then to this: that the earth moves round the sun; that she moves in an ellipse; that she moves unequally, that is to say, with different velocities at different times, but that these different velocities are bound together by a well-defined and well-recognised law.

Now comes another question connected with this movement of the earth round the sun. When the movement of the earth on its axis was being discussed, it was pointed out that observations made by the transit instrument gave ample evidence that the movement was a perfectly equable one, and of such a nature that the axis of movement remained always practically parallel to itself. Attention must now again be turned to this axis of rotation. Let us take the earth in any part of its orbit, then the question is this: Is the plane of the earth's motion round the sun, or, as it must now be called, the plane of the ecliptic, identical with the plane of the earth's motion of rotation? That is to say, if the earth were half immersed in an ocean of infinite extent, whilst it was performing its orbital motion, would its axis of rotation be at right angles to the surface of the ocean in which it swam. Suppose we had a globe to represent the earth, and on it a model of a transit instrument were placed in the direction it is pointed at Greenwich when the sun is being observed. Then if the axis of the earth were really vertical the instrument would always be at right angles to it, or practically so, for sun observations. Further, if the model were turned round to represent one rotation of the earth, then if the axis on which it turned were really perpendicular, the sun's declination would remain unchanged, and its polar distance would always be 90°. Now let us refer to the Greenwich observations of the north polar distance of the sun.

On March	16	N.P.D. was	91°·34
,,	22	,,	89·12
June	22	,,	66

That is to say, the observers at Greenwich in going from March to June had to alter the inclination of their instrument, in consequence of this variation in the N.P.D. of the sun, to the extent of the difference between 90° and 66°. On September 21 of the same year the N.P.D. was 90°, but on December 17 instead of being 90°, or 66°, it was 113°·24. How can these facts be explained? Suppose we had a lighted lantern to represent the sun, and round it four globes were placed with their axes vertical to represent the earth in four different positions in its orbit. It will be obvious that if we bring the light of the lamp in succession upon the four globes with the axes in each thus vertical, then the zenith distance of the sun, represented by the lamp, would be the same in each case. In this position of the globes we get the boundary of light and darkness at the poles, and the line joining the centres of earth and sun

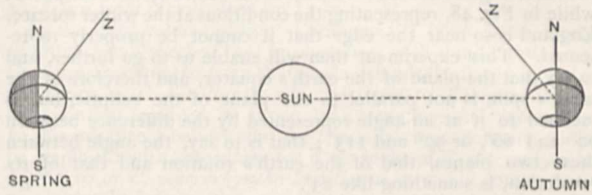

FIG. 45.—Diagram showing the equality of the sun's zenith distance at the two equinoxes. N, north pole of the earth; S, south pole; Z, zenith of Greenwich.

will give us the zenith distance of the latter. Now assume that the axis of the earth is not vertical but is inclined $23\frac{1}{2}°$ to the plane of the ecliptic. In that case its spin of course would not be at right angles to this plane. If the four globes were then illuminated in succession, it would be found that the presentation of Greenwich to the sun would be vastly different at the four

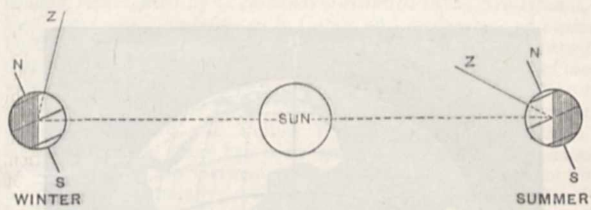

FIG. 46.—Diagram showing the variation of the sun's zenith distance from solstice to solstice. N, north pole of the earth; S, south pole; Z, zenith of Greenwich.

different positions. In the first, if it were placed in the proper part of the orbit, we should get Greenwich, not turned fully to the sun, but still well in his rays. In the second one we should find the vertical at Greenwich pointing very much more to the sun than before, when the axis was vertical. In the third globe the conditions would be about the same as in the first, while in

FIG. 47.—The earth, as seen from the sun at the summer solstice (noon at London).

the fourth the line which points towards the zenith at Greenwich, instead of being turned almost directly to the sun, would be turned most away from it. This fourth position is that in which the zenith distance, and therefore the N.P.D., was greatest, *i.e.* when it was 113°. The second represents the position of the earth when it was the least possible, whilst the first and third positions would occur when the N.P.D. of the sun was neither great nor small, but midway between the two extremes. These facts will be made clearer by the accompanying woodcuts, in which the globes are shown in four different positions. Fig. 45 represents cases 1 and 3, and Fig. 46 cases 2 and 4. In Figs. 47 and 48 these facts are shown in different ways: Fig. 47 represents the aspect of the earth as seen from the sun at the summer solstice, when it will be seen that England is seen to lie near to the centre of the hemisphere; while in Fig. 48, representing the conditions at the winter solstice, England is so near the edge that it cannot be properly represented. This experiment then will enable us to go further, and to say that the plane of the earth's equator, and therefore of the earth's spin, is not parallel to the plane of the ecliptic, but is inclined to it at an angle represented by the difference between 90° and 66°, or 90° and 113°; that is to say, the angle between these two planes, that of the earth's rotation and that of its revolution, is something like 23°.

