THURSDAY, OCTOBER 13, 1892.

VIVISECTION AT THE CHURCH CONGRESS.

THE attitude of the Church towards science at the present day shows a healthy spirit of tolerance. It fully recognizes that research in physical science is the very embodiment of the seeking after truth, and that the proper exercise of faith is consonant with an attitude of expectancy. This year, however, has seen an attempt, led by Bishop Barry, to disturb this harmony and to create an exception, namely, in the case of scientific research in Biology, whether of normal structure as physiology, or of abnormal, as pathology. At the Church Congress last week the following was referred for open discussion at the instigation of Bishop Barry, who, however, wished, it is stated, to have had a much more sweeping theme presented:—

"Do the interests of mankind require experiments on living animals, and, if so, up to what point are they justified?"

There was here presented to the Congress the twofold aspect of the question—utilitarian and moral—the obvious desire of the Subjects Committee being that they should thus have laid before them on these two points the evidence of the usefulness of scientific experiments on living tissues, and the evidence that such research is consonant with morality.

To all scientific men, even if not biologists, there is no need of evidence that experiments on living tissues are necessary to the progress of physiology and pathology. As Mr. Horsley showed in his speech, this position is *a priori* established, since the processes of life are chemical and physical in nature, and can only therefore be advanced by experimental observation whether in the laboratory or by the bedside. It seems, by the way, to have escaped the notice of all the speakers that every new clinical fact is as much the outcome of "experimental" observation as any note made in a laboratory. We would lay stress on this since not only do some dignitaries in the Church but even a few medical men seem to think that clinical discoveries are the result of inspiration, and not the outcome of trying this or that modification of factors and noting the subsequent effects. However, if the Church Congress wanted facts they were supplied in overwhelming degree, and not only facts on the utilitarian side but also many—some unexpected to judge by the excitement produced—on the moral condition of anti-vivisectionists and their beliefs. Putting aside for a moment the utilitarian side of the question, it is doubtful whether the moral responsibility of anti-vivisectionists has ever been more freely exposed to view. After Dr. Wilks had revealed the inconsistency of the agitators and their free use of animals (without anæsthetics) for their own ends, Mr. Horsley probed the consciences of the bishops by pointing out that "it has always been a matter of the utmost surprise to the medical profession that educated men in positions of the gravest moral responsibility like bishops should have in this matter descended to receive the information they require from sources of notoriously tainted character, rather than by seeing for themselves in our University laboratories what scientific experiments are in reality."

It is certainly a very fair question to ask of Bishops Barry and Moorhouse—What right had they to lend their help to any cause, however righteous it may appear to them, unless they have made a *bona-fide* effort to hear both sides? Has Bishop Barry visited the Physiological Laboratory at Oxford, or Bishop Moorhouse that and the Pathological Laboratory at Owens College? And if not, why not? Most especially ought such care to have been exercised in the case of anti-vivisectionism, since the leaders of that party have attacked not merely individuals, but the whole medical profession as "murderers," "torturers," &c., and have accused them of the grossest cruelty and self-seeking. The bishops referred to have, it is to be feared, forgotten that their office is a very reverend one, not to be lightly used to help any and every alleged reform, and above all not to be used as a means of unfounded denunciation of what Mr. Horsley truly calls an honourable, earnest, and hard-working profession.

It is difficult to see on what possible ground Bishop Barry can defend his use of the expressions "arrogance," "physiological insolence," when he applies them, as he has done, to the simple statements of fact which have been formulated into the following resolutions, the first passed at the International Medical Congress of 1881, and the second at the recent meeting of the British Medical Association at Nottingham:

(1) "That this Congress records its conviction that experiments on living animals have proved of the utmost service to medicine in the past and are indispensable to its future progress. That accordingly, while strongly deprecating the infliction of unnecessary pain, it is of opinion, alike in the interests of man and of animals, that it is not desirable to restrict competent persons in the performance of such experiments."

(2) "That this general meeting of the British Medical Association records its opinion that the results of experiments on living animals have been of inestimable service to man and to the lower animals, and that the continuance and extension of such investigations is essential to the progress of knowledge, the relief of suffering, and the saving of life."

We are glad to see that these unanimous resolutions were read to the Church Congress and appreciated by the audience at their proper value and not according to the estimate of Bishop Barry. Similarly, men of science may not only ask whether Bishop Barry was a moment justified in speaking of physiological research as "cruelty" and "demoralization" while ignorant of the real facts, but they certainly have the right to demand that, should he fail to respond to the challenge offered him by Mr. Horsley, and substantiate his grounds for making these assertions, he should withdraw from the agitation (which has, we suspect, only injured his reputation), and make a free and ample apology.

In the same manner also we would call upon Canon Wilberforce to retreat from the unworthy position into which he has been thrown by the force of feeling uncon-

trolled by reason, and not to make the wrong he has done to science greater by continuing to persist in it regardless of the published demonstration of his error.

One curious feature of the whole popular view of the anti-vivisectionist campaign is the general belief in the good faith of Miss Cobbe. To men of science her methods have been familiar ever since the commencement of the agitation, and more especially since they were clearly displayed in the published trial of Adams *v.* Coleridge. By the general public, however, she was regarded as a fanatic, but trustworthy. After this latter-day exposure at Folkestone to which she has been subjected we hope that such credulity has at last seen its end, for by the production of Miss Cobbe's latest book, "The Nine Circles," and by comparing it with the originals of the scientific papers from which her statements were alleged by her to be taken, Mr. Horsley had no difficulty in convincing the Congress that her statements of facts can no longer be relied upon.

It is an old story that a lie dies hard, but die it does at last, and the proceedings of the Church Congress have greatly accelerated the end.

Nothing can do this better than for scientific investigators to patiently instruct the public. At the Church Congress this heavy task fell on Dr. Raffer, who by way of answer to the vague rhetoric of the Bishops, piled fact upon actual fact until his audience showed how they welcomed the statements of truth as a counterpoise to Episcopal excommunication.

The painful position of medical men who can be found willing to sanction such an agitation was well exhibited by the action of Mr. Lawson Tait, who having publicly charged Church Congress officials with excluding him from the meeting, was positively proved to have withdrawn himself, the withdrawal being contained in his letter read to the Congress by the chairman of the Subjects Committee, the Bishop of Dover.

Lastly, on the broad question of utility, no member of the Church would, we are sure, feel justified in contravening the view that the general regard shared by all Englishmen, and expressed in the above-mentioned resolution of the International Medical Congress, for the proper, that is, humane, use of animals, is ample surety that whether for the sake of food or pursuit of knowledge, the object is obtained at a minimum cost of pain.

The most extraordinary illogicality was displayed on this very point by Bishop Moorhouse, of Manchester, for while declaiming against the killing of animals to gain knowledge, he clamoured for liberty to destroy any number to preserve the volume of his voice.

But if we were to speak of the illogicality of the anti-vivisectionists there would be no end, seeing that as they do not or will not learn the truth, they live in a circle of contradictions. Suffice it to say, that we believe the open discussion of the subject at the Church Congress will do more than anything to show the public that the feeling exhibited by the anti-vivisectionists is one of unmitigated hostility to science, and not one of genuine anxiety for the humane treatment of animals devoted to the service of man.

THE NEW VOLUME OF WEISMANN.

Essays on Heredity. By Dr. A. Weismann. Authorized Translation. Vol. II. Edited by E. B. Poulton, F.R.S., and A. E. Shipley. (Oxford : Clarendon Press, 1892.)

IN this second volume of the new edition of Dr. Weismann's essays there are brought together four essays which did not appear in the first edition ; they are in a convenient form, well translated, and well printed.

Nothing is more curious than the public appreciation of Weismann's essays, for in them is no trim, nicely balanced, carefully elaborated statement of his biological theories. The successive essays appear as they were published. You have the theories in their making, stretching from essay to essay ; alive, contradictory, disjointed. This historical method of publication is a thing to delight the student of biology, but, one had thought, a torture to the precisian and caviare to the general ; yet the public continue to buy, discuss, and no doubt read his works.

In "Retrogressive Development in Nature," Dr. Weismann describes cases of vestigial organs or rudimentary functions. To explain the occurrence of these, the transmission and accumulation of degenerate characters produced by disuse is unnecessary. In every organ, as in every animal, variations occur ; in every generation unsuitable variations are weeded out, and so the organ or the animal remains adjusted to its environment, or becomes more perfectly adapted to it. But when a change of habit or of environment occurs, as when an eyed animal takes to living in dark caves, or when an animal that has been saving its life by swiftness comes into a region devoid of enemies, the less far-seeing or the less swift are not more quickly killed than their better endowed neighbours. So far as sight or swiftness are concerned, a condition of panmixia occurs, and the organs of sight and flight slowly degenerate.

The argument in "Thoughts on the Musical Sense in Animals and Men" is subtle, ingenious, and less familiar. In insects and birds males are the musicians, and sexual selection is a sufficient explanation ; but it is not so in man. However, in the mammalia the organ of hearing is remarkably developed. In the auditory organ of a rabbit there are structural arrangements for nearly two thousand note sensations, while a concert grand piano contains only eighty-seven different notes. For the needs of life, the thousand gradations of sound in the woods and the field, of the hunter and the hunted, the mammalian organ is adapted. Music itself is an invention, and from the rude melodies of primitive man to the art of Beethoven and Chopin, it has been progressively developed as the intellectual faculties have been developed.

The third essay, "Remarks on certain Problems of the Day," is specially valuable, as in answer to certain criticisms by Prof. Vines[1] many doubtful points are explained. Specially to be noted is the clear re-statement of Weismann's contention that the nuclear substance is the sole bearer of hereditary tendencies, and the new evidence for it contained in the researches of Boveri and O. Hertwig. Equally noteworthy is the admission, in

[1] NATURE, October 24, 1889.

reply to Prof. Vines' citation of the parthenogenetic fungi, that not only sexual forms may vary into new species.

It is to the last essay, that on "Amphimixis, or the essential Meaning of Conjugation and Sexual Reproduction," that most attention will be directed Here there is a full statement, with important additions and alterations of the central part of Dr. Weismann's theories. However they may bulk in public imagining, questions of acquired characters, of retrogressive metamorphosis, and so forth, are side issues of a search for the morphological expression of the processes of variation.

Originally Weismann explained the two successive divisions of the nucleus of an unfertilized egg which form the two polar bodies as, in the case of the first, an extrusion of that nuclear plasm which, having served to guide the maturation of the egg, became useless when the egg was mature; and in the case of the second, as a halving of the nuclear substance to make way for the incoming sperm-plasm.

In parthenogenetic ova, one division and only one was predicted and found. It was suggested that parallel processes occur in spermatogenesis.

Subsequent research by O. Hertwig and others has brought to light these parallel processes, and Weismann, seeking for a sign, got rather more than he anticipated. For the processes in spermatogenesis show first a doubling of the germ-plasma, and then two successive reducing divisions, and it has been shown that exactly this happens in ova also. Accordingly, Weismann rejects his original explanation of the first polar body as an extrusion of ovo-genetic nucleoplasm, and the new problem comes to be, what is the cause of that doubling of the nucleoplasm which in primitive sperm and germ cells precedes the two reducing divisions?

Weismann supposes that the ancestral plasms or units of heredity, to which he gives the name "ids," are arranged in "idants," or nuclear rods. The doubling process takes place normally by longitudinal division, and simply doubles the number of idants without altering the arrangement of "ids." By this method the number of possible combinations is increased without alteration of the ids. The process is a mechanical one to increase the chances of combinations when the idants of sperm and germ cells meet. If the idants were coloured rods, to be arranged in pairs—say black, white, red, and yellow for four sperm idants, and orange, green, blue, and crimson for those of the egg-cell—obviously only four pairs are possible. The black would have to unite with one of the four others. But if before the arrangement in pairs each rod were split in two, there could be two combinations for black, and so on for the others. No doubt in many cases the number of idants is far greater than four, and the mechanical arrangement for variations correspondingly greater. From the large number of possible combinations there come the relative few individuals of the next generation, and there is thus a basis for the lawless and apparently capricious appearance of varieties. Next in importance comes Dr. Weismann's belief, based on theoretical considerations, and supported by experiments on *Cypris*, conducted for seven years, that in parthenogenetic reproduction heritable variations may occur. But they are far less frequent than in sexual reproduction. But the whole of this essay is full of intricate and curious speculation, speculation which will have to come before every student of biology, and which, whether much or little of it becomes incorporated in the body of accepted knowledge, will at least play a large part in guiding and stimulating present research. P. C. M.

ELEMENTARY CHEMISTRY.

The Standard Course of Elementary Chemistry. By E. J. Cox, F.C.S. Pp. 344. (London: Edward Arnold.)

THIS book consists of five parts, which may be obtained separately or bound up in one volume. It is based upon the syllabus prescribed by the Education Department for teaching chemistry as a class or specific subject, and professes to lead the beginner from the "familiar" to the "less known" by means of "investigation," the teaching thus afforded being regarded as a branch of mental education as well as of useful knowledge. The five parts deal respectively with the properties of the common gases, the atmosphere, water, carbon and non-metallic elements, and with metallic bodies, combination, symbols and formulæ.

The general plan of the book and the manner in which the subject is approached have a good deal to recommend them; the detailed treatment contains, however, much which could be improved, and unfortunately much which the learner will have to forget as he progresses in the study of his science. In the opening chapter, evidently for the sake of simplicity, the author uses the term heat in place of temperature. More confusion on the subject of heat is made later on by the use of equations, such as

$$\left.\begin{matrix}\text{"}\textit{Chalk}\\ \text{and}\\ \textit{Heat}\end{matrix}\right\} \text{yield} \left\{\begin{matrix}\textit{Lime}\\ \text{and}\\ \textit{Carbonic Acid Gas."}\end{matrix}\right.$$

which appears to attribute to heat a material existence; and even more unsatisfactory are bald statements to the effect that "no heat is produced in the formation of a mixture. Heat is produced in the formation of a chemical compound."

Considerable space is occupied in the comparison of the affinities of the elements. Because certain metallic oxides, including iron-oxide, are reduced when heated in a stream of hydrogen, the affinities of the metals for oxygen are said to be weaker than that of hydrogen for oxygen. In the case of iron and steam the author has to note that the inverse change—the oxidation of the metal by steam—readily occurs, and that the former statement as to the affinities of iron and hydrogen for oxygen, is apparently contradicted. This contradiction might have indicated the futility of attempting to compare affinities in a general way and not with reference to the special conditions under which the experiments were performed. The inverse change in the case of iron is said to occur when the "temperature" is favourable, but in reality the active masses of the reacting materials determine the direction of the change.

Inaccurate statements are numerous. Hydrogen is said to form "one-third part of water by volume," "a formula" is stated to "represent a molecule," and a base is given as "a compound of a metal with hydrogen and

oxygen." More objectionable still are occasional instances of bogus reasoning, the most striking example being an erroneous proof of the conservation of mass. On three different occasions the indestructibility of matter is stated to be a consequence of the law of definite proportions. Almost equally bewildering is an attempt to show that "a molecule occupies two volumes," an attempt which even when correctly carried out might well be excluded from a book which professes to discourage anything akin to cramming. No advance is made in familiarizing the learner with accurate conceptions of atom and molecule; indeed the need for the latter conception in chemical philosophy is quite overlooked.

Throughout the book the author's mode of expressing himself is frequently not the happiest. To say that "air allows all bodies that will to take fire in it," or that "chlorine does not combine with an excess of hydrogen" is harmless enough perhaps. On the other hand to talk of the "properties of a mixture" being the "sum of the properties of its constituents," or of the gas being kept dissolved in a bottle of soda water "by the pressure of the cork," or to say that "water has weight and exerts pressure" cannot but be puzzling to the intelligent reader.

To prepare a thoroughly good introduction, of the most elementary kind, to the study of chemistry, is a work of considerable difficulty, indeed it is one which few of our leading chemists seem desirous of undertaking. Enough we think has been quoted from the book under notice to show that the author has by far underrated the difficulty of this task. J. W. R.

LIFE AND DEATH.

Essai sur la Vie et la Mort. Par Armand Sabatier. (Paris: Babé et Cie.)