In the non-coincidence of these two planes we have one of the most fundamental points in astronomy, for the reason that what Greenwich is to earth measurement the point of intersection of these two planes is to heaven measurement. The result of this inclination of these two planes is that at one particular point in its course round the sun the equatorial plane of the earth seems to plunge below the plane of the ecliptic, whilst at another and an opposite point it seems to come up from below that plane.

These two points are known as the nodes of the orbit, the

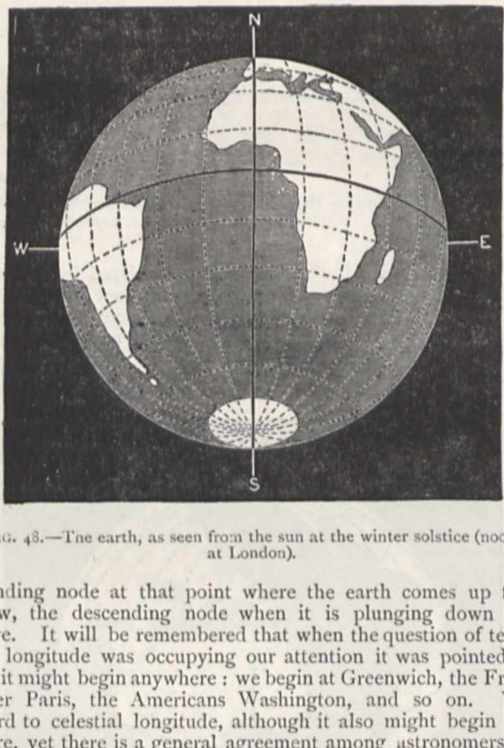

FIG. 48.—The earth, as seen from the sun at the winter solstice (noon at London).

ascending node at that point where the earth comes up from below, the descending node when it is plunging down from above. It will be remembered that when the question of terrestrial longitude was occupying our attention it was pointed out that it might begin anywhere: we begin at Greenwich, the French prefer Paris, the Americans Washington, and so on. With regard to celestial longitude, although it also might begin anywhere, yet there is a general agreement among astronomers that the right ascension of stars shall be counted from this ascending node, or, as it is otherwise called, the first point of Aries, where we get the intersection of the earth's plane of rotation with the ecliptic plane of revolution. That is the start-point not only of right ascension for the stars, but of celestial longitude, because it is necessary that we should have a means of determining the positions of stars, not only with reference to the plane of the earth's rotation, but with reference to the plane of the ecliptic itself, and the number of degrees which a heavenly body is observed above or below that plane (such degrees being called degrees of celestial latitude) require to be known in order to determine absolutely the position of any star. With the transit instrument and the sidereal clock the precise angle of intersection of these planes is determined, but it is necessary to know also the precise point in the orbit at which the intersection takes place, before we can use either our transit instrument or our clock for the determination of the precise position of a heavenly body. And now that so much has been said, we can go further with regard to our sidereal clock, and say that it shows oh. om. os. when the first point of Aries is exactly on the central wire of the transit instrument, and that it will come back to that time, oh. om. os., after an interval of twenty-four hours. In that way, by discussing the point of the intersection of the planes, we come to the conclusion not only that the earth's axis is inclined 23½° to the ecliptic plane, but that we have at that point the most convenient starting point both for the right ascension of stars as determined by a sidereal clock, and the longitude of stars, if we choose to define their positions with reference to the ecliptic plane, instead of with reference to the plane of the earth's rotation. It is curious how in dealing with these matters we find that phenomena apparently the most diverse are really bound up in a most intimate connection with each other. In further considering the subject it will be seen that not only do we get these precious start-points from these considerations, but that they bring before us questions of the greatest interest and value to all earth-dwellers, questions that enable us accurately to study not only time as applied to the dealing out of our days and nights, as applied to those changes which take place during the year, as applied to those changes which effect the years themselves, but as applied to those yet greater changes which have probably been going on in this planet of ours for very many millions of years.

J. NORMAN LOCKYER

(To be continued.)

ZOOLOGICAL NOMENCLATURE

ON Tuesday last week a meeting was held in the Lecture Room of the Natural History Museum, where a number of leading British zoologists assembled to meet Dr. Elliott Coues, who is now on a visit to this country, and to hear from him an exposition of the views advocated by himself and the leading American zoologists with regard to the adoption of Trinomial Nomenclature.

Among those present were representatives of many branches of science, and we noticed the following British naturalists:—Lord Walsingham, Prof. Flower, F.R.S., Dr. Günther, F.R.S., P. L. Sclater, F.R.S., Dr. H. B. Woodward, F.R.S., Prof. Traquair, F.R.S., W. T. Blanford, F.R.S., Henry Seebohm, F.L.S., Howard Saunders, F.L.S., Prof. F. Jeffrey Bell, J. E. Harting, F.L.S., G. A. Boulenger, H. T. Wharton, F.L.S., S. O. Ridley, F.L.S., W. F. Kirby, Sec. Ent. Soc., Herbert Druce, F.L.S., W. R. Ogilvie Grant, and R. Bowdler Sharpe, F.L.S.

The chair was taken at 3 p.m. by Prof. Flower, F.R.S., the Director of the Natural History Museum, who briefly opened the proceedings by reading a letter from Prof. Huxley, P.R.S., expressing his great regret at not being able to be present, being prevented by pressure of official business.

The Chairman said:—The subject we have met to discuss is one of extreme importance as well as difficulty to zoologists, for though in so many respects the name attached to any natural object is the most trivial and artificial of any of its attributes, and may hardly be thought worthy of scientific consideration, laxity in the use of names causes endless perplexities and hindrances to the progress of knowledge. I must confess that I feel some sympathy with the young lady, lately quoted in a speech by Sir John Lubbock at the University of London as an instance of hopeless stupidity, who, after listening to a lecture on astronomy, said she had no difficulty in understanding how the distances, motions, and even chemical composition of the stars were discovered, but what puzzled her was how their names were found out. Now, I have often had little difficulty in making out the characters and structure of an animal, and even the functions of some of its organs, but when I have to decide by what name to call it, I am often landed in a sea of perplexity. Yet those of us who work in museums are constantly engaged in cataloguing and labelling, and we are supposed to be able at once to give the correct name to every creature in the collection. I hope that this discussion will help to clear up our ideas upon the subject. With the impartiality due from the chair, I shall not give any opinion upon the merits of the rival schemes to be proposed, at all events not until after hearing the arguments to be brought forward for or against them, and I cannot say that I am very sanguine of being able to do so then. I now call upon Mr. R. Bowdler Sharpe to read a paper "On the expediency, or otherwise, of adopting Trinomial Nomenclature in Zoology."

Mr. Sharpe then read his paper:—I approach the discussion of this subject without the least prejudice either for or against the adoption of trinomial nomenclature. It has been for some time recognised and allowed by zoologists on the other side of the Atlantic, and to a certain extent the principle has been admitted by more than one worker in the Old World, but the presence in this country of one of the most able advocates of the system in the person of that distinguished American zoologist, Dr. Elliott Coues, has recently stimulated the thoughts of many of us as to the wisdom of its adoption for the zoology of the Old World, and it occurred to me that a friendly meeting to discuss the matter with Dr. Coues and some of our leading British zoologists could certainly do no harm, and might be productive of a considerable amount of good. Understanding from Dr. Coues that he would not object to attend a small conference of zoologists on this subject if we desired to talk over the matter, I appealed to many of the latter to appear to-day, and I think that this gathering of British naturalists, under the presidency of our esteemed director, Prof. Flower, is sufficient to show that that there is a considerable amount of keen interest felt in the solution of the question.

It is now more than ten years ago that Dr. Coues, in his "Key to the North American Birds," first began to adopt the trinomial nomenclature which is now so generally accepted by American ornithologists. But until quite recently both he and his coadjutors have been in the habit of inserting the word *var.* before the sub-specific name. At present, however, the system which he adopts is trinomialism pure and simple, and this is shown in the second edition of his "Key," which has just appeared.

Now I can only speak as an ornithologist, and my views must be regarded as purely personal; but I do think that it is good for zoologists in general to learn from the lips of Dr. Coues exactly what the system is which he proposes to adopt for ornithology, and to what lengths it would lead us. I shall listen with attention and respect to the remarks with which any of my colleagues learned in other branches of zoology may favour us this afternoon.

It seems to me that there are certain facts in nature which we all of us recognise as facts, but about the expression of which many of us entertain different views. I propose merely to place before you certain difficult aspects of the question as they present themselves to me, and I shall be glad to have an expression of opinion upon the facts which I bring forward. I would therefore crave permission for a few moments to run over some of the published volumes of the "Catalogue of Birds," and to discuss some changes of nomenclature that might be involved if the trinomial system were to be adopted in a second edition of that work. It will be noticed that in 1874 I recognised the existence of "sub-species" among the *Accipitres*, and I now lay on the table one of the most interesting examples of what I conceive to be a series of sub-species, or representative races, of one dominant form. In Southern Africa we have a small Goshawk called *Astur polyzonoides*, which inhabits the whole of the South African sub-region, but does not, so far as my knowledge goes, extend beyond the Zambesi. In Senegambia and North-East Africa it is replaced by a race called *Astur sphenurus*, in which the colour of the under-surface is much more delicate than in *Astur polyzonoides*. From Central Russia, throughout Turkey, Asia Minor, Persia, and Syria, a large race called *Astur brevipes* replaces the two foregoing sub-species, and forms a third. From Baluchistan, throughout India, and Ceylon, a somewhat smaller form, *Astur badius*, takes up the running, and throughout the Burmese countries, extending to Formosa and Hainan, we have yet another race, *Astur poliopsis*, which is a purer and more elegantly coloured edition of *Astur badius*. This little group of Goshawks has been well worked out, and we may fairly presume that we have the facts before us. Now I should like to know if this is a case where we might adopt the trinomial system, and call these birds

Astur badius,
Astur badius poliopsis,
Astur badius brevipes,
Astur badius sphenurus,
Astur badius polyzonoides.