PROF. SABATIER'S "Essai sur la Vie et la Mort" forms the fourth volume of the "Bibliothèque Évolutioniste," a series of books published under the direction of M. de Varigny, with the view of expounding in a strictly scientific manner the different principles and the diverse applications of the theory of Evolution. The series most appropriately begins with a translation of Wallace's "Darwinism," and it is gratifying to our national pride to find that the two other works which have as yet appeared in the series, Ball's "Treatise on Use and Disuse," and Geddes' and Thomson's "Evolution of Sex," as well as the two others announced as in the press, are all by British authors.

The present essay, which extends over 280 pp., is the outcome of a series of lectures delivered at the University of Montpellier. It is written in a clear, simple style, devoid for the most part of all technicalities which appeal only to the specialist. The problems of life and death are dealt with from an exclusively biological point of view, and questions of morality and theology are hardly touched upon. It is difficult to do justice to the views expounded in the book in the short space at our disposal, but an attempt may be made to give a short account of its contents. The first part deals with life: the properties of living matter are considered in great detail, and Prof. Sabatier endeavours to show that the attributes of life are found to some extent, at any rate, in dead matter. According to his views "la matière brute est vivante aussi," but the manifestations are slow and dull. To the Professor's mind living matter and dead matter are not absolutely distinct: between the two states of matter there is only a difference of degree and not of kind. "La vie donc est partout, dans la matière dite inanimée comme dans la matière vivante." The various features in which dead matter behaves like living, are considered at great length; but, curiously enough, no mention is made of Bütschli's remarkable experiments on artificial amœbæ, recently described in the "Quarterly Journal of Microscopical Science."

This view being accepted, death in the ordinary sense of the word, naturally cannot exist, and the phenomenon which we usually call death becomes but another form of life—"la vie intense" simply passes into the state of "la vie lente." Immortality, according to our author, consists in the indefinite continuity of life ("la vie intense") without arrest or interruption. Like Weismann, he maintains that the negation or the contrary of such immortality involves the presence of a dead body or corpse. Weismann holds that ciliated infusoria are immortal if kept under favourable conditions, these conditions, of course, including frequent opportunities of conjugating. Sabatier considers that such infusoria are only potentially immortal, and that the act of conjugation converts this potentiality into a real immortality. In his opinion the primitive protoplasm was immortal, and the habit of dying has been acquired by the higher organisms in response to two stimuli, one internal and one outside themselves. The internal cause of death is associated with a tendency innate in the living being to improve its position in the world, in response to which it has become more specialized, and developed new organs and powers. This specialization has borne with it the seeds of death. The external cause is the surrounding world, which constantly stimulates and promotes the organism to new efforts, and in the struggle for the mastery death is brought about.

Although we fail to see that Prof. Sabatier has thrown any new light upon the problems he attempts to solve, and although the explanations he advances seem to us inadequate, his book is a useful one, inasmuch as he gives us a careful summary of the numerous views advanced by various writers in the last twenty-five years, on the subject of life and death, and criticises with considerable ability the theories of Weismann, Goette, Minot, &c. In fact, his destructive powers seem greater than his constructive. A. E. S.

OUR BOOK SHELF.

Contagious Foot Rot in Sheep. By Prof. G. T. Brown, C.B., 16 pp., 8 illustrations, (John Murray).

THIS pamphlet is a reprint from the second part of the current volume of the Royal Agricultural Society's Journal. A few additional remarks on the prevention of foot rot have been added, and if the instructions given were fully carried out, the disease would soon cease to be troublesome. The preventive suggestions are (1) separation from the rest of the flock for one month of all animals newly purchased; and (2) isolation of all animals affected.

In discussing the treatment of the disease, Prof. Brown

insists upon the importance of detecting it at an early stage, and in the first part of the pamphlet he explains how to do this with certainty.

The pamphlet ought to be read by everyone interested in agriculture: and to make it better known the Society has printed as a leaflet a few notes upon the subject. In America the pamphlet would be sent broadcast amongst those interested, and it is to be hoped that Government assistance may soon enable our own Agricultural Society to disseminate knowledge in a similar way.

W. T.

How to Make Common Things. By John A. Bower. (Society for Promoting Christian Knowledge, 1892.)

IT would be a strange boy who never wanted "to make something." The present little book has been prepared for boys who feel this desire very strongly, but do not quite know how to set about the fulfilment of their wish. They will here find ample information on the best way of making a vast number of things, from a hat-rail to a galvanometer, from a pair of stilts to a needle-telegraph. The author assumes throughout that those whom he addresses are not being taught by a personal instructor in handicrafts, and that they are not the possessors of an elaborate array of tools. His directions are clear and practical, and cannot fail to be appreciated by boys who find much to interest them in the exercise of ingenuity and manual skill.

The Student's Manual of Deductive Logic, Theory and Practice. By K. R. Bose. (Calcutta: S. K. Lahari and Co., 1892.)

THIS book is intended for the use of students at the various Indian colleges, and will be regarded by most teachers of the subject as, upon the whole, a very good text-book. The author has read many of the best European writers on logic, and presents clearly a summary of their results. He begins with a definition of logic, gives some account of its "branches and parts," and then considers terms, propositions, and inferences. What he himself describes as "the distinguishing feature" of the book is a collection of problems and exercises with solutions, or hints towards solution, in close correspondence with the subject-matter of the text.

A Text-Book of Agricultural Entomology. By Eleanor A. Ormerod. Second Edition. (London: Simpkin, Marshall and Co. 1892.)

THE first edition of this book was published about eight years ago. It consisted of lectures which the author had delivered at the Institute of Agriculture of South Kensington. There was not much demand for it until last year, when attention was directed to it by the arrangements of the County Councils for the promotion of agricultural education. The work was then so widely appreciated that a new edition was soon called for, and there can be no doubt that in its new form it will be more popular than ever, for Miss Ormerod has done everything in her power to make it not only scientifically accurate but practically useful. Students will find it of great service in helping them to a knowledge of insect life and of the best remedies for "infestations."

LETTERS TO THE EDITOR.

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

A Functional Hermaphrodite Ascidian.

As of late years a considerable number of structural hermaphrodites have been shown to be protogynous or protandrous, or to have some special modification for the purpose of preventing self-fertilization, it may be of interest to have on record a case of a completely functional hermaphrodite.

I had living lately in one of my dishes a large *Ascidia* (probably *A. rubicunda* of Hancock) which I observed one morning to be expelling eggs from the atrial aperture. The eggs were emitted in batches of from about twelve to twenty at a time, and immediately after each set of eggs came a little white milky jet which hung like a string in the water for a few seconds and then spread out and disappeared. On catching some of this string in a pipette and examining it with the microscope it was seen to be a mass of active spermatozoa. This alternating passage of ova and spermatozoa continued for fully an hour.

The ova at first floated at the surface of the water for a short time and then slowly sank to the bottom. On examining some of those on the bottom of the dish after a couple of hours they were found to have commenced development, being in various stages of segmentation: so there can be no doubt that self-fertilization had taken place.

Very likely this occurs in some other species also, but another common Ascidian (*Corella parallelogramma*), of which I had had several large specimens living a few weeks before, laid eggs in my dishes, and I could not detect any spermatozoa being produced by these individuals. They were functionally female although structurally hermaphrodite.

W. A. HERDMAN.

University College, Liverpool, October 3.

The Present Comets.

ON the 27th ult. about 15½h. G.M.T. comet Brooks (*c*, 1892) had a tail 10′ long, pointing at a position-angle of 280°.

At the latter part of last month Swift's comet (*a*, 1892) was still a very conspicuous object in a 4¼-inch refractor. Observations on several nights showed that it not only still had a very faint tail—at position-angle 260° on the 24th at 8½h, when I observed it to be certainly 11′ long, and suspected it to 21′—but that also there was an elongation nearly in the opposite direction; while I believe the radius of the head was less towards *n* than towards *s*, but I have not been able to satisfy myself of this.

Sunderland, October 5. T. W. BACKHOUSE.

Women and Musical Instruments.

IN looking over a very large collection of musical instruments from the aborigines of America, I am surprised to find that there is not one peculiar to women, and that those of the men are never played by the women. It is true that the females beat time on various objects and may now and then use the rattle. This disappointing fact arrested my attention, and I am curious to know whether savage women, or any other women for that matter, have ever invented a musical instrument, and whether in savagery they even play upon those invented by the men. The composition and singing of songs might also be inquired into, though our American savage women do join in certain choruses. OTIS T. MASON.

Washington, U.S.A., September 26.

Determination of *g* by Means of a Tuning Fork.

MR. C. V. BOYS informs me that for the converse process of determining the pitch of a tuning-fork, the experiment I described recently is no new one, but has been used by him for the last ten years in the instruction of students in South Kensington. I observe, however, that he has not made the same use of the trace to eliminate the zero error. A. M. WORTHINGTON.

THE TOTAL ECLIPSE OF THE SUN, 1893.

AS I have been asked by some astronomers to give a description of the general appearance and climate of this part of Chile, in which a total eclipse of the sun occurs next year, I have drawn up for publication the following account:—

The eclipse takes place on April 16, 1893, at about 8.15 A.M., Chile local time, and will be seen to the greatest advantage in this part of the Province of Atacama.

At the sea coast the central line of total eclipse passes close to Chañaral 29° S.L. This is not the better known Chañaral, north of Caldera, but a small place equidistant from Coquimbo and Carrizal Bajo. The southern limit of total eclipse is 29° 50′ S.L. just north of Coquimbo, and the northern limit 28° 10′, just south of Carrizal Bajo.

The band of total phase stretches between these two limits in a north-easterly direction, across the country, from the coast towards the rising sun. Along the central line of this band the sun will be hidden by the moon for nearly three minutes. The eclipse will be total everywhere within the limits given above, but the total phase will be shorter and shorter the nearer those limits are approached, and outside of them the eclipse will be partial.

On the accompanying map of the Carrizal and Cerro Blanco and Copiapo Railway systems I have marked the northern and southern limits, and the central line of totality.

It will be seen that the port of Carrizal Bajo, 28° 4′ S.L., is just outside the total band, but the railway connecting it with Yerba Buena intersects the central line of total eclipse 70 miles inland, and a branch to Merceditas, 60 miles inland, at an altitude sufficiently high to be above the damp and hazy atmosphere of the coast. At the points of intersection the climate is simply perfect for astronomical observations, and is also, during the month of April, delightful to live in.

The accompanying form was filled up, in compliance with a request from Amherst College Observatory, to show the cloud conditions in the inland region during the month of April this year as an indication of what might be expected during the same month next year.

I had two series of observations made, one at Mina Bronces by Mr. Martin, chemist to the works (the results of which are hereto appended), the other at Cerro Blanco by Señor Miranda, at his mine. Both reports are in every respect alike. The 10th and 27th were cloudy, all the other days absolutely clear. As the two stations are some twenty-five miles apart, these reports show that there is no local weather, and that it is only when a general atmospheric disturbance, originating in the Cordillera de los Andes, occurs that the weather is affected at these high stations.

It will be seen that there was only one day—the 27th—out of twenty-one days of observation on which the sun was not visible at eight o'clock in the morning, for on the other cloudy day—the 10th—the sun was bright at intervals.

Cloud Observations at "Mina Bronces," Chile, 1892.

Day.	Local time. 7.45 a.m.	8.15 a.m.	8.45 a.m.	Remarks.
April 10	2	2	2	Clouds were light, allowing a slight shadow to be cast. Bright sun at intervals.
,, 11	2	0	0	Clouds were on the horizon, so that the sun rose above them at 8 o'clock.
,, 12	0	0	0	Perfectly clear sky.
,, 13	0	0	0	Perfectly clear sky. Sun rose at 6.22 a.m.
,, 14	0	0	0	Sun rose at 6.22 a.m.
,, 15	0	0	0	Fresh wind. Sun rose at 6.23 a.m.
,, 16	0	0	0	Sun rose at 6.24 a.m.
,, 17	0	0	0	
,, 18	0	0	0	Slight haze at sunrise. Sun rose at 6.25 a.m.
,, 19	2	0	0	Bank of clouds near north-east horizon, which the sun rose above at 8.05.
,, 20	0	0	0	Sun rose at 6.26 a.m.
,, 21	0	0	0	,, ,, 6.27 ,,
,, 22	0	0	0	,, ,, 6.28 ,, Strong wind.
,, 23	0	0	0	,, ,, 6.29 ,, ,, ,,
,, 24	0	0	0	
,, 25	0	0	0	
,, 26	0	0	0	
,, 27	4	3	3	Haze thick at 8.15 a.m., but light at 8.45 a.m.
,, 28	0	0	0	Sky got cloudy at midday.
,, 29	0	0	0	
,, 30	0	0	0	

KEY.

0 = "Sun entirely clear from clouds."
1 = "Clouds generally scattered."
2 = "Clouds massed about the sun."
3 = "Sun in haze or fog."
4 = "Sun invisible in thick clouds."

Observatory Stations.

I have marked on the map, along the central line of totality, several stations that I think suitable for observatories; the positions are only approximately correct, for I have no means of determining them accurately, but the errors, if any, cannot be great.

Undernoted are heights above sea level of some places shown on the map:—

Yerba Buena railway terminus	3867 feet
Cerro Blanco, north hill	10,000 ,,
,, south, Peineta	8000 ,,
Carrizo, in the valley, a small farm ...	5000 ,,
Merceditas railway station	2900 ,,
Cerro del Jote	6000 ,,
Cerro del Cobre	8000 ,,
Lay observatory	4000 ,,

Cerro de Peineta is part of Cerro Blanco; this Cerro Blanco is not part of the Andes, but a detached hill with low ground all round, and a clear view to the north-east. It is easily ascended by pack-mules.

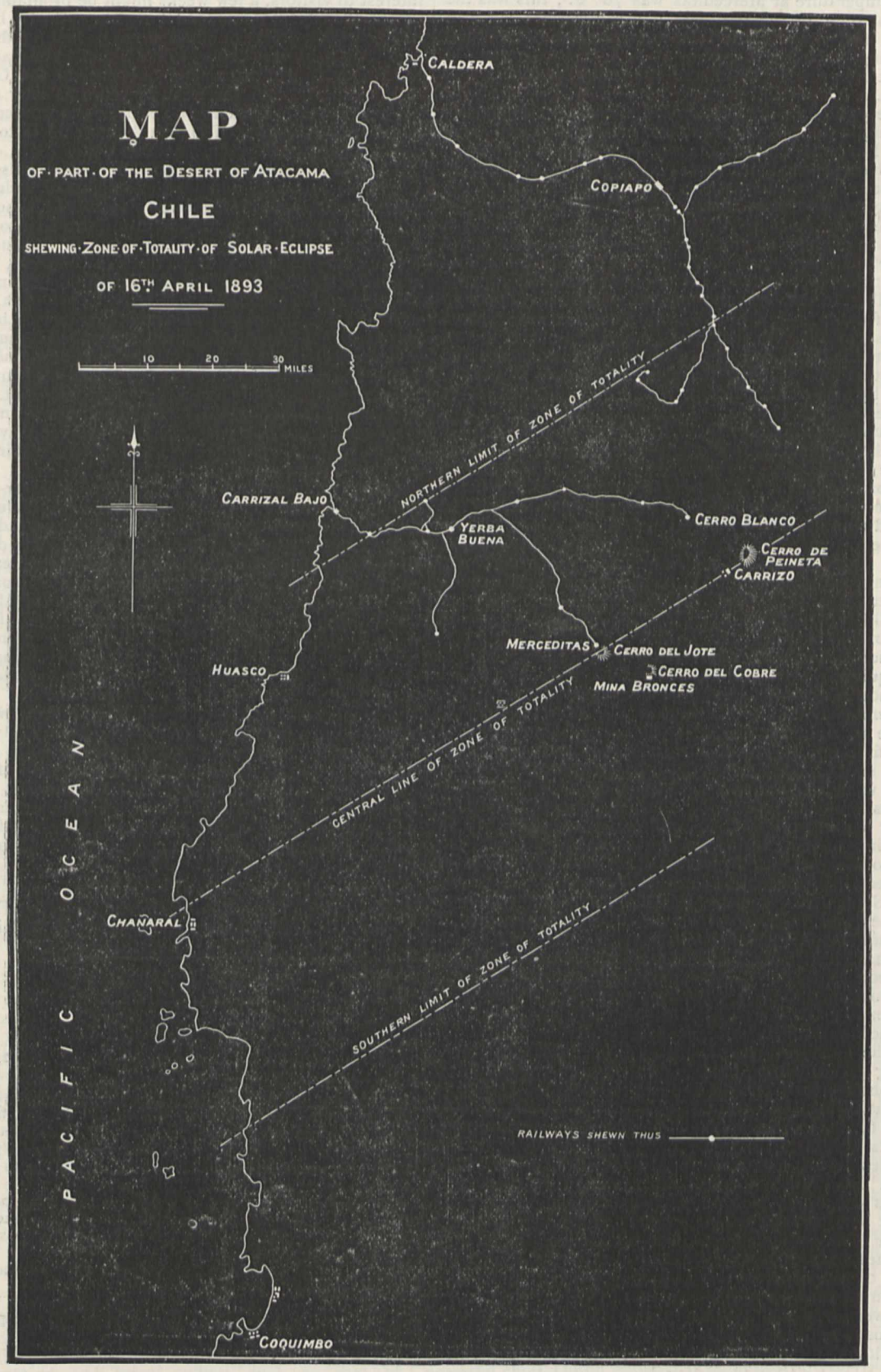
Carrizo is not a hill, but a small farm or large garden, irrigated by a mountain stream. The advantages of this station are: nearness to the railway, a good road, and plenty of small hills of easy ascent to select from.