At present, were I writing about the South African bird or the Abyssinian bird, I should never speak of them as *Astur badius*, which is the name belonging to the Indian bird exclusively, and I am not quite sure that we gain in this case anything whatever by adopting trinomial nomenclature. The same parallel may be drawn with some of the species of *Scops* among the Owls, as may be seen by the series now exhibited, and here trinomial nomenclature might perhaps be employed. Thus the representative races of *Scops giu* would be *S. giu capensis* in Africa, *S. giu pennatus* from the Himalayas, *S. giu minutus* from Ceylon, *S. giu stictonotus* from China, *S. giu japonicus* from Japan, *S. giu malayanus* from Malacca, *S. giu rufipennis* from Madras, and *S. giu brucii* from North-Western India.

In the third volume of the "Catalogue" I have again freely admitted "sub-species," as, for instance, with some Crows, *e.g.* *Corone macrorhyncha* from the Sunda Islands, replaced in India and China by *C. levaillantii*, which extends to Eastern Siberia, but is further replaced in Japan by a large race—*C. japonensis*. In this instance I believe that the trinomial nomenclature could be employed with advantage, for if we spoke of *C. macrorhyncha japonensis* or *C. macrorhyncha levaillantii*, it would convey to us an absolutely definite idea, viz. that these were merely forms of the typical *C. macrorhyncha* with a distinct geographical area assigned to each.

To take another case of a different kind. I place on the table several species of *Chibia* from the Malay Archipelago, and the difficulty which anybody would find at first sight in the separation of these Moluccan Drongos can be explained off-hand by the fact that they are nothing more nor less than representative insular forms of one dominant species. If, therefore, you speak of these birds as *Chibia carbonaria* from the Papuan group of islands, represented by *C. carbonaria assimilis* in the Aru Islands, by *C. carbonaria amboinensis* in Ceram and Amboina, and again by *C. carbonaria atrocærulea* in Batchian and Gilolo, I contend that these names, although long, convey an exact impression of the value of these forms, which are so closely allied as to be almost indistinguishable. A more difficult question arises when we come to treat of the Yellow Wagtails, concerning which, curiously enough, there has been quite a consensus of opinion among some of the German ornithologists that they ought to be treated trinomially. Thus in the "Vögel Ost-Afrikas," by Drs. Finsch and Hartlaub, we find these birds spoken of as *Motacilla flava melanocephala*, &c., and the same phraseology is adopted by Baron von Heuglin in the "Ornithologie Nord-ost Afrikas." Having recently studied these birds, I can only say that I think the employment of trinomial nomenclature by these authors was somewhat premature, inasmuch as, from the showing of the writers themselves, these birds to which they gave trinomial names are not only migratory, but have well-defined geographical areas of distribution. I myself consider that the intermediate forms which undoubtedly exist are due to another and totally different cause, viz. to hybridisation, inasmuch as many of these birds occupy nearly the same winter areas in Africa, and doubtless many of them pair with birds of an allied form on their return to Europe. Thus *Motacilla kaleniczenkii*, which is *M. melanocephala* with a white eyebrow, is probably (although there is no proof of the fact) the latter species with a strain of the white-eyebrowed *M. flava* admixed, as both *M. kaleniczenkii* and *M. melanocephala* occur together.

There is one advantage which we must all admit that the American zoologists possess over ourselves, and that is, that they have a clear idea of the natural geographical divisions of their continent, and their zoology has been studied from many distinct points of view, such as the presence or absence of rainfall, &c., and it only requires a glance at Mr. Hume's essay on the distribution of Indian birds with respect to the distribution of rainfall throughout the Indian peninsula to see how very important is this aspect of the subject. Even in the British Islands there are variations in the size and coloration of some of our resident birds, as any one may learn from Mr. F. Bond, who has devoted sixty years of his life to the study of British ornithology, and who now has one of the most interesting collections in this country. But when we come to study the birds of Europe and the Palæarctic region generally, how small is our real knowledge, and what vast areas are there concerning the ornithology of which we know next to nothing! Great praise is, therefore, due to men like Dr. Menzbier, who has just written the first part of an elaborate treatise on the geographical distribution of birds in Russia; but it will be a long time before we can have in any museum such a series of birds as is possessed by the Smithsonian Institution for any one wishing to study the geographical distribution of the birds of North America. The British Museum is fully alive to the importance of the question, but I find that there is nothing more difficult than to procure from my colleagues in the other countries of Europe a representative set of the common resident birds of their respective countries. The value of such collections as that which Mr. Seebohm is making cannot be over-estimated.

I have exhibited to-day three distinct illustrations of birds from the Old World where trinomial nomenclature might be employed. In the case of the Goshawks, the Scops Owls, and the Crows, I am not yet certain that my way of treating them in the "Catalogue" as sub-species is not as advantageous as the employment of trinomials. But in the case of the Long-tailed Titmice the circumstances seem to me different, and the adoption of trinomial nomenclature would be a positive advantage, because *Acredula caudata* undoubtedly mixes with *A. rosea* in the Rhine provinces and other parts of Europe; therefore in England, where the *rosea* strain is apparently pure and unmixed, it is advantageous to speak of the bird as *Acredula caudata rosea*, because such a name clearly conveys the idea that *A. rosea* is a form of *A. caudata*, with which it is connected by intermediate forms elsewhere. *A. caudata irbii* would also express the relationship of the South European bird, and *A. caudata trivirgata* the Japanese form.

The case of the Wagtails is not so clear, because we do not yet seem to have sufficient material to work upon. Even here some of the races might be fairly expressed by the employment of trinomials, as *Motacilla flava dubia* for the Siberian and Indian race of *M. flava*. *M. viridis* being a form without an eyebrow, would have a Mediterranean race, *M. viridis cinereocapilla*, while *M. melanocephala* has at least one race, *M. melanocephala kaleniczenkii*, unless the last-named ultimately proves to be a hybrid.

I may say in conclusion that the great difficulty which I perceive in the adoption of trinomial nomenclature, both at home and abroad, lies in the fact that it will open the door to a multiplication of species, or races, founded on insufficient materials, and bestowed by authors who have not sufficient experience of the difficulties of the subject; but I cannot conceal from myself that the code of nomenclature proposed by the British Association and followed by most of us scarcely accounts for the treatment of facts as they have been developed in zoological science since the promulgation of that code, and that before long it will be the duty of British zoologists to attempt its modification.

Mr. Henry Seebohm read the following paper:—The question of a binomial or trinomial nomenclature is not a very simple one. So long as ornithologists were under the delusion that all species were separated from each other by a hard and fast line, the binomial system of nomenclature was sufficient. Now that we know that many forms which have been regarded as species are connected by intermediate links with each other, and that many species present important local variations which cannot be ignored, we are obliged to admit the existence of sub-species as well as species. There can be no doubt that the too tardy recognition by European ornithologists of what might not unreasonably be regarded as the most important fact in ornithology discovered during the present century has been very largely due to a pedantic adherence to a binomial system of nomenclature. Now that we have emancipated ourselves from the fetters with which our predecessors, with the best intentions in the world, cramped our ideas, the question arises, how shall we recognise in our nomenclature the existence of sub-specific forms; by a word, or by a sentence? The ornithologists of America think that a system of trinomial nomenclature will answer the purpose. They have come to the conclusion that the insertion of a third link in the chain which binds us will give our ideas scope enough. Their theory is that the judicious ornithologist will be able to select from the infinite number of steps which form the series of intermediate races which lie between two intergrading species, one, two, three, or even in some cases more local or climatic races which are worthy of being dignified by a name. This theory is on the face of it somewhat illogical. It credits ornithologists with an amount of discretion which their past history does not justify, and totally ignores the inordinate desire to introduce new names which is unfortunately too conspicuous in most if not in all ornithological writers, culminating in the absurdities of a Brehm. That ornithology should be preserved from being Brehmised must be the devout prayer of every well-wisher of the science. On the other hand, the recognition of sub-species by a sentence would be to revert to the customs of the præ-Linnean dark ages of nomenclature, a retrograde step from which all zoologists would instinctively shrink. Members of the British Ornithologists' Union are probably all prepared to admit that a medium course is safest at least for an Ibis (*medio tutissimus ibis*), and, with a very slight modification, I for one am prepared to adopt the American system in spite of its dangers. If no paths are to be trodden in which the indiscreet may err, there is an end at once of all progress.

To point out the modifications which I propose to introduce into the American system of nomenclature to change it from an empirical system to a logical or scientific system, I will take as an example the Common Nuthatch (*Sitta europæa*) and show how the nomenclature of its various races may be made exhaustive, so that the temptation to introduce new names, which appears to be irresistible to the indiscreet ornithologist, may be minimised.

Sitta uralensis, with white under parts, is found in Siberia; *Sitta cæsia*, with chestnut under parts, is found in England; intermediate forms connecting these species together are found in the Baltic provinces. What can be more simple than to call the intermediate forms by both names, *Sitta cæsia-uralensis?* But there is a third species which turns up in China, *Sitta sinensis*, and which is also connected with *Sitta uralensis* by intermediate forms. Never mind; they too can be called by both names, and our series of Nuthatches runs geographically in an unbroken series:—

Sitta cæsia,
Sitta cæsia-uralensis,
Sitta uralensis,
Sitta uralensis-sinensis,
Sitta sinensis.

So far so good; but, unfortunately, two more complications arise. Besides the series running south-west into *S. cæsia*, and that running south-east into *S. sinensis*, two other series run from the central form *S. uralensis*, one running due west and then round by the Baltic into the Scandinavian *S. europæa* (a larger bird, and somewhat darker on the under parts), and a second running due east and then round the Sea of Okotsk into the Kamchatkan *S. albifrons* (a bird much paler on the head, which shades into white on the forehead), so that it is necessary to add four more names to the list, which will stand as under:—

Sitta cæsia is found in Britain, South-West and South Europe, and Asia Minor. It is medium in size, but extreme in the darkness of the chestnut of the under parts.

Sitta cæsia-uralensis (with a hyphen between the two specific names) represents all the forms intermediate between South European and Siberian examples, which occur in Denmark, Pomerania, the Baltic provinces of Russia, Poland, and the Crimea.