Cerro del Cobre is a good hill, but probably too far south. However, there are hills all the way from Merceditas that might be selected (see Mr. Martin's letter).

Serra del Jote, near Merceditas, is accessible to pack-mules half-way up, higher than which it would not be necessary to go. Moreover, it is said that the rest of the ascent is difficult. The three hills, Cerro de Peineta, Cerro del Cobre, and Cerro del Jote, can all be seen from one another.

Lay Observatory. On April 15 I went to Merceditas and stayed overnight, as I wished to find near the railway station a hill on which the sun shone at an early hour on the morning of the 16th, through some opening among the surrounding hills, and which would be suitable for ordinary lay observers who had no expensive apparatus, but who wished to see the eclipse well through a smoked or coloured glass. To the south of the railway station I found a range of hills eminently suited to the purpose; at a height of 4000 feet above the sea the sun shone over a dent in the Jote at 6.40 a.m. The hill is much higher than 4000 feet, but I did not go higher. This is an excellent, well-sheltered spot, and would do well as a station for professional astronomers. I went up on horseback in forty minutes, but the ascent, from the railway station, could be easily made on foot in an hour. As I could not find any local name for this hill, I called it the Lay Observatory.

Climate.—At two o'clock in the afternoon of April 15


MAP
OF PART OF THE DESERT OF ATACAMA
CHILE
SHEWING ZONE OF TOTALITY OF SOLAR ECLIPSE
OF 16TH APRIL 1893
10 20 30 MILES
CALDERA
COPIAPO
NORTHERN LIMIT OF ZONE OF TOTALITY
CARRIZAL BAJO
YERBA BUENA
CERRO BLANCO
CERRO DE PEINETA
CARRIZO
MERCEDITAS
CERRO DEL JOTE
CERRO DEL COBRE
MINA BRONCES
HUASCO
CENTRAL LINE OF ZONE OF TOTALITY
PACIFIC OCEAN
CHAÑARAL
SOUTHERN LIMIT OF ZONE OF TOTALITY
RAILWAYS SHEWN THUS
COQUIMBO

the temperature at Merceditas was 78° F.; this was the hottest time of the day, and it was a warmer day than usual, and at 8 p.m. the temperature was 62° F. Next morning, the 16th, I got up at two o'clock to see the comet then visible, and found the temperature was 58°; at 5 a.m. it was 56°.

Everywhere on the coast of Chile, north of Coquimbo, the sun, in the morning, is almost always obscured by a thick haze which makes the sky of a dull lead colour. This haze is sometimes driven away by the sun during the forenoon, but just as often it remains all day, especially during the months of March, April, and May.

This hazy morning atmosphere extends inland for a distance of about 40 miles and up to an elevation above the sea of about 2500 feet; beyond this distance and height the sky is almost always clear and the air dry. Standing, in the early morning, on a mountain of 3000 to 4000 feet, or higher, you look down on a great white sea of mist covered with whiter ridges like motionless waves, and studded here and there with islands, which are the mountain tops piercing through. This haze is usually gone by nine o'clock, except within about five miles of the sea.

Accommodation on the Hills.—Tents can be quickly and cheaply made with "esteros de totora," that is mats made of reeds. All the more temporary houses of miners and prospectors and of railway track repairers are made of these mats, which are seven feet square, and may be rolled up and carried from place to place. They form an article of commerce, and cost eighteen-pence each, or from eighty to ninety cents. of Chile paper currency. During all the month of April and part of May it is quite safe to trust to this kind of tent, but not later than the middle of May, for rain or snow sometimes falls in the end of that month.

There are no venomous reptiles in Chile, nor are there mosquitoes on these hills, and fleas cannot live at an altitude of 4000 feet—no slight advantage.

Rain.—On the Chilian side of the Andes, in the province of Atacama, rain generally falls twice in the year: the first rain is expected in June, the next in July, each rain usually lasting two days, and always accompanied with wind from the north. As soon as the wind changes to its prevailing quarter, the south, there is beautifully clear but cold weather. From two to three inches of rain fall in the year, but sometimes less than one inch. On Cerro Blanco it usually freezes every night from July till the end of August, and some snow lies on the mountain till September. On the hillsides there are plenty of bushes and small trees for firewood, and excellent water is found in all the higher valleys.

I have heard one objection to this district for observing the eclipse, which is, that as the eclipse takes place in the morning, and the sun is not high in the sky, it would be better to go farther east. This objection has no weight, on account of the extreme dryness of the atmosphere. At the mines on Cerro Blanco and the other hills everything gets dried up; Huasco raisins grow hard and rattle on one's plate like nuts; agricultural produce, such as wheat, beans, and barley, brought from Southern Chile as food for man and beast at the mines, loses two per cent. of its weight every month for several months, office ink bottles have to be kept tightly corked or the ink very soon dries up, chairs and tables fall to pieces, veneer peels off, and a piano soon loses its tone. The sky is dark blue, and the sun rises white and dazzling without a trace of any other colour. The hills, the rocks, and the bushes cast dark shadows, and even every pebble the size of a hazel nut casts its shadow, so that in the early morning the gravelly ground seems half wetted with a shower; one side of every pebble is in bright light, the opposite in deep shadow.

Although the eclipse would be the object of greatest interest to visitors, a few weeks might be profitably spent among the copper mines, and if any one wished to become a mine owner, plenty of mines are to be had for the asking. Alll the mines belong to the State. You have only to take up a mine, pay a nominal licence to the Government annually, and the mine is yours as long as you pay the licence. There are no royalties,no surface rents, and no export duties. The next thing to do is to make the mine pay, and this is sometimes done.

There is no sport in April, but after snow falls on the Cordillera, huanacos and immense flights of turtle-doves come down to feed on the lower slopes. Life, however, is never wanting. The region from Cerro Blanco southward as far as Coquimbo is the home of the fur chinchilla. It feeds on the nut of the carbon tree, *Cordia decandra* (Hook. et Arn.), and on the pea of the algarrobillo, *Balsamocarpon brevifolium* (Clos.). This bush, which produces the tannin pod of commerce, thrives best far inland, on sunny, almost rainless slopes, but it must have one shower in June or July, otherwise it bears no fruit. If there be no rain for three or four years—as sometimes happens—the bushes do not die—they just wait. The same thing happens with all the other bushes; sometimes, for several successive years, they are without leaves, and though the soil seems as dry as dust, whenever rain comes they show themselves full of life.

British astronomers—professional and amateur—ought not to lose the opportunity of observing under such favourable circumstances this great eclipse. I doubt if better conditions were ever offered before. The distance to come is long, but the expense is not very great, and can be exactly counted beforehand. An expedition might leave Liverpool in February, by Straits of Magellan steamer, and be home again in June. Or, after the eclipse, go by steamer to San Francisco or Vancouver, and thence by rail to the World's Fair at Chicago, and instead of encountering hardship and danger in some unhealthy climate, have a pleasant trip all the way.

Though horses and mules can be got here, every one should bring a saddle and bridle.

In conclusion I would impress on the members of every expedition that may come out, the importance of selecting, as observing stations, places at a distance of at least 60 or 70 miles from the sea. On the other hand, the advantages of going farther inland are doubtful, and as the railways go no farther, travelling would be more difficult.

JOHN KING,

British Vice-Consul, Carrizal Bajo, and Engineer of the Carrizal and Cerro Blanco Railway.

Carrizal Bajo, Province of Atacama, Chile,
May 1892.

(COPY OF MR. MARTIN'S LETTER.)

Mina Bronces, Jarilla, May 2, 1892.

DEAR SIR,—I have now the pleasure of enclosing the form which you sent to be filled up. As I did not receive your letter till April 9, I could not of course fill in the first nine days, but as you will see by the observations that as the last twenty days have been almost invariably clear, I think the astronomers could safely decide to come here as far as clearness of sky is concerned.

An observatory could very easily be placed on one of the spurs of the Cerro del Cobre, to the south of the latter. It is easily accessible to mules with 250 pounds and affords an uninterrupted view of the sunrise.

Hoping that the filling up of the form will be found to fulfil all requirements. I remain, dear sir,

Yours sincerely,
(Signed) WILLIAM M. MARTIN.

John King, Esq., Carrizal Bajo.

DR. MODIGLIANI'S RECENT EXPLORATIONS IN CENTRAL SUMATRA AND ENGANO.

LITTLE more than two years ago, writing in this journal on the results of Dr. Elio Modigliani's accurate and highly interesting exploration of Nias (NATURE, vol. xli. p. 587), I made the remark that our young traveller had shown that he was made of the stuff of the very best of scientific explorers. It is therefore with no small pleasure and pardonable satisfaction that I now have the good fortune to show further proofs that I was not mistaken in thus judging him.

Those who have once tasted the sweets of true exploration in little-known lands, and who are animated by the smallest spark of *fuoco sacro*, have felt and know well that thirst for further travels which goads the late traveller to new wanderings. It was thus with my friend Modigliani, and he had hardly finished seeing his book on Nias through the press, when he began to long to be away again. He first thought of taking off the edge of his peregrinatory desire with a visit and collecting tour to the less-known parts of our new "Eritrea," but an accident, which might have had serious consequences, kept him back on the eve of departure. On regaining his health, far from being discouraged, he matured a wider and bolder plan—that of returning to the vast and lovely lands of the Malayans, and penetrating to the heart of Sumatra through the country of the Toba Battaks.

Dr. Modigliani left Florence in August 1890. Early in October he was at Siboga, then at Padang Sidempuan, in Sumatra, where he interviewed Mr. van Hasselt, well known in connection with the big Midden Sumatra exploration; however, as the sequel proved, not much information and aid were got from Mr. van Hasselt and his Government; besides, war was going on in the Toba region, but this did not deter Modigliani from his object. He had secured the services of Abdul Kerim, the Persian collector and taxidermist, who had been with Marquis G. Doria from 1862 to 1874, first in Persia, then in Borneo and Tunis, and finally at the Museo Civico at Genoa, which, under Doria's energetic and enlightened direction, has, during the last twenty-five years, been one of the most active and fertile centres of zoological research in the world. This was fortunate, for the Javanese hunters and collectors engaged at Buitenzorg were not very efficient.

Although he included in his baggage only things that were strictly necessary, he had to engage at Siboga forty-one carriers, mostly Toba Battaks, to convey it to the lake. That route, hardly practicable twenty years ago, is now safe, and the only trouble met with was from Dutch convicts engaged in repairing the road. It was on this road, at Ayer Kotti, that the American missionaries, Messrs. Munson and Lyman, not many years ago, were killed and eaten by the Battaks of the neighbouring village, Huta Sakkak. The country rises continually from the coast until the highlands of the Toba plateau are reached; it is undulated with mountains and broad valleys, such as that of Silindung, but on the highlands the forests have disappeared, and the watered depressions with dense vegetation and the clumps of bamboos surrounding the villages are dotted about. At Tarutung, the principal village of Silindung, Modigliani obtained important information on the independent Battaks from Mr. Welsink, the Dutch Assistant-Resident, who had long resided in the Battak country, and been some time *Controleur* at Laguboti on Lake Toba, now occupied by the Dutch. The Singa Manga Rajah, head chief and religious primate of the Battaks, who had already given so much trouble to the Dutch, was again coming to the front, and this time in connection with the irrepressible Atchinese from the north—an alliance of hereditary foes, for the Battaks have always repulsed the Mohammedan Malays against the invading whites.

By the middle of October 1890, Modigliani was at Balige on the shore of Lake Toba, and on the edge of the wild and unexplored Battak country, the land of his dreams. He describes the lake as grand and imposing, but more like a northern lake, such as Loch Lomond, because of its bleak bare mountains and early mists, than what might have been expected in the heart of a tropical island. Lake Toba is about forty-four geographical miles in length; a large mountainous peninsula divides it in two—Tao Silalahe on the north, and Tao Balige on the south. At Balige Modigliani had the use of a good house, once occupied by Mr. Welsink. He paid an early visit to the *Controleur*, Mr. van Dijk, at Laguboti, who placed at his disposal the Government boat with its crew, but requested to be informed of any excursion on the lake beforehand, as some of the lacustrine villages were hostile. Modigliani started for a first exploration of Lake Toba on October 27. An old chieftain, Ompu Rajah Doli, went with him, partly as guide, partly as protector. He was on his *solu*, the long swift canoe, excavated from a single tree, with which the piratical enterprises on the lake are so deftly performed; this, not one of the largest, was 18 metres long and 1 metre in width; it was manned by eighteen paddlers and one steersman. The place of honour is at the prow, which is singularly ornamented. At Ade Ade, one of the further villages, he secured the good will of the powerful chief, Ompu Raiah Hutsa, and with him visited

FIG. 1.—*Solu* (boat) on Lake Toba.

the site of Lumban Rajah, the former residence of the Singa Manga Rajah, destroyed by the Dutch. The chiefs and head men of several neighbouring villages had assembled, and many were the questions they put to Modigliani. Amongst others, they asked him who was his Rajah. "The Rajah Roma," said he. This caused a great discussion, after which one of the chiefs said: "How is it that we, having sent to Rajah Rom (not Roma) presents of horses and buffaloes, have never received a return or an answer?" Modigliani was at first rather embarrassed at so direct a question, but replied that the presents had not been received, having perhaps been intercepted. This appeared to convince them, and a Rajah Uti was mentioned as apparently the guilty party. I have mentioned this episode because it turned out to be a most fortunate

FIG. 2.—The *guru* Samalain.

one for our traveller, who got to be known as the envoy of Rajah Rom, and even as that mystic personage himself. It appears that by that name a venerated authority is known to the Battaks, and Modigliani thinks it may be no less a personage than the Hindu god Rama. As the sequel will show, under the patronage of Rajah Rom, Modigliani was able to penetrate into the heart of the independent Battak country, where, in all probability, no other European would have been able to go; and many were the things he had to promise in Rajah Rom's name, and many the presents and great the aid he got as his envoy. The greatest depth found by Modigliani in Lake Toba was 450 metres; the temperature of the water was 24° to 23° C. at the surface, and 23° to 22° C. near the bottom. Only four species of fish, two of molluscs and two of crustaceans, appear to live in the lake.

As a locality better suited for zoological collections, Modigliani went in November to live in the forest of Si Rambe, where, at an elevation of about 1370 metres, he built himself a log hut. Here the maximum day temperature ranged from 28° to 30° C., the minimum night temperature from 12° to 13° C.