Sitta europæa is the Scandinavian form, and represents the extreme of size, whilst in colour it is intermediate between the forms found in the Baltic provinces of Russia and Central Siberia.

Sitta europæa-uralensis comprises all the intermediate forms in Russia which connect the Scandinavian with the Central Siberian forms.

Sitta uralensis is found in the valleys of the Ob, the Yenesei, and the Lena, and combines the small size characteristic of the various Asiatic sub-species of Nuthatch with the dark upper parts of the sub-tropical forms, whilst the under parts are nearly as white as in the Kamchatkan form.

Sitta uralensis-albifrons may be applied to all those intermediate forms found in East Siberia and the north islands of Japan which are not quite so pale on the upper parts as the Kamchatkan form.

Sitta albifrons is found in Kamchatka, and represents the extreme form so far as whiteness of the forehead and under parts is concerned.

Sitta uralensis-sinensis may be applied to the series of forms found in the valley of the Amoor, the island of Askold, and the main island of Japan. They are intermediate in colour between the Central Siberian and Chinese forms, and are scarcely to be distinguished from the Baltic province forms.

Sitta sinensis is found in China, and only differs from the British form in being slightly smaller and in not having quite so much dark chestnut on the flanks.

I have purposely chosen a complicated case in order to show the capabilities of the system, which, if the specific name of *europæa* is always repeated after the generic name of *Sitta*, becomes a compromise between that adopted by the Americans and that which I imperfectly carried out in the fifth volume of the "Catalogue of Birds in the British Museum," and which was originally suggested to me by a conversation with Mr. Salvin. It has at least the merit of being exhaustive, and differs so slightly from that in common use in America that its adoption does not involve a change in, but only an addition to, the system which in some form or other is destined to supersede the binomial system now rendered inadequate by the acceptance of the theory of evolution.

As an example of the compromise I propose, I add a list of the local races of the Dipper, with their geographical ranges :—

Cinclus aquaticus melanogaster (Scandinavia).

Cinclus aquaticus melanogaster-albicollis sive *Cinclus aquaticus* (West Europe, as far north as the Carpathian and as far south as the Pyrenees).

Cinclus aquaticus albicollis (South Spain, Algiers, Italy, Greece).

Cinclus aquaticus albicollis-cashmiriensis (Asia Minor, Caucasus, Persia).

Cinclus aquaticus leucogaster (East Siberia).

Cinclus aquaticus leucogaster-cashmiriensis (Central Siberia).

Cinclus aquaticus cashmiriensis (Cashmere, South Siberia, and Mongolia).

Cinclus aquaticus cashmiriensis-sordidus (Altai Mountains).

Cinclus aquaticus sordidus (Thibet).

In this system it must be observed that wherever there is a fourth name it is always connected by a hyphen to the third name, and comprises all the intermediate forms between the two. It is somewhat cumbrous, but it provides for the contingency of any intermediate links that may occur. To express it algebraically, it provides not only for A B and B C, but also for A C. It is perhaps the only system which is theoretically perfect, but the question whether its voluminousness renders it impracticable or undesirable is one requiring careful consideration.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

UNIVERSITY COLLEGE, BRISTOL.—A correspondent writes :—This session has been most successful, the numbers of students in attendance being considerably larger than in the two preceding years. Funds are wanted more seriously than ever to complete the building and provide additional accommodation. Nothing has yet been done towards an endowment fund. Mr. E. Buck, M.A., Lecturer in Mathematics, has resigned his position on the staff. The Demonstrator in Physics, Mr. Colman C. Starling, has also resigned his post in consequence of internal rearrangements. The Chair of Geology and Physiology, left vacant by the resignation of Prof. Sollas, has been filled by the appointment of Mr. Lloyd Morgan.

SOCIETIES AND ACADEMIES

SYDNEY

Linnean Society of New South Wales, April 30.—Dr. James C. Cox, F.L.S., vice-president, in the chair.—The Hydromedusæ of Australia, part 2, by R. von Lendenfeld, Ph.D. According to the principles set forth in part 1 of this paper, the Hydromedusæ are classified in a new manner, and the Australian representatives of the first four families in this system are described or referred to. The paper contains descriptions of several new and interesting forms, and in every case an abstract of everything known on the histology of every species is given with references. The most interesting of the new forms is *Eudendrium generale*, the male polypastyles of which show a great similarity to Medusæ. They possess four aboral tentacles in the principal radii, and on these the spermatozoa reach maturity. These tentacular appendages are therefore homologous to the radial canals of the Craspedote Medusæ. Some deductions are drawn herefrom, and the homology of the parts in Medusæ and Polypes described differently to the views expressed by Allman and others. The Umbrella is not homologous to a web between the tentacles of the mouth, but between the generative tentacular processes at the aboral pole.—Revision of the recent Rhipidoglossate and Docoglossate Mollusca of New Zealand, by Prof. F. W. Hutton, F.G.S. The synonymy of all the species is fully given, with, in many instances, revised descriptions and notes on the dentition where known.—Notes on hybridism in the genus Brachychiton, by Baron Ferd. von Mueller, K.C.M.G., M.D., Ph.D., F.R.S., &c. The plant which is the subject of this paper is a beautiful tree of forty feet in height and a stem diameter of one foot, grown at Fern Hill, near Penrith, New South Wales, and is an undoubted hybrid between *Brachychiton populneum* and *Brachychiton acerifolium*. Like most hybrids, the flowers never perfect their seed.—Mr. Macleay read a letter from the Rev. J. E. Tenison-Woods, vice-president of the Society, dated from Perak, February 27 last, giving a long and interesting acount of his proceedings and experiences in the Malacca Peninsula. He had examined and reported on the rich tin mines of the settlement, and the geological features of the whole territory ; and he had spent some time in the investigation of its zoological and botanical productions.