It was from his hermitage in Si Rambe that Modigliani, eluding the official impedimenta, started on his adventurous and bold journey across Sumatra, right through the country of the independent and hostile Battaks. Now his supposed connection with the legendary Rajah Rom did him a right good turn; for the yet more or less independent chiefs sought him out, hoping that through his influence Rajah Rom might be induced to redress their wrongs. Amongst these was a *guru*, one of their priests, wise men, and *literati*, named Samalain, a staunch friend of the Singa Manga Rajah, who not only visited Modigliani but undertook to guide and protect him in his exploration of the (by Europeans) untrodden Battak territory. In one of his letters to Marquis Doria, Modigliani gives a vivid description of the savage energy of *guru* Samalain, of his devotion to the Singa Manga Rajah, and of his love of independence. The *guru* sent seven of his devoted followers to act as carriers, and taking one of his Javanese hunters and his interpreter, Si-gu-tala, a Battak, Modigliani left his encampment in the forest of Si Rambe at midnight on December 19, 1890. The utmost caution was necessary to cross the frontier line without being discovered by the colonial authorities. After a forced march of ten hours, the *guru* having joined him on the way, Modigliani reached the village of Lumban Bulu, well within the territory of the independent Battaks. The village chiefs, with armed retainers, and those of some neighbouring villages, all fully armed and equipped, with spears, flint-lock muskets plated with silver and ornamented with ribbons, and their peculiar swords with heavy ivory handles, accompanied and surrounded him. His reception was far from friendly. They would not believe that he was not a Dutch emissary, and spoke of sending him back; even the energetic protestations of the *guru* Samalain were received with signs of doubt. At this juncture our traveller had a happy thought, and drawing from a pocket the flag of Italy, he suddenly displayed it, exclaiming: "This is the flag my Rajah gave me; see, it is different from that of the Dutch; but when it is unfurled Debata (God) is present—you must rise and uncover your heads." The difference was at once noted, and Puttua, the chief who had shown himself most hostile, turned to Modigliani and said, "*Tabi, rajahnami*" ("Hail, my chief"). The others joined, and then two fowls and a pipe were brought to our traveller, and orders given to prepare the *sirih* of welcome and friendship. This is done with special ingredients, the absence of any of which would do away with the sincerity of the offering.

Modigliani was thus allowed to enter the independent Battak country. The next day he resumed his journey towards the east coast. He had to pay for passing a bridge. The Battaks know well the value of money, and use the Spanish dollar divided into 480 *doits* of copper, bearing the date 1804, the British arms, and the inscription "Island of Sumatra" (or the same inscription in Arabic), or else simply a fowl.

Amongst the many interesting things he saw, heard, and learnt, special mention must be made of the magnificent waterfall formed by the emissary of Lake Toba. Modigliani had some difficulty in visiting it, for it is the reputed abode of powerful spirits, or *sombaon*. It is, he says, grand beyond description; all the rivers of the region join the emissary of the lake in the fall, the native name of which is Martua Sapuran Si-arimo: the result is the River Assahan, which flows into the Eastern Sea near Tangion Balei. This is an important geographical discovery, and our friend may well be proud of it. He succeeded in taking a magnificent photographic view of

the principal cascade. Two Battak villages, Tanga and Suanan, are on each side of the fall. Modigliani managed to visit both, though hostile to each other, as he learnt, on account of cannibal feats recently committed reciprocally; thus cannibalism is not yet extinct amongst the Battaks. In this trip Modigliani went as far as Bandar Pulo, near the east coast; but not wishing to get into difficulties with the *Controleur* at Tangiong Balei, he turned back towards Toba, taking this time a new route up the valley of the Qualu or Kuwalu River.

The return journey was adventurous, and more than once Modigliani and his small party were in imminent danger. A war expedition of the Dutch had recently been this way, and the depredations and looting of the so-called friendly chiefs and their followers had left behind visible traces, and a burning sense of hate and vengeance against the *sordado* of the Cumponi (Dutch), although nothing can be said against the conduct of the Dutch colonial troops. It required all the energetic persuasions of *guru* Samalain and all the calm courage of Modigliani to avoid hostilities. At the village of Si Buttua, well fortified and in a commanding position, as most are, admittance was gained with difficulty; and matters went worse at the village of Lumban Ballic, where, however, finally Modigliani, as Rajah Rom, was treated with high honours and a dance. His last station was at Hite Tano, the native village of his man Si-gu-tala. Here, after some delay and hesitation, he was treated with friendliness; and to celebrate the return of Si-gu-tala a buffalo was killed, a very grand feast in the Battak country. A good tramp of fourteen hours took Modigliani from Hite Tano back to his log hut in the forest of Si Rambe. He had been away a little more than a month.

Of course, this adventurous trip of Modigliani amongst the independent Battaks got known; the Dutch authorities informed him that he would be expelled if he attempted again to cross into the Battak country, and he found that all his movements were watched and reported by the native police (*opas*). He therefore decided to return to Siboga, where he was on March 14, 1891. He remained there collecting and taking notes until the first days of April, when he proceeded to Bencoolen.

The Geographical Society of Batavia had invited him to explore the island of Engano, and a Government steamer was to convey him there. Modigliani had accepted with delight; but, after waiting some time in vain at Bencoolen for the promised steamer, he decided to start on his own account, and did so, engaging the *prahu* of a Chinaman.

Engano, the furthermost of the interesting islands which guard the western coast of Sumatra, has up to the present date been all but a *terra incognita*. Crawfurd, in his admirable "Dictionary of the Indian Archipelago," gives scant and partly erroneous information on Engano; whilst Vivien de St. Martin, generally so accurate, in his great "Geographical Dictionary," now being issued, says very little, and tells us that the natives are Negritos! And yet Rosenberg visited and explored the island not many years ago. Modigliani, during his stay of over two months, made a thorough exploration of Engano, and of the ways and customs of its natives; and it is indeed fortunate that he went there and gathered such rich ethnological and anthropological materials, for the natives of Engano are rapidly dying out, like those of other savage islands. Ten years ago they were about 8000; now, by the last reckoning of the Dutch Agent, they are reduced to 840!

The natives of this island certainly belong to the great Malayan family. On looking over the photographic portraits taken by Dr. Modigliani, I was forcibly reminded of the Nicobarese; and Modigliani agreed with me on examining the fine series of photographs of natives of the Nicobar Islands in my collection, which I owe to the kindness of my friend, Mr. E. H. Man, Deputy Commissioner of the Andaman and Nicobar Islands, and well known for his exhaustive anthropological researches in those two interesting groups.

FIG. 3.—Battak chief and his wife.

Modigliani remained in Engano from April 25 to July 13, 1891. His health, which had hitherto resisted many

and various sore trials, was at last injured by the pestilential miasmatic emanations of the mangrove swamps of Engano, and he came away just in time to save his life. At the end of July he embarked at Batavia, and by the end of August we had the pleasure of welcoming him back to Florence.

He has already given brief accounts of his exploration of the Toba country in letters and in two lectures recently delivered at Rome and Florence. He is now busy working out his ethnological materials; those pertaining to zoology have already been partly examined by specialists. The principal novelties in zoology are, as was to be expected, from Engano. Amongst those already published I recall the following:—Birds: *Graucalus enganensis*, *Pericrocotus modiglianii*, *Zosterops incerta*, *Geocichla leucolæma*, *Calornis enganensis*, *Gracula enganensis*, *Carpophaga œnothorax*, and *Macropygia cinnamomea*, are new species from Engano, recently described by Count Salvadori; besides, Modigliani has established the hitherto unknown habitat of a lovely Parroquet (*Palæornis modesta*). Reptiles: *Draco modiglianii*, *Lycosoma relictum*, and *Coluber enganensis* are new species recently described by Dr. Vinciguerra, also from Engano.

On the anthropological and ethnological materials collected by Dr. Modigliani on this voyage, which are many and of great interest, I intend writing a special report, which will be published elsewhere. I will therefore, in concluding this communication, merely draw attention to their scientific value, mentioning the more important series.

Amongst the Toba Battaks, Modigliani was not successful in obtaining human skulls, but, with the help of *guru* Samalain, he was able to take with rare ability and perfection a magnificent series of plaster masks of the face from life, both of men and women. He has made, besides, a splendid collection of photographs illustrating the people and their habits. A most extensive and perfect series of actual specimens and carefully constructed models made on the spot illustrate completely the houses, *sopos*, and boats, with their ornaments; the agricultural implements, house furniture, dress and personal ornaments; food and stimulants, with the utensils pertaining thereto; work-tools, and weapons offensive and defensive; religion and superstitions, witchcraft and literature. The carvings on the houses, and the patterns of the textile fabrics of the Toba Battaks, are indeed remarkable as specimens of the finest style of ornamentation. Amongst the numerous series illustrating the crude religion and manifold superstitions of this singular people, I may mention the carved wooden figures, with movable arms and a square hole in the chest, in which is the sacred relic (*pangulubalang*) or talisman containing part of the remains of a sacrificed child; these figures, of which Modigliani has collected quite a number, are as rudely made as the *karwars* of North-west New Guinea. Of the remarkable magic staffs, called generically *tungal pagñaluan*, but which appear to have individual names, Modigliani has secured seven; they consist of superposed figures, more or less conventionalized, but beautifully carved in a hard dark wood in most cases, in which the human figure and those of the elephant, buffalo, lizard, and serpent are variously entwined. Modigliani thinks that each of these staffs symbolizes the history of the village or clan to which it belongs, in which case they might be compared to the genealogical Maori staffs, like the one recording the history of the Ngatirangi tribe, now in the British Museum. As samples of the little-known literature of the Battaks, Modigliani was fortunate enough to secure twenty of their books, now rare. They are ancient-looking tomes of various sizes, bound in wooden boards; the leaves are of beaten bark, the writing minute, mystic figures (*hatiha*) being occasionally intercalated. These books, written by learned *gurus*, are of a sacred, medicinal, and encyclopædic nature, and much very valuable information on the Battaks will certainly be gained by their translation.

At Engano, Modigliani was able to obtain three skulls, and took six excellent plaster casts from the living. His series of photographs is also fine; but unfortunately some of the best were spoiled by the heat. I have already noted the remarkable resemblance which the natives of Engano show with those of the Nicobar Islands. There are amongst them faces which also recall Polynesian and especially Micronesian types. Thus the photographs taken by my friend, over a hundred,

FIG. 4.—Battak gentleman.

are of great ethnological value. The collections illustrating the ethnography of the Engano islanders are, I should say, complete: besides beautiful models of the singular houses and canoes, and actual specimens of the ornamented portions, viz. doors, cross-seats, &c., the mourning and ceremonial dresses and ornaments, house utensils, weapons, &c., are represented by a great number of carefully selected specimens.

In conclusion, I can only say that Dr. Modigliani has done much excellent work, and that we may look forward with pleasure to the publication of the results of his investigations, both in zoology and in anthropology.

HENRY H. GIGLIOLI.

A MODERN REVIVAL OF PROUT'S HYPOTHESIS.[1]

IT frequently happens in the history of science that the line of thought engendered by one branch of study proves applicable in a totally distinct field. In accordance with this principle a great stimulus is occasionally given in some particular line of research by the encroach-

[1] "On the Origin of Elementary Substances and on some New Relations of their Atomic Weights." By Henry Wilde, F.R.S. (London: Kegan Paul, Trench, Trübner, and Co., 1892.)

ment of an investigator who brings the vitalizing ideas derived from his own work to bear upon a new subject. It was with some such notions as these that we were predisposed to welcome Mr. Wilde's attempt to deal with the greatest of all the problems presented by modern chemistry, but a careful consideration of the author's views has, we regret to say, left us in a state of disappointment for reasons which we will endeavour to explain to the readers of NATURE.

The work under consideration is a quarto pamphlet of eighteen pages and a folding table giving the author's and other arrangements of the chemical elements. It consists of a preface dated May 1892, and a paper reprinted with additional notes from the Memoirs of the Manchester Literary and Philosophical Society for 1883 and 1887, the results having been first made known in the Proceedings of the same Society for April, 1878. The preface and paper are followed by translations of the same into French. Everything emanating from a recognized authority in a distinct department of science is worthy of consideration by chemists, and there are scattered throughout the work many statements which we cannot but endorse. There are, moreover, a few suggestions here and there which might be fruitful, and although the general result is disappointing, it is opportune that the author should have restated his hypothesis at a time when all chemists have more or less assimilated the views of Newlands, Mendeléef, Lothar Meyer, and their followers. It may be stated at the outset that Mr. Wilde's theory has nothing to do with an electrical origin of the elements as his reputation as an electrician might at first lead us to imagine.

In very brief terms the author's theory is that the elements have been evolved from hydrogen by a process of nebular condensation. In so far as he regards the elements as polymerides (as we might now express it) of hydrogen, there is nothing new in the idea. It is Prout's hypothesis pure and simple. We are far from asserting that this hypothesis has been disproved; there is a fascinating simplicity about it—it is so much in harmony with the general course of nature that matter should have been evolved from some primordial stuff that we should like it to be true; but unfortunately the most exact determinations of atomic weights have in later times not always conformed to the requirements of the hypothesis. Mr. Wilde in effect, if not in words, says *tant pis pour les faits!* These numbers ought to be whole multiples of the atomic weight of hydrogen, and Mr. Wilde unhesitatingly makes them so. In some cases the discrepancy between the observed atomic weights and those calculated from the theory is so great—apart from the doubling or other manipulation of some of the old numbers—that this alone will damage his case in the eyes of those who know the scrupulous care taken and the variety of methods resorted to in order to secure purity of material in such determinations. We give a few examples:—

	Accepted Atomic Weight.	Calculated.		Accepted Atomic Weight.	Calculated.
Cu ...	63·18	62	Cr ...	52·45	54
Be ...	9·08	8	W ...	183·6	186
Sc ...	43·97	42	Si ...	28·2	35
Ga ...	69·9	96	Ni ...	58·6	56
Y ...	88·9	123	Co ...	58·6	56
In ...	113·6	150	Ir ...	192·5	196
Ta ...	182	185	Os ...	191·12	196

A large number of atomic weights not given above differ by one unit from the experimental results; in fact, more than half the existing determinations are in the light of the present theory erroneous to a most humiliating extent.

We are not bigoted in our faith respecting the unassailable accuracy of the determinations of these constants; we all know the enormous difficulties which meet the chemist in his attempts to obtain his compounds in a state of purity. In one part of his paper the author suggests "that slight differences in the determinations may arise from the latent affinity which some elements have for minute quantities of another," which is a reasonable supposition in its way, although not very happily expressed. But later he somewhat inconsistently remarks "that these discrepancies are due to . . . some unknown cause which prevents their [*i.e.* Cu, Zn, &c.] true atomic weights from being ascertained."

From a purely philosophical standpoint the author's proposed emendations of the atomic weights are perfectly legitimate. If it can be satisfactorily proved that these constants are the numerical consequences of some general law requiring that the relative combining weights referred to hydrogen should be whole numbers, it is correct to conclude that our determinations are, through experimental error, difficulty of separation, &c., faulty. That some such law exists has been surmised again and again, but unfortunately the proof has not yet been found. Now the central idea of Mr. Wilde's paper is that there is an analogy between Bode's law of the planetary distances and the numerical relationships between the atomic weights, and he even attempts to show that this analogy is the result of a causal connection between the phenomena. This is the most important suggestion in the work, as the whole novelty centres in this idea, and the subsequent acceptance of his views will turn upon the strength of his case in demonstrating these two points: first, that Bode's "law" is the expression of a physical reality; and, secondly, that the numerical relations between the atomic weights are the physical expressions of a causal connection between the distances of the planets and the condensation of the primordial matter (? hydrogen.)

The first point is purely astronomical, and we prefer to let astronomers speak on the subject. Prof. Simon Newcomb says ("Popular Astronomy"):—

> It is true that many ingenious people employ themselves from time to time in working out numerical relations between the distances of the planets, their masses, their times of rotation, and so on, and will probably continue to do so; because the number of such relations which can be made to come somewhere near to exact numbers is very great. This, however, does not indicate any law of nature. If we take forty or fifty numbers of any kind—say the years in which a few persons were born; their ages in years, months, and days at some particular event in their lives; the numbers of the houses in which they lived; and so on—we should find as many curious relations among the numbers as have ever been found among those of the planetary system.

The author thus gets but little support from astronomy and it is to be observed that in the list of planetary distances which he gives he stops short at Uranus; Neptune occupies an awkward position for Bode's "law." The flight which is taken in connecting this "law" with the atomic weights is, however, a bold one and worthy of being given in the author's own words. After stating the nebular hypothesis he says:—

> That this gaseous or primordial substance consisted of a chaotic mixture of the sixty-five elements known to chemists is a notion too absurd to be entertained by any one possessing the faculty of philosophic thinking, as the regular gradation of properties observable in certain series of elements clearly shows that elementary species are not eternal, but have a history, which it is the proper object of physical science to unfold.

With this we most cordially agree, and as the same idea has been repeatedly expressed by chemists and physicists, we do not imagine that it is likely to be controverted. Then he continues:—

> One of the principal facts which, to my mind, establishes the nebular theory of the formation of planetary systems on a firm basis is Bode's empirical law of the distances of the members of the solar system from each other and from the central body, as in this law is comprehended the idea of nebular condensation in definite proportions. Now, if elementary species were created from a homogeneous substance possessing a

capacity for change in definite proportions, it is probable that the greater number of elements would be formed during or after the transition of the nebular matter from the annular to the spheroidal form. Moreover, as great cosmic transitions are not made *per saltum*, it might be expected that some modification of the law of nebular condensation into planetary systems, as exhibited in Bode's law, would be found on the further condensation of the primitive matter into elementary species.

There appears to be a flaw in this chain of reasoning which weakens the whole paragraph. It is difficult to see how a law, which the author himself describes as "empirical," can establish a theory on a "firm basis." We admit that an empirical law may be of use—Bode's law is a case in point—but surely it must pass beyond the stage of empiricism before it can establish anything on a firm basis. The astronomical foundation having therefore been shown to be insecure, or, in the opinion of astronomers, even non-existent, it remains next to consider the second point, with respect to which we shall let the author speak for himself:—

One objection raised against the theory which I have propounded on the origin and compound nature of the elements I will remark upon, is an alleged want of causal connection between the series of planetary distances and a series of atomic weights. Now, considering that specific gravities and atomic weights are admittedly correlated properties of the elements, and that specific gravities are fundamentally correlated with the dimensional properties of space, it follows that planetary condensations within interplanetary space are correlated directly with atomic condensations and atomic weights within that space. Hence the law that every increase of atomic weight, in a well-defined odd or even series of elements, is attended by an increase of specific gravity, is a natural consequence of the theory.

This is quoted from the preface; the mechanism of the process is described in the paper as follows:—

In the present hypothesis it is assumed:—(1) That a mass of hydrogen, of a curvilinear form, acquired a motion of rotation about a central point, which caused it to take a spiral or convolute form. (2) As each successive spiral or convulution was formed, the particles of hydrogen combined with themselves, as far as the septenary combination, to constitute the type of each series of elements—the number of types or series being equal to the number of convolutions of the rotating gas. According to this view, the elementary groups may be represented as forms of Hn, H2n, H3n, H4n, H5n, H6n, H7n; the internal convolutions forming the highest type, H7n, and the outer convolution the type Hn. (3) That on a further condensation of the elementary matter a transition from the spiral to the annular form occurred, during or after which the series under each type was generated in concentric zones and in the order of their atomic weights, until the highest member of each species was formed. (4) That as the elementary vapours begin to condense, or assume the liquid form, their regular stratification would be disturbed by eruptions of the imprisoned vapours from the interior of the rotating mass. The disturbance would be further augmented by the subsequent combination of the negative with the positive elements, and also by the various solubilities of their newly-formed compounds; so that the evidence of such stratification of the elementary vapours as I have indicated must necessarily be more fragmentary than that of the geological record.

In support of this last statement the author mentions the well-known association of allied elements in minerals.

The idea of an evolution of matter by a process of nebular condensation as above set forth is to be found under various forms in the writings of Herbert Spencer, of Sterry Hunt, Lockyer, and others. Also, it may be remarked in passing, that the hypothesis of stratification in the order of density was applied to the sun by Johnstone Stoney about the year 1867. In fact the general notion of elementary evolution is so obvious that it cannot fail to present itself again and again to those who think over such problems as are here dealt with. For the sake of chemical philosophy we only wish that this speculation could be placed on a firmer basis of observation or experiment—if for no other reason in order that the minds of chemists might be cleared of this inorganic *Urschleim* in which since the time of Prout they have been compelled to wallow.

Reduced to its ultimate terms it will appear, then, that Mr. Wilde's view is a combination of the nebular with Prout's hypothesis, the latter being stated with a precision and boldness which certainly goes beyond any utterance on this subject to be met with in chemical literature since the time of its promulgation. Although the author takes hydrogen as the first stage in his evolutional series he admits, with Prout, that this element "may have been evolved from an ethereal substance of much greater tenuity." Under the seven stages of condensation comprised from Hn to H7n. The author arranges all the chemical elements in a tabular form, leaving gaps for unknown elements, and correcting the atomic weights where necessary so as to make them accord with the hypothesis. Some of the results of this treatment have already been alluded to. The way in which Bode's method is applied will be understood by taking one example, viz. the first series, Hn:—

0	0	7	= Li =	7
1	× 23	− 0	= Na =	23
2	× 23	− 7	= K =	39
3	× 23	− 7	= Cu =	62
4	× 23	− 7	= Rb =	85
5	× 23	− 7	= Ag =	108
6	× 23	− 7	= Cs =	131
7	× 23	− 7	= — =	154
8	× 23	− 7	= — =	177
9	× 23	− 7	= Hg =	200

The rule of construction is: multiply the atomic weight of the second member (Na=23 in the above) by the arithmetical series and subtract the atomic weight of the first member (Li = 7 in the above) from the products; the results are the atomic weights of the elements of the series. This method is applied also to the group H2n with tolerable success, *provided the atomic weights are modified to even numbers and that the atomic weight of beryllium is made* 8. Mr. Wilde's second group is given below:—

Be, 8; Mg, 24; Ca, 40; Zn, 64; Sr, 88; Cd, 112; Ba, 136; *x*, 160; *x*, 184; Pb, 208.

This is presumably one of the new relations between the atomic weights referred to in the title of the paper. In the third group, however (H3n), very considerable modifications of the atomic weights have to be made, as will be seen from the author's results:—

C, 12; Al, 27; Sc, 42*; Ce, 69*; Ga, 96*; Y, 123*; In, 150*; Er, 177*; Tl, 204; Th, 231.

The six numbers marked with an asterisk stand for 44; 92 or 141; 70; 61·7 or 89·5; 75·6 or 113·4; and 170·6 respectively. A system which necessitates this amount of manipulation of experimental results will certainly fail to commend itself for adoption by chemists. The proposed change of beryllium from 9·2 to 8 is directly opposed by the determination of the vapour density of the chloride by Nilson and Pettersson, and if adopted would cause this element to become still more divergent from the law of Dulong and Petit. The vapour density of indium chloride as determined by Nilson and Pettersson is in accordance with the accepted atomic weight of that element and opposed to that given by Mr. Wilde. The elements associated in the first and second groups respectively, may be allowed to pass as natural allies, but the separation of carbon from its analogues, silicon, titanium, &c., and its association in the third group with aluminium, scandium, gallium, &c., is a violation of known relationships. The four halogens according to their atomic weights belong to the author's first (Hn) group. They are regarded as the negative analogues of the alkaline metals and are therefore placed in a separate column

in such a way as to bring out the relation that there is a constant difference of 4 between each halogen and its positive analogue :—

Na, 23 − 4 = 19, F ; K, 39 − 4 = 35, Cl ; Rb, 85 − 4 = 81 Br ; Cs, 131 − 4 = 127, I.

In a similar way the oxygen group is made into a negative column having positive analogues in the H2n group and showing a constant difference of 8 :—

Mg, 24 − 8 = 16, O ; Ca, 40 − 8 = 32, S ; Sr, 88 − 8 = 80, Se ; Ba, 136 − 8 = 128, Ta.

Of course chemists have long been familiar with various numerical relationships between groups of allied elements, but this does not appear as sufficient evidence for altering the atomic weights of Br, Cl and Se, unless these relationships can be conclusively shown to be the necessary result of a general law.

But apart from such defects as have been pointed out, it will be seen that the proposed grouping breaks down altogether after the third group. The author is hardly fair when he says (Preface, p. iv.) :—"While the multiple relations subsisting among the atomic weights of the other series of elements are highly interesting, they do not possess, in the present state of our knowledge, that degree of precision which is the distinguishing feature of the series Hn and H2n. An exception might, however, be made in favour of the series H3n, &c."

As a matter of fact it is not a question of "degree of precision" at all, for, as far as we can see, the other groups do not lend themselves to the Bodeian method ; at any rate, not in the form applied to the groups Hn, H2n, and H3n. We give the author's results as compared with those obtained by the application of his own method :—

Group H4n.

$x = 16$; $x = 32$; Ti = 48 ; Ge = 72 ; Zr = 92 ; Sn = 116 ; La = 140 ; $x = 164$; D = 188 ; U = 240.

The numbers obtained by the rule (1, 2, 3, 4, &c. × 32, and 16 subtracted from each product) are 32, 48, 80, 112, 144, 176, 208, 240, &c., which, after Titanium, do not represent any atomic weights in the group till Uranium is reached.

Group H5n.

B = 10 ; P = 30 ; V = 50 ; As = 75 ; Nb = 95 ; Sb = 120 ; $x = 140$; $x = 165$; Ta = 185 ; Bi = 210.

Calculated (1, 2, 3, 4, &c. × 30 and 10 subtracted from each product) the numbers are :—30, 50, 80, 110, 140, 170, &c.

Group H6n.

$x = 18$; $x = 36$; Cr = 54 ; Mo = 96 ; $x = 144$; W = 186.

Calculated (1, 2, 3, 4, &c. × 36 and 18 subtracted from each product) the numbers are :—36, 54, 90, 198, &c.

Group H7n.

N = 14 ; Si = 35 ; [Fe = 56 ; Mn = 56 ; Ni = 56 ; Co = 56] ; [Pd = 105 ; Rh = 105 ; Ru = 105 ; Da = 105] ; [Au = 196 ; Pt = 196 ; Ir = 196 ; Os = 196].

Calculated (1, 2, 3, 4, &c., × 35 and 14 subtracted from each product) the results are :—35, 56, 91, 126, 161, and 196.

The association of nitrogen with silicon and the metals of the iron and platinum groups is, to say the least of it, incomprehensible. We have thought it desirable to give this analysis, for no reason is given in the paper for this particular grouping after the third series, beyond the well-known chemical relationships of the elements which, as we have seen, is sometimes violated in a most unaccountable way. The groups are obviously not constructed by the Bodeian method ; the atomic weights are modified in many cases by one or two units, and the result is a classification which differs only from the received classification on points which cannot possibly be conceded by chemists. The reason why silicon is separated from its analogues is as follows :—

Now, if silicon were the true analogue of titanium, the oxides of these elements should be isomorphous, whereas the crystalline form of quartz is hexagonal, while rutile, anatase, brookite, zirconia, and tinstone (similar oxides of members of the series H4n) are tetragonal ; consequently, silicon does not belong to the series H4n.

This is a point, and out of justice to the author we give it for what it is worth,[1] but the atomic weight of silicon has been determined by the vapour density of its chloride, and the result is fatal to Mr. Wilde's classification. His attempt to justify the atomic weight 35 by an appeal to the specific heat is unfortunate, because he takes the old determination by Regnault (0·176) instead of the more recent determination by Weber (0·203 at 230° C.). Moreover, he is inconsistent in not allowing the same correction for boron and the other elements which deviate from Dulong and Petit's law.

We cannot go much further into the details of this paper. Enough has been written to justify the disappointment which we expressed at the outset, and it is only the intrinsic importance of all questions bearing upon the origin of the elements that has warranted such extended treatment. It appears that the numerical relations which are brought out by the author's method have either long been known or else—as in his application of the Bodeian method—they do not exist beyond a limited number of groups. The results do not take us beyond the point at which chemists were left by Döbereiner, Pettenkofer, Dumas, and numerous other chemists who, for three-quarters of a century, have directed attention to such numerical relationships. In some respects—such, for example, as in the exactness with which the atomic weight of an element is the arithmetical mean of the elements above and below it in the same series—Mr. Wilde's numbers express the relationship more closely than those of any other author ; but this agreement is simply brought about by forcing the atomic weights into the requirements of the case. The increase in density as the odd and even series are ascended, is nothing more than an imperfect way of stating the well-known relationship between atomic weight and atomic volume, which is so much better shown by Lothar Meyer's curves. The table of elements presented by Mr. Wilde ignores that fundamental principle of periodicity or recurrence of properties which is the key-note of Mendeléeff's system, and which has led to the general adoption of that system by chemists. We do not pretend that Mendeléeff's classification is faultless ; the illustrious founder of the Periodic Law would be the first to admit that his system has certain imperfections. Mr. Wilde has emphasized a few of these in his preface, and he somewhat summarily dismisses the whole scheme in the following words :—

From the numerous discrepancies which present themselves in the classification of the elements when arranged in the regular order of their atomic weights, it will be obvious that the idea of recurring properties or periodic functions, in terms of the vertical series of Newlands or the horizontal series of Mendeléeff, has no more relation to chemical science than the law of the increase of population, or the laws of variation and inheritance in organic species.

This paragraph, penned in the present year, will, perhaps better than any other statement that could be reproduced from the paper, enable chemists to form a correct estimate of the value of the work and of the author's qualifications for dealing with the question of the origin of the chemical elements.

R. MELDOLA.

[1] "Stannic and titanic oxides resemble silica both physically and chemically . . . . . they might be expected to form analogous compounds, and be isomorphous with silica, as Marignac (1859) found actually to be the case." Mendeléeff's "Principles of Chemistry," vol. ii. p. 95.

NOTES.

BY the death of Lord Tennyson not only does England lose one of her noblest sons, but the world loses the Poet who, above all others who have ever lived, combined the love and knowledge of Nature with the unceasing study of the causes of things and of Nature's laws. When from this point of view we compare him with his forerunners, Dante is the only one it is needful to name; but although Dante's knowledge was well abreast of his time, he lacked the fulness of Tennyson, for the reason that in his day science was restricted within narrow limits. It is right and fitting that the highest poetry should be associated with the highest knowledge, and in the study of science, as Tennyson has shown us, we have one of the necessary bases of the fullest poetry—a poetry which appeals at the same time to the deepest emotions and the highest and broadest intellects of mankind. Tennyson, in short, has shown that science and poetry, so far from being antagonistic, must for ever advance side by side. We are glad to know that the Royal Society, of which Lord Tennyson has been for many years a Fellow, was fittingly represented at his funeral by its President and officers.

WE regret to announce the sudden death of Mr. Robert Bullen, the curator of the Glasgow Botanic Gardens. He was well known as a horticulturist, being especially successful in the cultivation of orchids. The post vacated by his death is one of the best of the kind in the country, and we understand that the appointment will rest with the Corporation of Glasgow, who took over the management of the Botanic Gardens in 1891.

THE death of Dr. Léon Poincaré, professor in the Faculty of Medicine at Nancy, is announced. He died on September 15 at the age of sixty-four.

AT the meeting of the Linnæan Society of New South Wales on August 31, Mr. H. Deane, Vice-President, who occupied the chair, referred to the loss the Society had sustained by the death of Mr. R. D. Fitzgerald, well known for his knowledge, and for his artistic delineations, of Australian orchids.

RUSSIA, which already possesses some of the best equipped chemical laboratories in Europe, is to have another which is to eclipse all others. On September 13/25 the foundation stone of the new chemical laboratory of the University of St. Petersburg was laid with befitting ceremony. The new laboratory, which is designed by Prof. Mentschatkin in collaboration with the architect Krassowsky, is based upon the best existing models in Germany and Austria.

IN the *Times* of the 10th inst. there is an announcement that Surgeon-Major Laurie has proved that the fall of blood-pressure in animals rendered insensible by chloroform is due to the action of the anæsthetic on the brain, and not on the heart. When blood containing chloroform is allowed to reach the brain only all the ordinary phenomena of anæsthesia are observed, but when such blood is conveyed to every other part of the body except the brain, which, by a peculiar arrangement of the experiment, is supplied with pure blood, the anæsthetic effects of chloroform and also its depressing effects on the circulation are not observed. We are glad to see that Dr. Laurie is still continuing his experiments on a subject of such vital interest, and we trust that his energy and the generosity of the Nizam, to which we owe the elaborate work of the Hyderabad Chloroform Commission, will meet an ample reward.

THE British Ornithologists' Union, founded in 1858, consists of upwards of 250 votaries of this branch of natural history, who maintain as their organ the well-known ornithological journal, *The Ibis*, now in its thirty-fourth volume. The more active members of the union have just formed themselves into a club, and will meet together once a month to read and discuss papers and to exhibit specimens. The first meeting of the "British Ornithologists' Club" will be held on October 19. Mr. Howard Saunders, F.Z.S., is the treasurer and secretary.