Royal Society of New South Wales, May 7.—Annual Meeting.—Hon. Prof. Smith, C.M.G., president, in the chair.—The Report of the Council stated that thirty new members had been elected during the year, and the total number on the roll, April 30, was 494. M. Louis Pasteur, M.D., of the French Academy of Sciences, had been elected an honorary member in the place of the late Dr. Charles Darwin, and Ottokar Feistmantel, M.D., Palæontologist to the Geological Survey of India, had been elected a corresponding member.—The Clarke Medal for the year 1884 had been awarded to Alfred R. C. Selwyn, LL.D., F.R.S., in recognition of his scientific labours in Great Britain and as Director of the Geological Surveys of Canada and of Victoria.—During the year the Society held nine meetings, at which the following papers were read, viz. :—Presidential Address by Chr. Rolleston, C.M.G.—On the aborigines inhabiting the great lacustrine and riverine depression of the Lower Murray, Lower Murrumbidgee, Lower Lachlan, and Lower Darling, by P. Beveridge.—On the Waranamatta shales, by the Rev. J. E. Tenison-Woods, F.G.S., F.L.S.—Further remarks on Australian Strophalosiæ, and description of a new species of Aucella from the Cretaceous rocks of North-East Australia, by R. Etheridge, jun., F.G.S.—On plants used by the natives of North Queensland, Flinders, and Mitchell Rivers, for food, medicine, &c., by E. Palmer (M.L.A. Queensland).—Notes on the genus Macrozamia, with descriptions of some new species, by Charles Moore, F.L.S., V.P.—A list of double-stars, by H. C. Russell, B.A., F.R.A.S.—Some facts connected with irrigation, by the same.—On the discoloration of white bricks made from certain clays in the neighbourhood of Sydney, by E. H. Rennie, M.A.—On the roots of the sugar-cane, by Henry Ling Roth, F.M.S.—On irrigation in Upper India, by H. G. McKinney, A.M.I.C.E.—On tanks and wells of New South Wales ; water-supply and irrigation, by A. Pepys Wood.—Additions to the census of the genera of plants hitherto known as indigenous to Australia, by Baron F. von Mueller, K.C.M.G., F.R.S., &c.—The Medical and Microscopical Sections held regular monthly meetings. At the preliminary meeting of the Medical Section this year, the Chairman stated that never during the history of the Section had its meetings been so numerously attended, and that the value of the papers read before it was attested by the fact that so many of them had been reprinted in the Home journals.—The Council has issued the following list of subjects, with the offer of the Society's bronze medal and a prize of 25*l.* for each of the best researches, if of sufficient merit :—Series III. To be sent in not later than September 30, 1884. No. 9. Origin and mode of occurrence of gold-bearing veins and of the associated minerals. No. 10. Influence of the Australian climate in producing modifications of diseases. No. 11. On the Infusoria peculiar to Australia. No. 12. On water-supply in the *interior* of New South Wales. Series IV. To be sent in not later than May 1, 1885. No. 13. Anatomy and life history of the Echidna and Platypus. No. 14. Anatomy and life-history of Mollusca peculiar to Australia. No. 15. The chemical composition of the products from the so-called kerosene shale of New South Wales. Series V. To be sent in not later than May 1, 1886. No. 16. On the chemistry of the Australian gums and resins.—The Chairman read the Presidential Address, and the officers and Council were elected for the ensuing year.