THE university of Padua is about to hold a festival in honour of Galileo. The seventh of December, 1892, will be the tercentenary of the day upon which Galileo ascended the chair of mathematics at that university. In the words of the letter of invitation which the rector, Prof. Carolus Ferraris, has just issued to some of the learned societies of Europe, "Illo enim die Ann. mdxcii. summus acerrimusque investigator legum, quibus caelestium terrestriumque rerum natura continetur, hic cathedram ascendit eamque voce sua immortalitati commendavit." It is to the honour of Padua that it welcomed Galileo to this high position the very next year after he had been publicly hissed and obliged to resign his professorship at Pisa. The festival will extend from the 6th to the 8th of next December.

THE Linnæan Society of New South Wales has just issued a second circular with respect to the Macleay Memorial Volume by which it appears that only £170 has been contributed out of £400 which is required for the publication of the Memorial Volume. The circular calls to mind Sir William Macleay's contributions to science, in purchasing and fitting out at his sole expense the ship *Chevert* and exploring the island of New Guinea, and in presenting to the University of Sydney his entire collection valued at £23,000, together with £6000 to provide salary for a curator. Sir William Macleay was also the founder of the Linnæan Society of New South Wales, for which he erected a suitable building, and which he endowed with the sum of £20,000. He further founded a chair of bacteriology and four scientific fellowships at the University of Sydney, at a cost altogether of £47,000. The sum of £170 seems hardly adequate as a recognition of these munificent gifts to science, to say nothing of the original researches which Macleay himself conducted.

MR. THOMAS HODGKINS, of Long Island, New York, has sent to the Royal Institution no less than £20,000 for the promotion of scientific research. Not very long ago, as we noted at the time, Mr. Hodgkins presented £40,000 to the Smithsonian Institution at Washington.

THE Severn Valley Field Club has completed the work of the current year. It has paid some attention to the glacial deposits at Gloppa, near Oswestry, which have recently yielded to Mr. A. C. Nicolson a large series of fossils. The members have also visited the Triassic rocks of the area round Warwick. Their work concluded with an investigation of the Uriconian and Longmyndian formations of Western Shropshire under the guidance of the President, Dr. C. Calloway.

DR. J. M. MACFARLANE has been appointed to the chair of Biology in the University of Pennsylvania, Philadelphia. He formerly held the post of senior assistant in the Botanical Department of the University of Edinburgh.

AN influential association has been formed for the promotion of the study of the Hausa language and people, in commemoration of the services of the Rev. J. A. Robinson, who died last year at his work as a missionary in the Niger Territories. Hausa is the *lingua franca* of the Central Sudan, extending from the Sahara to the tribes near the Gulf of Guinea, and from the Egyptian Sudan to the French colony of Senegal. Mr. Robinson convinced himself that no satisfactory work of any kind could be carried on among the races of the Central Sudan without a knowledge of Hausa. The Executive Committee of the new Association have decided to endeavour, with the least practicable delay, to appoint two "Robinson Students," conversant with Arabic or Hebrew, whose preliminary labours would be carried on in the comparatively temperate climate of Tripoli, with a view to their proceeding at a later date to the Central Sudan, where they would make the language and cus-

toms of the Hausas subjects of careful study. All scientific observations collected by these students during their residence in Africa will be sent to the Association for distribution to the appropriate societies.

THE Association of American Agricultural Colleges and Experiment Stations will hold its sixth annual convention at New Orleans on November 15. The different subjects assigned to station workers for the Columbian Exhibition will be discussed.

PROF. H. MARSHALL WARD, F.R.S., of the Royal Engineering College, Cooper's Hill, will give a course of ten lectures at University College, London, on "The Morphology and Physiology of Fungi and Schizomycetes." The course will begin on Thursday, October 13, at 3 p.m., and be continued at the same time each week till Christmas.

A LARGE plant of *Fourcroya* is now in flower in the conservatory of the Royal Botanic Society. The secretary of the Society referred to it at the meeting of the Council on Saturday last. The plant is sometimes called the century plant, the idea being that it flowers only once in a hundred years. In reality the flower is produced only once in the life of the plant, the duration or term of life varying considerably, according to the treatment the plants individually receive. Specimens of the *Agave Americana* have flowered in the Royal Botanic Society's garden, the ages of them being well authenticated as over 80 years; but the plant is known to flower in warmer climes before twenty years of age. The present specimen of *Fourcroya* is between twenty and thirty years old. It began on August 1 last to produce its flower spike, which, although the plant is slow growing generally, developed at a rapid pace, so that on September 15 the tip had reached the glass roof. A square of glass being removed, the flower spike continued its growth, and it is now some 3 feet or 4 feet above the ridge, a total of over 30 feet in height. The leaves vary from 6 feet to 7 feet in length.

IN his treatise, "On the Propagation of Electric Force," Prof. Hertz mentions some experiments tending to prove that the production of resonance and the period of oscillation in resonators are not influenced by the specific resistance or the magnetic properties of the secondary conductor. But if the phenomena be observed electrometrically, the individual properties of the metals soon show themselves. This method was employed by Mr. V. Bjerknes, of the University of Christiania, who gives an account of his results in No. 9 of *Wiedemann's Annalen*. Experiments made with copper, brass, German silver, platinum, nickel, and iron show that metals have different powers of absorbing the energy of electric waves. The rate of absorption increases with the resistance and with magnetization of the metal. Iron and nickel were able to follow the oscillations to a certain extent, which means that their magnetization was actually reversed one hundred million times per second.

A method of exhibiting the Hertzian oscillations to a large audience is described in the same number by Mr. L. Zehnder, of the University of Freiburg. The two conducting rods placed in the focal line of the concave mirror are connected with a Geissler tube, within which the ends are placed very closely together, but so that a discharge produces not a spark but a general luminosity inside the tube. The secondary Hertz effects are too feeble to be visible except at a very short distance and in a darkened room. In this case they are augmented by a kind of relay. On either side of the terminals of the resonator are two other terminals from a circuit of 600 secondary cells, which can be regulated so that the current is just unable to traverse the distance between the terminals. As soon, however, as the resonator responds to electric oscillations, the relay is brought into action, and a brilliant discharge takes place. In cases where such a large accumulator is not available, it is possible to work with another inductorium, or, still better, to obtain the oscillating current from the primary coil by bringing one end of a wire into its neighbourhood, the other being led to earth. By such means it is possible to exhibit the phenomena in question without even darkening the room.

THE weather during the first part of the past week was very boisterous and inclement over the whole of these islands. Between Thursday, the 6th inst., and Monday last, two deep depressions closely following each other passed over the country from off the Atlantic, and heavy gales were experienced in all parts of the United Kingdom, accompanied by much rainfall, while thunderstorms and hail occurred in many places. The sea also was exceptionally rough, especially on our north-west coasts, and caused much damage on shore. Temperature was somewhat low for the time of year, the daily maxima rarely reaching 60° in any part, while the nights were very cold. As the depressions passed to the eastward the weather cleared and the temperature decreased considerably, sharp frost occurring on the ground over the inland parts of England. Towards the close of the period the type of weather was becoming more settled in character than it had been for some time past, but on Tuesday a depression lay over the Bay of Biscay, which might disturb our conditions. The *Weekly Weather Report* of the 8th inst. showed that during that week the rainfall exceeded the mean in all districts except the south of Ireland, and that temperature was from 2° to 4° below the mean, the lowest of the minima ranging from 32° to 38°. The only district in which bright sunshine exceeded the mean was the Channel Islands; the percentage of the possible duration amounted there to 40, while it was only 8 in the north of Scotland.

THE Meteorological Council have published the hourly means obtained from their self-recording instruments at four observatories for the year 1889, for periods of five days, calendar months, and for the year, while means of pressure and temperature and totals of rainfall are also given for every day. This is the third year in which the observations have been published in this form, instead of the actual hourly values, as formerly, and an addition has been made by including the monthly and yearly mean values of the daily maximum and minimum temperatures for this and the two previous years in this volume. The work contains 112 quarto pages of very clearly drawn-up tables.

MR. H. DEVAUX has been making interesting experiments on the sense of taste in ants. Among other results he has found that *Lasius flavus*, while fond of sugar, dislikes saccharine. The ants swarmed around sugar laid out for them, but turned away from saccharine as soon as they tasted it. Even sugar became unpleasant to them when it was mixed with saccharine. It seems, therefore, that sweetness is not the only quality which attracts them to sugar.

PROF. SCOTT has a note in the new volume of "the Transactions and Proceedings" of the New Zealand Institute, on the occurrence of cancer in fish. The fish afflicted with this disease were all specimens of the American brook-trout (*Salmo fontinalis*) kept in confinement in one of the ponds at Opoho belonging to the Dunedin Acclimatisation Society. Males and females were alike affected, and the diseased fish never recovered. Prof. Scott has been able to examine several specimens showing the disease in various stages of advancement, and gives in his paper a short account of the naked-eye and microscopic appearances of the growth. The occurrence of cancer in the lower animals has been frequently observed of late years, and it is by no means so rare among them as it was at one time thought to be. Prof. Scott does not, however, know that it has ever before been noted in fish.

IN his report as surgeon-naturalist of the Marine Survey of India, to which we referred last week, Dr. A. Alcock records some interesting observations on the little estuarine crab *Gelasimus*. The most obvious structural peculiarity of *Gelasimus* is the enormous development of one of the chelæ in the male only, the chelæ in the female being minute. The species observed by Dr. Alcock was *Gelasimus annulipes*, Edw. This species lives in vast swarms in "warrens" on the muddy tidal swamps of the Godávari and Kistna, each individual having its own burrow, round which it ranges, and into which it retreats when alarmed. In the colder months, at any rate, the males far outnumber the females. In a fully adult male the length of the large chela is two-and-a-half times the greatest length, and one-and-a-half times the greatest breadth, of the whole body, and 40 per cent. of the entire weight of the animal, and is coloured a beautiful cherry-red fading to a rose pink, the rest of the animal being of a dingy greenish-brown colour. Dr. Alcock has been able to observe that, whatever other functions the great chela may serve, it also, in the species under consideration, is (1) a club used in the contests of rival males, and (2) a signal to charm and allure the females. This last function is particularly apparent. As one walks across the mud one first becomes aware of the presence of these crabs by noticing that the surface of the mud is everywhere alive with twinkling objects of a brilliant pearly-pink colour. Carefully watched, these prove to be the enormous chelæ of a crowd of males of *Gelasimus* waving in the air, each little crab standing at the mouth of its burrow and ceaselessly brandishing its big claw. On closer observation, among every ten or so males a small clawless female may be seen feeding in apparent unconcern. If the female should approach the burrow of a male, the latter displays the greatest excitement, raising itself on its hindmost legs, dancing and stamping, and frantically waving its beautifully-coloured big claw. From prolonged watching, Dr. Alcock feels convinced that the waving of the claw by the male is a signal of entreaty to the female, and he thinks that no one can doubt that the claw of the male has become conspicuous and beautiful in order to attract and charm the female. The second function, as a fighting weapon, becomes apparent when in the general tournament one of the rival males approaches too close to another. The great claw is then used as a club, the little creatures making savage back-handed sweeps at each other.

AN excellent paper on fungous diseases and their remedies was read lately by Prof. J. E. Humphrey before the Massachusetts Horticultural Society, and has now been printed. One of the principles on which he insists is that the treatment of these diseases, to be efficient, must be preventive rather than remedial. He points out that it is not enough to take care that plants shall have abundant nourishment. No practice, he says, is more common among American fruit growers than to leave in the vinery and the orchard, lying on the ground or hanging from the branches, the dead fruits of the season, which have been rendered worthless by fungi. Nothing could produce more unhealthful conditions, for these dead fruits commonly furnish to the fungi which attack them precisely the most favourable soil for further and complete development. In the next spring the air is full of the spores of these fungi, which find lodgment on the new leaves and fruits of the very plants on which they grew last year; and so the story goes, year after year. "In a word," says Prof. Humphrey, "keep your orchards and gardens and greenhouses *clean*. Allow no rubbish to be about on which fungi can breed. Remove and destroy all diseased fruits or plants as scrupulously as you preserve saleable ones, and you will have more saleable ones to preserve. It is surprising how far generous culture and clean culture will go toward preventing fungous diseases, without special treatment."

THE Marquis de Nadaillay contributes to *Science* (Sept. 23) an interesting account of the various discoveries which have been made in the caves of Baoussé Roussé, between Mentone and Ventimiglia. The caves were found in 1872 by M. Rivière, who has since vigorously prosecuted his excavations. These have yielded many human skeletons, all belonging to the Cro-Magnon race. They are robust, and bespeak an athletic constitution and great muscular power. The men were remarkably tall, the crania are dolichocephalic, and the tibias platycnemic. The bones of all the adults, after the total decomposition of the flesh, were painted red with the help of peroxide of manganese or other substances frequently met with in the caves: a custom which the Marquis de Nadaillay believes prevails, or till lately prevailed, among some Indian tribes. Much attention has been devoted to the latest discovery, made early in the present year, of three skeletons—a man, a woman, and a "young subject," whose wisdom teeth had not been developed. They were found eight metres below the ground, and had been buried on a bed of cinders, broken fragments of charcoal, and remains of all sorts, evidently the hearth on which the family cooked their victuals. The boy wore a necklace formed of two rows of the vertebræ of a fish and one row of small shells. At different points hung pendants cut out of the canine teeth of stags, decorated with parallel striæ. The man had also a necklace of fourteen canines of the stag, also striated. With the skeletons were found stone instruments, some of them finely worked, but none of them polished, and some bone implements of very rude fabrication. The man was very tall. If we judge by the length of his thigh-bone, his height must have exceeded six feet six inches. The teeth even of the boy were very much worn; those of the man were worn to the roots. The bones of many mammals have been found, but none belonging to extinct species, or even to the reindeer. On the other hand, no polished stone implement has been discovered. The remains, therefore, must be ascribed to the end of the quaternary or the beginning of the neolithic times. One cave is still unexcavated. The Prince of Monaco, whose property it is, has given orders that the excavations are to begin next spring.

MR. C. HEDLEY read before the Linnæan Society of New South Wales, on August 31, a paper in which he presented an interesting study of ancient geography. The immediate subject was the range of *Placostylus*. He remarked on the essential unity of the *Placostylus* area as a zoological province, embracing the archipelagoes of Solomon, Fiji, Hebrides, Loyalty, New Caledonia, Norfolk Island (?), Lord Howe, and New Zealand; a unity explicable only on the theory that they form portions of a shattered continent, and are connected by shallow banks formerly dry land. Deep sea soundings, especially those of the *Challenger* in the Coral Sea, further demonstrate the existence of such a submarine plateau, for which the name of "The Melanesian Plateau" is proposed. Further, Mr. Hedley contended that the Melanesian Plateau was never connected with, nor was ever populated from, Australia; that its fauna and flora were originally derived from New Guinea.

In the *Proceedings* of the U.S. National Museum (vol. xv.), Lieut. Dix Bolles calls attention to an interesting object included in a collection of ethnological specimens given by him to the museum in 1883-85. This is a wooden mask, which has for its eyes two large bronze Chinese coins. The grave from which the mask was taken is near the Chilcat village, at the mouth of the Chilcat River, Alaska, where stands a row of six grave-houses on a narrow strip of land close to the river, with a swamp behind them. From this particular grave very little was obtained by the explorers, its contents having nearly all rotted away. Lieut. Bolles was told by the natives that it

was the grave of a medicine man who had flourished more than 200 years before, six successors having filled his office, each one living to a good old age. Careful questioning failed to evoke any other answer. When the coins were shown to the Chilcats, they could not remember having ever seen such objects. Lieut. Bolles concludes that the coins probably were derived from a junk driven on the coast about two centuries ago. "To those," he says, "who doubt the advent of junks on the west coast at this early date, these facts will probably not be satisfactory, but it will be necessary for them to break down by direct evidence such a strong plea."

MESSRS. H. ALABASTER, GATEHOUSE & Co. have now in the press, shortly to be issued, a new work, entitled, "Domestic Electric Lighting, treated from the Consumer's Standpoint." The author is Mr. Ed. C. de Segundo.

"THE ELECTRICIAN" Printing and Publishing Co., Limited, have in preparation for their "Electrician" Series the following volumes:—"Electromagnetic Theory," by Oliver Heaviside; "Electrical Engineering Formulæ, &c.", by W. Geipel and H. Kilgour; "Submarine Cable Laying and Repairing," by H. D. Wilkinson; "Drum Armature Winding and Commutators: in Theory and Practice," by F. M. Weymouth; and "Electricity as a Motive Power," by Albion T. Snell, M.I.C.E., M.E.

THE first series of lectures given by the Sunday Lecture Society begins on Sunday afternoon, October 23, in St. George's Hall, Langham Place, at 4 p.m., when Dr. Andrew Wilson will lecture on "The Distribution of Animals and what it teaches." Lectures will subsequently be given by Mr. Willmott Dixon; Prince Kropotkin; Mr. R. Brundenell Carter; Mr. Arthur W. Clayden; Prof. H. Marshall Ward, F.R.S.; and Dr. E. E. Klein, F.R.S.

ANOTHER memoir upon persulphuric acid and the persulphates is contributed by M. Berthelot to the *Annales de Chimie et de Physique*. As described in our note of vol. xliv., p. 577, the potassium, ammonium, and barium salts of this interesting acid were obtained last year by Dr. Marshall, of Edinburgh, in tolerably large quantity and in well-developed crystals. M. Berthelot, to whom the honour of the first preparation of persulphuric acid and its anhydride is due, now publishes his further work upon the subject, fully confirming Dr. Marshall's results, and adding a few more facts to our knowledge of the acid and its salts. The form of electrolysis apparatus which has been found by M. Berthelot to yield the best results consists of a double cell, the inner vessel of which is constructed of porous porcelain. The liquid contents of both the interior and exterior vessels are cooled by means of glass worms through which a constant current of cold water is maintained. The inner cell of 150 c.c. capacity contains a concentrated solution of potassium or ammonium sulphate, according as potassium or ammonium persulphate is required, in sulphuric acid diluted with six or seven times its volume of water. The nearer the composition of this liquid approaches to that of a solution of bisulphate of potassium or ammonium, the greater is the yield of persulphate. The exterior cell is simply filled with dilute sulphuric acid. The positive pole in the interior cell is most advantageously formed by a stout platinum wire, about one millimetre in diameter, as persulphuric acid is found by M. Berthelot to be rapidly decomposed in contact with a large surface of platinum. Platinum sponge, indeed, instantly decomposes the acid or solutions of its salts. The negative pole in the outer cell may conveniently take the form of a large plate of platinum. The current employed was one of three amperes derived from accumulators. At the expiration of fifteen to twenty hours the internal cell is found to contain large quantities of beautiful crystals of the persulphate. The usual yield of the potassium salt was 20-25 grams, and of the more soluble ammonium salt as much as 40-45 grams, in one operation. M. Berthelot has also obtained potassium persulphate by the direct electrolysis of sulphuric acid and subsequent addition to the product of a concentrated solution of potassium bisulphate, crystals of potassium persulphate, KSO_4, being at once deposited. This mode of preparation is not so advantageous as the method of production by the electrolysis of potassium sulphate as above, but affords interesting proof of the formation of free persulphuric acid by the electrolysis of oil of vitriol. M. Berthelot has further succeeded in preparing persulphuric acid by the gradual addition of anhydrous barium peroxide to concentrated sulphuric acid in a small flask surrounded by ice. So rapid is the action that if the addition of the peroxide is continued until the sulphuric acid is almost exhausted, even although the vessel is maintained in pounded ice, dense vapours are evolved which possess the remarkable odour and other properties of persulphuric anhydride. Another interesting fact observed by M. Berthelot is that a solution of potassium persulphate attacks mercury, even at the ordinary temperature, with production of a yellow basic sulphate which appears to be identical with the salt known since the times of the alchemists as *turpith mineral*.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Miss E. A. Hill; two Racoons (*Procyon lotor*) from North America, presented by Captain Sharp; a grey Ichneumon (*Herpestes griseus*) from India, presented by Mrs. Wyndham Bewes; a Stanleyan Chevrotain (*Tragulus stanleyanus*) from Java, presented by Mr. Chas. J. Noble; a Vulpine Phalanger (*Phalangista vulpina*, ♂) from Australia, presented by Master H. H. Barret; a White Stork (*Ciconia alba*), European, presented by Sir H. Rae-Reid, Bart., F.Z.S.; an Ostrich (*Struthio camelus*, ♂) from Africa, presented by H.M. the Queen; a Common Chameleon (*Chamæleon vulgaris*) from North Africa, presented by Mrs. Davidson; three Negro Tamarins (*Midas ursulus*) from Guiana; a Canarian Laurel Pigeon (*Columba laurivora*, ♂) from the island of Gomera, Canary Islands; two Nicobar Pigeons (*Colœnas nicobarica*) from the Indian Archipelago, deposited; an Indian Muntjac (*Cervulus muntjac*, ♀) from India; four Ringed Plovers (*Ægialitis hiaticula*) and two Dunlins (*Tringa alpina*), British, purchased.

OUR ASTRONOMICAL COLUMN.

LUMINOUS NIGHT CLOUDS.—In an article communicated to *Astronomische Nachrichten*, No. 3120, Herren W. Foerster and O. Jesse invite astronomers and geophysicists both here and abroad to make observations of the very interesting phenomena of luminous night clouds, the appearance of which has, up till now, been observed more or less only at Berlin. Since the year 1885, the authors tell us, these appearances have been most noticeable, and it is because they are now becoming less so that they wish to have as many observations made as possible. The phenomenon appears in the form of cirrus clouds, which stand out bright against the twilight sky. The colour generally noticed is that of a bluish white, and when the horizon is approached, gold and red tints are added. The best time for observation is said to be just before and after sunrise and sunset. From photographs taken at Berlin. it has been computed that these clouds are at a height of 82 kilometres. Long after the sun has set they are seen to reflect the sunlight, but as soon as they fall within the reach of the earth's shadow they immediately become invisible. The observations show, so far as may be judged from those already at hand, that the movements of this phenomenon after midnight are directed from the north-east ± 40°, and the authors think it highly probable that the resistance of the medium surrounding the earth accounts for these movements. This is to a certain extent affirmed by observations made at Punta Arenas and other places, the phenomena occurring six months after the conclusion of the Berlin observations. The authors suggest that eye observations

(taken every few minutes) should be made in different latitudes, to ascertain the apparent height to which these clouds attain. The determinations of azimuth and altitude should also be current to three or four minutes of arc, and the time to two or four minutes. Notice should also be taken of the general state of the atmosphere at the time of observation, while photography should be employed to record their place and motion. The paper contains one or two more suggestions, among which is the employment of the spectroscope, and concludes with the hope that the importance of this phenomenon in relation to cosmical problems will arouse much interest and enlist many observers, for, in such a case as this, the observations of one institution will not help to solve such a general question as this.

NOVA AURIGÆ.—From the communications, in *Astronomische Nachrichten*, No. 3120, we make the following notes with reference to the magnitude and spectroscopic appearance of the Nova Aurigæ.

Dr. J. Holetschek, of the Vienna Observatory, has examined the star with regard to the former, and finds that, if any, an increase in brightness has taken place since August 24. The following are his figures, N. standing for the Nova, and *a* a neighbouring star, the magnitude of which is taken as 9·7. The hours refer to Vienna mean time :—

1892.	h.	N.	m.
August 24	13¾ ...	0·5*a* ...	9·65
,, 26	14 ...	2*a* ...	9·5
,, 27	14 ...	1·5*a* ...	9·55
,, 28	12¾ ..	2·5*a* ...	9·45
,, 30	12¼ ...	2*a* ...	9·5
Sept. 2	14 ...	3*a* ...	9·4

Observations made on Sept. 15 12h., Sept. 16 11½h., and Sept. 17 12½h. showed that N. was at least four degrees brighter than *a*, and two degrees brighter than the star, 9·5m. B.D. + 30°·924.

Using the 30-inch of the Pulkova Observatory, Mr. A. Belopolsky has made some measurements of the brightest line visible in the spectrum. His measures are :—

1892.	W.L.	Mean.
September 10	501·2μμ	
,, 12	501·1	
,, 14	(499·5) ...	501·0
,, 15	500·9	
,, 16	500·7	

Of the other lines there were seen D or D_3, F, and a dark line about wave-length 465μμ.

MINOR PLANETS.—The application of photography to the search of minor planets seems to be rewarded with remarkable success, for no less than four new ones, 1892, E, F, G, and H, have, since September 25, been discovered. The first two are due to M. Perrotin, while the last two were photographed by M. Wolf. A fact worth recording is that the plate, on which the latter planets were found, contained also two other images, those of the planets (34) Circe, and (184) Dejopeja ; thus the positions of four planets were obtained with one exposure.

REPORT OF MR. TEBBUTT'S OBSERVATORY.—In this small pamphlet we have a condensed account of the present state of the observatory buildings, instrumental equipment, &c., together with the work done during the year 1891. Although the staff is not very great, yet the work carried out shows that all the available time has been made the most of. The observations include forty-six occultations of stars by the moon, phenomena of Jupiter's satellites, transit of Mercury, conjunction of Venus and Jupiter, and filar micrometer comparisons of the minor planet Ceres, comprising 106 comparisons and four comparison stars. Several comets were observed with the square bar-micrometer, while some interesting double stars and the two variables of Argus and R. Carinæ have also been worked at. The 9h. a.m. meteorological observations have been continued with the usual regularity.

PHOTOGRAPHIC CHART OF THE HEAVENS.—In a paper read on July 1, 1891, before the Royal Society of New South Wales, Mr. H. C. Russell relates many of his experiences, together with some of the results obtained during the preparation of the Sydney Observatory for the photographic chart of the heavens. The first difficulty that turned up had reference to the photographing of the stars of the fourteenth magnitude. The two minutes' exposure was found quite long enough for ninth magnitude stars, but the thirty minutes was not sufficient to record those of the fourteenth. A question also arose as to coloured stars, for in many cases stars visible telescopically were not photographed at all. Of the many objects photographed with the portrait camera, Mr. Russell describes very fully the beautiful nebula 30 Doradus. This nebula, as he says, is a great spiral structure, of which we see the greatest diameter, its thickness measured through in the line of sight being comparatively small. He has been able also to obtain a very fine photograph of N. Argus, a nebula, which, as may be concluded from the negative, "covers a much larger area than that of Orion." The same photograph also confirms the observations made by Mr. Russell in 1872 that a conspicuous part of the nebula which Herschel drew and described in 1838 has wholly disappeared, and that its place is now occupied by a dark round spot. What this may be is a doubtful question, but as Mr. Russell says "It cannot be a solid body, because the stars are there, but a slight misty body would hide the nebula and not affect the stars very much." The pamphlet concludes with an excellent picture of the κ Crucis cluster.

GEOGRAPHICAL NOTES.

COLONEL BAILEY, R.E., lecturer on Forestry in the University of Edinburgh, has been appointed secretary to the Royal Scottish Geographical Society, in room of Mr. A. Silva White, whose resignation on account of ill-health we noticed some months ago.

PROF. CHERSKI, whose projected journey in Eastern Siberia was mentioned in Geographical Notes for June 30 (p. 212) is reported to have died near Sredne Kolymsk, on his way down the Kolyma river towards Nizhne Kolymsk, where he intended to have passed the winter. Cherski has travelled frequently and far in Siberia, and has done much to elucidate the geographical conditions, and in particular the geology of many parts of Northern Asia. His great geological map of the Lake Baikal district is the work by which he will be best remembered.

THE current number of the *Scottish Geographical Magazine* contains Mrs. Bishop's account of her travels in Ladak and the adjacent territories, often called Lesser Tibet. As a record of personal adventure and observation of native character the paper ranks worthily with the published records of this traveller's earlier and later journeys.

THE *Proceedings* of the Royal Geographical Society for October publishes a short statement of the progress of Indian surveys during the last field season. In Bengal the Behar detachment completed the traverse survey of 1610 square miles in districts Muzaffarpur and Champaran. In Bombay 2536 square miles of detailed survey were completed on the scale of two inches to one mile, and 2100 square miles were triangulated in the Gujarat and Mahratta country. Two parties were at work in Burma. In district Sagaing 1842 square miles of cadastral survey and 1142 of traverse survey were completed, while 700 square miles of traverse survey were made in district Shwebo, and a topographical survey, on the scale of one mile to an inch, of 106 square miles of the Chindwin coalfields. There were also carried out in districts Amherst, Tavoy, and Mergin 881 square miles of cadastral survey, besides a traverse survey of 510 square miles.

THE MICRO-ORGANISMS OF THE SOIL.[1]

THE high office with which you have honoured me entails the delivery of an address, which I keenly feel I cannot give in keeping with the standard set by my distinguished predecessors.

Fermentation, though observed since pre-historic times, is perhaps less understood than any chemistry has to deal with. The exciters of fermentation are rendered exceedingly difficult of investigation, because they, like all living things, are subject to physiological—or more specially pathological—functions of life ; they are so sensitive that any abnormal influence either changes their whole mode of existence or destroys it altogether ; a medium suitable to the life of one special kind is changed by

[1] Address delivered by Prof. Alfred Springer as Vice-President of Section C. at the meeting of the American Association for the Advancement of Science.

it into a product which ceases to sustain it, but can nourish a lower class of organisms whereby concomitant fermentations arise, whose united effects are frequently such as to completely modify those produced by each separately; and for this reason have the specific actions of some ferments either totally escaped observation or have been misconstrued. Every succeeding year brings additional proof of the important rôle played by these minute organisms, and to such an extent, especially, has this been the case in connection with the rendition of available nitrogen, that there are good reasons to believe that a clearer comprehension of the action of soil ferments will dissipate all the anxiety chemists now entertain as to a gradual diminution of this so essential nutrient.

To Hellriegel, Wilfarth, Wollny, Engelmann, Winograwdski, Warrington, and Heräus can be attributed the most noteworthy experiments in this special line. In order to appreciate the importance of their discoveries, I will, with your kind indulgence, first give a brief historical *résumé* of the study of fermentation. Owing to the extreme age of the use of alcoholic beverages, ferments entering into their production are best known, and this, added to the fact of their being larger and thus permitting of better examination, has been the determining cause of basing investigations and deductions upon their behaviour.

The very fact that the art of cultivating the vine and making wine is attributed by the Egyptians to Osiris, the Greeks to Bacchus, the Israelites to Noah—the brewing of beer to Gambrinus—shows how old these discoveries must have been. The effects of fermentation are sufficiently striking to have called the attention of primitive man to them. The ancient tribes of Asia and Africa understood how to ferment not only grape juice, but also to obtain alcoholic beverages from substances like starch, not directly fermentable. They used soured dough or beer-yeast as leaven for their bread, and knew how to prepare vinegar. The alchemists were wont to clothe their thoughts in such words as to make it difficult for us to decide what precise ideas they attached to the expressions of "Fermentation and Ferments" which are so frequently found in their writings of the thirteenth to the fifteenth century. They even speak of the philosopher's stone as fermenting unlimited quantities of lead and mercury into gold.

In the fifteenth century Basil Valentine in his "Triumphal Car of Antimony" claims that yeast employed in the preparation of beer communicates to the liquor an internal inflammation, thereby causing a purification and separation of the clear parts from those which are troubled; but considers alcohol as already existing in the decoction of germinated barley. In 1648 Van Helmont declared fermentation the cause of all chemical action and spontaneous generation, going so far as to give directions for the production of mice, frogs, eels, &c. He clearly observed the production of a special gas (gas vinorum) during alcoholic fermentation, and stated that something from the ferment passes into the fermentable substance, developing therein like a seed in the soil, thereby producing fermentation.

Willis, an English physician, in 1659 claimed that all functions of life depended upon fermentation, and that diseases were but abnormal fermentations. Both he and Stahl regarded a ferment as a body endowed with a motion peculiar to itself, which it imparts to the fermentable matter. Stahl in 1697 advanced the following theory: "Under the influence of the internal motion excited by the ferment, the heterogeneous particles are separated from each other, recombining so as to form more stable compounds, including the same principles but in different proportions. Putrefaction is but a particular case of fermentation." This theory remained unchallenged eighty years.