PARIS

Academy of Sciences, June 30.—M. Rolland, President, in the chair.—Remarks on the hygrometric reports from nearly a hundred French stations, yearly published by M. Mascart in the *Annales du Bureau météorologique de France*, by M. J. Jamin.—On the use of formene in the production of very low temperatures, by M. L. Cailletet. The author finds that, when slightly condensed and cooled in boiling ethylene under atmospheric pressure, this gas is resolved into an extremely volatile colourless fluid, which, in again passing to the gaseous state, yields a degree of cold sufficient immediately to liquefy oxygen. Under these conditions the liquefaction of oxygen becomes one of the simplest operations of the laboratory.—Remarks on the project of creating a so-called inland sea in Algeria and Tunisia, by M. E. Cosson. The author regards as chimerical Dr. Rouire's scheme for converting the Shott Melghir into a marine basin by means of a canal, 145 miles long, communicating with the Mediterranean.—Note on the development of the graphic meth d of representation by means of photography, by M. Marey.—On a new species of Sirenian discovered in the Paris basin, by M. Albert Gaudry.—Observations on the new planet, 237 Palisa, made at the Paris Observatory (equatorial of the west tower), by M. G. Bigourdan.—On the effects of mutual forces: determination of a function represented by a simple curve involving most of the laws of general physics (one illustration), by M. P. Berthot.—Researches on the laws of diffraction of light in the shadow of an opaque screen with rectilinear edge, by M. Gouy. In this paper the author's remarks are restricted to rays diffracted in the geometrical shadow, the edge of the screen being normal to the plane of diffraction containing the incident ray and the diffracted rays.—On certain chemical compounds obtained by means of a gas pile, and of appliances for subjecting the gases to electric effluvium, with tabulated results, by M. A. Figuier.—A method of transforming liquid to dry electric piles, by M. Onimus.—Further researches on the coagulation of colloidal substances, by M. E. Grimaux. Here the author deals first with substances whose coagulation is checked by dilution, secondly with those whose dilution stimulates coagulation.—Researches on the preparation of hydrated chromic acid, and on some new properties of anhydrous chromic acid, by M. H. Moissan.—On the production of the neutral orthophosphate of aluminium in the anhydrous and crystallised state, by M. A. de Schulten.—On a new alcohol derived from the birdlime prepared from the inner bark of the *Ilex aquifolium*; note on a process of the late J. Personne, by M. J. Personne, jun.—Complementary observations on colchicine and colchicéine, by M. S. Zeisel.—On the various processes employed for determining the phosphoric acid in the superphosphates of commerce, by M. E. Aubin.—On the efficacy of vinous yeast artificially prepared, by M. Alph. Rommier.—On the theoretical figures of certain simple substances (lithium, sodium, potassium, rubidium, cæsium) forming a series, by M. L. Hugo.—On a new type of the leech family infesting crocodiles in the Senegambian rivers, by MM. Poirier and A. T. de Rochebrune.—On the fossil cones of the genus Sigillaria in the Carboniferous flora, by M. R. Zeiller.—Note on the assimilation of maltose in the animal system, by MM. A. Dastre and E. Bourquelot.—On the dyspepsia of liquids, by M. V. Audhoui.—Note on a meteorite observed at Concarneau on June 28, 1884, by M. G. Pouchet.—On a meteorite observed at the Trocadéro Observatory on the same night, by M. L. Jaubert.

BERLIN

Physiological Society, June 20.—Prof. du Bois Reymond showed a rabbit with highly-deformed incisors, which had been reared in the Institute. The two lower incisors were several times their natural length, projecting deeply as they did into the nostrils, and were gladiate above and crooked behind. In the upper jaw only one incisor was of about the same size as either of the two under ones. Interiorly it was curved in the form of a semicircle, and rested in a furrow of the under jaw. Mastication, which was rendered difficult by the deformation of the incisors, was effected by lateral movements of the jaws.—Prof. Christiani spoke on the physiology of the brain, connecting his remarks with his former experiments, by which he had demonstrated the existence of two respiratory centres above the medulla oblongata, one of which, situate at the base of the third ventricle, was a centre for inspiration, the other located in the fossa sylvii for expiration. These two centres exercised an influence also on the heart, the one under moderate stimulation producing cessation in systole and retardation of pulsation, the other cessation in diastole and acceleration of pulsation. By the side of the inspiratory centre, and in association with it, Prof. Christiani found a co-ordinatory centre for collective combined movements of the body. On the excision of the brain of a rabbit, if these three centres were left uninjured, and if all considerable bleeding that might prejudicially affect the preserved parts of the brain were avoided, the animal acted entirely as in a normal state: it was able to walk, to run, to spring, to avoid objects in its way, to respond to impressions of seeing and hearing. If, on the other hand, the co-ordinatory centres were injured, these movements all failed: the animal lay on its side, and occasionally showed epileptiform convulsions. Prof. Christiani, having further communicated a series of detailed observations gathered from his experiments with disbrained rabbits, developed the hypothesis he had conceived for himself respecting the function of the brain. According to this hypothesis a large number of energies acted on the brain, in part directly, in part by the medium of the nerves, which, in the ganglia at the base of the brain, were transformed into reflex movements. To this primary circuit the cerebrum formed a kind of secondary circuit into which were derived a large number of the advancing energies, and there hoarded up. If the cerebrum were removed, then all energy was transposed into reflex movement, and consequently disbrained and decapitated animals manifested much stronger reflex movements than did such animals as possessed this secondary derivation. In the higher animals the energy distributed into the cerebrum formed ideas and consciousness, the quality of which might vary, even when the operative sensuous stimulations were completely equal, according to the relative activity of the particular parts of the cerebrum which were stimulated, and according to their configuration. With this conception of the function of the cerebrum Prof. Christiani could not accept the doctrine, advocated quite recently by Hitzig, Ferrier, and Munk, regarding the localisation of the activity of the cerebrum, and in support of his conception he adduced the highly contradictory data that had been accumulated on the sphere of vision. As was known, one portion of the observers, after removal of the sphere of vision, had found blindness to be the result, while another portion, after such an operation, had found that the animals operated on were yet able to see. These contradictions Prof. Christiani sought to reconcile by the assumption that the removal of the sphere of vision produced a stimulation which interfered with those derived from the sensuous organ, and so presented the appearance of the failure of the function.

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