Lavoisier, by applying the new methods of organic analysis he had invented, quantitatively ascertained the relations between the fermented matter and the products.

Guy Lussac considered oxygen the sole cause of fermentation, putrefaction, and decay, by transmitting its motion to the ferment and this imparted its motion to the loosely combined fermentable mass.

The present theories of fermentation originated with Schwann and Pasteur. It took a century and a half before the experiments which led up to Schwann's theory found a scientific explanation by the work of this chemist. Leuwenhoeck had in 1680 already noticed that beer yeast was composed of small spheroid globules. Cagniard de Latour declared yeast a plant and the exciter of fermentation.

Schwann's experiments were made to determine the possibility of spontaneous generation. He found that fermentable fluids, when first heated in closed vessels in the presence of oxygen, to the temperature of boiling water would not ferment. This disproved Guy Lussac's theory that oxygen caused fermentation. He next showed that purified air or oxygen passed into a sterilized fermentable fluid did not induce fermentation; but that this set in with the introduction of ordinary air. He concluded from these experiments that the air was not the exciter, but simply the medium containing it, and that in the floating particles of the atmosphere were organisms capable of developing in the fluid; should these be killed by heat, fermentation would not take place. In his examination of these organisms, although his methods were not absolute, his conclusions that alcoholic ferments are of a vegetable nature were correct.

Instead of general acceptance, Schwann's theory received but little recognition.

Schultze's method of first passing the air entering a sterilized fermentable fluid through oil of vitriol, and that of Schroeder and Dusch of filtering it through cotton can be regarded as modifications of Schwann's experiments. All these experiments conclusively show that the particles in the atmosphere are the exciters of fermentation but do not render them visible.

Pasteur, spurred on by the same motive as Schwann—namely, to determine the question of spontaneous generation—made a simple modification of Schroeder and Dusch's experiment, by substituting gun-cotton, and achieved most remarkable results. The gun-cotton, containing the particles filtered from the air, was dissolved in ether under the microscope, and now for the first time the organisms could be thoroughly examined.

Tyndall's well-known experiments, with the air-tight box coated with glycerine, demonstrated that gravity alone can purify the atmosphere so as to debar fermentation from setting in.

Pasteur's theory is that "The chemical act of fermentation is essentially a correlative phenomenon of a vital act beginning and ending with it; there is never an alcoholic fermentation without there being at the same time organization, development, multiplication of globules, or the continued consecutive life of globules already formed.

The following few examples will serve to show that the slightest changes in nutrients may render them worthless as such to certain ferments and available to others. Organic substances showing optical rotation chiefly exist already formed in the animal or vegetable organisms, or they can be easily obtained from such substances formed during vital processes.

When these substances are made synthetically, they are chemically and physically similar to the natural isomers, but usually do not rotate the plane of polarized light. This leads to the belief that these synthetical products consist of active and inactive molecules in such proportions as to neutralize each other.

Pasteur[1] verified his hypothesis by splitting inactive racemic acid into dextro-tartaric acid. Neutral ammonium racemate in a solution to which the proper inorganic salts had been added was fermented by means of *Penicillium glaucum* and beer yeast. The dextro-tartaric acid was consumed and the lævo left.

Lewkowitch[2] took inactive mandelate of ammonia, employing either *Penicillium glaucum* or *Bacterium termo*; in each case at the end of several weeks all the fluids showed more or less dextro rotation. Natural mandelic acid from amygdalin is lævo rotary, therefore here, as in Pasteur's experiment, with racemic acid it showed that the organisms consumed the naturally produced isomer.

Sac. ellipsoideus and split fungi consume the dextro and leave the lævo. The dextro has the same positive as the lævo negative rotation. The melting points and solubility of the right and left are the same, yet we see that these substances, chemically and physically the same, save in their opposite rotatory powers, can serve in one case as nutrients to certain organisms, and the other are worthless as such.

The Micro-Organisms of the Soil (*Sacchse*[3]).

These organisms, according to their actions, can be divided into three groups. Those oxidizing constituents of the soil those reducing or destroying the same; and lastly those by whose activity the soil is enriched. As regards the first group the oxidation can take place in two ways—they can either oxidize by assimilating the organic substances of the soil and re-

[1] Cr. xlvi. 615; li. 298. [2] B. xvi. 1505, 1569.
[3] *Chem. Cent. Bl.*, 1889, vol. ii. 169, 225.

ducing them to carbonic acid and water, in order to obtain the necessary heat and energy; or they can oxidize by giving off oxygen. The first may be termed intra-cellular, and the second extra-cellular acting organisms. Amongst the intra-cellular we have primarily, the usual ferments of decay, which assimilate and respire at the expense of the carbon compounds. In some cases the organisms have accommodated themselves to seemingly most remarkable materials for respiration, the combustion of which affords the necessary heat. Thus the Iron Bacteria of Winograwdski[1] require ferrous carbonate for their life and development, oxidizing the same to oxide. This can be physiologically interpreted as a respiration process, the protoxide of the respiration material becoming the oxide of respiration product.

The Sulphur Bacteria are equally remarkable. Their cells are distinguishable by containing from time to time granules of amorphous sulphur. These organisms were formerly regarded as causing the formation of sulphuretted hydrogen in sulphur springs.

Winograwdski[2] claims the reverse to be the case. They do not produce sulphuretted hydrogen but consume it, burning it partially first to sulphur, which deposits in the cell water, then completely to sulphuric acid, which passes out and forms sulphates from the carbonates of the surrounding water. When no more carbonates are present, the combustion of sulphur to sulphuric acid ceases. Physiologically this is also a process of respiration directed towards generating heat and energy; sulphuretted hydrogen is the respiration material and sulphuric acid the respiration product.

(Olivier[3] does not agree with Winograwdski and De Rey Pailhade[4] claims the existence of a substance, philothion, in many plants and animal tissues capable of converting sulphur in the cold to sulphuretted hydrogen.)

Certain nitrification ferments can be regarded as intra-cellular. They may take up ammonia and give it off as nitrates, this process ceasing as in the case of the Sulphur Bacteria, when no more carbonates are present.

We now come to the discussion of two ferments, the concomitant actions of which have heretofore caused much confusion. Schloesing and Muntz were the first to observe nitrifying ferments, but to Warrington and Winograwdski belongs the credit of isolating the nitrous from the nitric ferment; furthermore, the striking discovery of a colourless organism, capable of existing and performing its functions, in a medium totally devoid of organic material, and synthetically producing organic bodies independent of sunlight. The importance of this discovery cannot be over-estimated.

Warrington[5] succeeded in obtaining organisms from meadow soil, cultivated in a solution of ammonium chloride and calcium carbonate, which oxidized ammonia to nitrous acid, but had no effect on nitrates. Assimilating the carbon of the carbon-dioxide, they require no organic substance for sustenance. They obtain from the oxidation heat of ammonia the necessary energy to dissociate the carbon-dioxide.

Winograwdski[6] obtained the same ferment employing 1 gr. ammonium sulphate, 1 grm. potassium phosphate dissolved in 1 litre Zurich water, to which he added basic magnesium carbonate. After inoculating the sterilized fluid with the nitrifying agent every trace of ammonia disappeared the fifteenth day. He describes this ferment as being an elongated ellipsoid, the smaller diameter 0·9 - 1 Mkr., the larger 1·1 - 1·8 Mkr. The organisms congregate about a piece of carbonate, cover it with their gelatinous mass, and as the carbonate disappears the cells take the shape thereof.

(Although the two investigators do not quite agree as to the morphological attributes of the ferment, Warrington arrived at the same conclusions as Winograwdski.)

Winograwdski[7] has at last succeeded in isolating the ferment which converts the nitrites into nitrates. He employed gelatinous hydrate of silica, impregnated it with a fluid containing the cultivated nitrous ferment. This medium was next inoculated with strongly nitrifying soil from Quito; shortly afterwards two different organisms formed respective colonies, one of these was the one sought for. It was composed of irregularly shaped rods, dissimilar to the nitrous ferment of the same soil. He has since found this ferment in many other soils; it is capable of converting solutions of nitrites into nitrates.

1 *Bot. Ztg.*, xlvi. 261.
2 *Bot. Ztg.*, xlv. 489, 513, 545, 569, 585.
3 Cr. cvi. 1744.
4 Cr. cvi. 1683; cvii. 43.
5 *Chem. News*, lxiii. 296.
6 A. J. P., September 1890.
7 A. J. P., v. 577; Cr. cxiii. 89.

Strange to say the isolated ferment from Quito does not oxidize ammonia; it produced neither nitrites nor nitrates when sowed in ammoniacal fluids, easily nitrified by the nitrous ferment.

In normal soils the nitrate ferment only produces nitrates even in the presence of a large quantity of ammonia, which does not retard the oxidation of the nitrites immediately after their formation.

Muntz[1] claims the existence of an ammoniacal ferment in the soil which converts organic nitrogen into ammonia, preparatory to nitrification.

Extra-Cellular Oxidation.

In order to oxidize outside of the organisms, oxygen must be evolved by an assimilation process. Assimilation as an oxidizing cause, for conditions prevailing in the soil, has heretofore received no significance, since the evolution of oxygen, according to the generally accepted theories, depended upon light and chlorophyll, consequently the produced oxidation could only occur on the extreme outer surface. An exception to this heretofore unrestricted rule has been found by Engelmann as well as one by Heräus. According to Engelmann,[2] Bacterium photometricum sharply discriminates between lights of different intensity and wave lengths. The influence of light upon the bacteria is directly proportionate to the intensity. When the intensity is suddenly decreased, the bacteria shoot backwards with opposite rotation (the author calling this a terror motion), consequently a well-defined illuminated spot in an otherwise dark drop serves as a trap for these bacteria. They cannot leave, since the terror motion causes them to move back into the illuminated field as soon as they come to the dark outline.

The mobile forms principally congregate in the ultra red rays, *i.e.* physiologically in darkness, and in them as in the visible parts of the spectrum in places closely corresponding to the absorption bands of bacteriopurpurin. This constant ratio between absorption and photokinetic action clearly indicates that the prime effect of light is equivalent to the carbon-dioxide dissociating processes of plants containing chlorophyll.

The bacteriopurpurin is a true chromophyll, inasmuch as it converts the actually absorbed energy of light into potential chemical energy. When lights of different colour were employed, the evolution of oxygen increased with the absorption of light by the Purple bacteria. This shows that the power of developing oxygen is not the specific property of a certain colouring matter, as these organisms contain no chlorophyll.

It is not surprising, therefore, that other organisms, either coloured or uncoloured, be found to possess the property of assimilating carbon in the absence of light and evolving oxygen. Such a discovery has now been made—Hueppe[3] substantiating a communication from Heräus that certain colourless bacteria produce from humus and carbonates, in the absence of light, a body closely resembling cellulose. Oxygen is liberated, but remains unobserved, as it is immediately used to oxidize the ammonia to nitric acid.

The next question is: To which extent do the oxidizing organisms partake in the oxidation phenomena actually taking place in the soil? According to E. Wollny[4] the oxidation of carbon-dioxide is almost completely to be attributed to the activity of small organisms, of which Adametz[5] estimated that there are about 500,000 to 1 gr. soil. As in all such experiments, this conclusion is based upon the fact that no evolution of carbon-dioxide takes place, or is forced to a minimum, in a sterilized soil under otherwise favourable conditions.

Liberation of Combined Nitrogen.

This may take place during putrefaction under the greatest possible exclusion of oxygen, or during decay in the presence of oxygen. It does not necessarily occur in all cases, or may not be observed owing to a reverse concomitant process, *i.e.*, the fixation of nitrogen. Nitrogen losses can be expected during decay, on account of the action of the produced nitrous acid upon the amidlike dissociation of humous bodies, as well as in the formation of easily dissociable ammonium nitrites. A peculiar case of the disappearance of available nitrogen exists in the reduction of nitrates, as noticed by Springer,[6] Gayon and Dupetit,[7] and Deherain and Marquenne.[8]

1 Cr. cx. 1206.
2 *Bot. Ztg.*, xlvi. 661, 677, 693, 709.
3 Ntf. Vers., lx.
4 LV. St., xxxvi. 197.
5 Inaug. Diss., Leipsic, 1886.
6 *Amer. Chem. Jour.*, iv. 452–53.
7 Cr. xcv. 644.
8 Bot., vii. 138.

Organisms by whose Activity the Soil is Enriched in Nitrogen.

A distinction must be drawn between the higher and lower plants. It is a well-known fact that most plants cannot assimilate free nitrogen; whereas there are sound reasons for the belief that the legumes are exceptions to this rule. The explanation has been sought in the tubercles. These tubercles contain a tissue, consisting of thin-walled cells filled with an albuminous substance, consequently they are richer in nitrogen than the roots; they have been regarded by some as pathogenic growths, by others as reserve reservoirs for albumin. We may now conscientiously assume that these tubercles arise through exterior infection, and that they are not normal growths.

Hellriegel and Wilfarth,[1] in their great work, state:—"The legumes deport themselves quite differently from the non-leguminous plants respecting the assimilation of nitrogen, whereas the latter are totally dependent for their nitrogen needs upon the nitrogen compounds present in the soil, and their development proportional to such disposable supply. The legumes have, besides, the soil nitrogen, a second source, from which they can abundantly cover any deficiency existing in the first. This second source is free atmospheric nitrogen. The legumes attain this power by the co-operation of active living micro-organisms. The mere presence of low organisms in the soil does not suffice to make the free nitrogen serviceable, but it is necessary that certain kinds of organisms enter into a symbiotic relationship with the legumes.

Lupines acquire nitrogen like the other legumes. They starve in a soil free from nitrogen when the presence of low organisms is excluded; but when this is not the case their growth is normal. The experiments were carried on in sand containing a suitable nutritive solution. Some of the pots were sterilized; to some infusions from soil were added. In all and in only those, to which fresh infusions of lupine soil had been added the lupines developed normally bearing the well-known tubercles on their roots, and contained, when harvested, conspicuously larger amounts of nitrogen than the soil and infusion could have given them. Wherever the infusion had not been added, or where it had been sterilized at 100 or even 70, the development remained abnormal, the production scant; tubercles remained absent and the harvested plants contained less nitrogen than had been offered them.

According to Ward,[2] Breal,[3] and Pradmowski,[4] tubercles will grow on plants free from them when infected with an infusion from tubercles of other plants.

Beyrenick [5] has named the infecting organisms, of which there may be many varieties, Bacterium Radicola. With the growth of the tubercles the behaviour of the plant towards nitrogen is changed, and the just mentioned independence begins; this has been proved by an almost superabundance of experiments. Still the explanation of the manner in which the nitrogen is acquired is not definitely settled. The first inference would be that the root-inhabiting bacteria possess the power of assimilating atmospheric nitrogen, and the higher plants as hosts harbouring these bacteria in their roots, use the nitrogen compounds so produced. Thus there would exist a case of symbiosis between Split Fungi and the higher plants. We cannot be too slow in accepting this seemingly simple explanation—still the difficulty of a correct interpretation does not alter the fact that the legumes acquire free nitrogen from the atmosphere, and that the refuse of their roots thus enrich the soil. They may be called nitrogen collectors in contradistinction to the graminaceous nitrogen consumers.

Berthelot [6] has long contended that the free soil can fixate nitrogen; he considers a sandy and clayey nature of the soil essential, it must admit of free access of air, must not be too moist, be rich in potash and poor in nitrogen. Gautier and Drouin [7] claim that the presence of humous substances causes increase of nitrogen.

Soils free from organic substances do not fixate nitrogen, or the gain is slight. The presence of ferric oxide so long considered capable of fixing nitrogen, has no effect. Berthelot, as well as most investigators in this line, attribute the fixation to the activity of nitrogen fixing chlorophyll free bacteria. In most cases the amount is much less than that obtained in soils with legumes. No inorganic soil constituents are known to possess the power of fixing nitrogen, and it is questionable whether humous substances can directly do this.

In 1881 Atwater claimed that peas during their growth obtained large quantities of nitrogen from the air. Atwater[1] and Woods made another series of eighty-nine experiments; the result will be found in their admirable paper in the American journal. I will quote the following: "There was in no case any large gain without root tubercles; but with them there was uniformly more or less gain of nitrogen from the air. As a rule, the greater the abundance of root tubercles, the larger and more vigorous were the plants, and the greater was the amount of atmospheric nitrogen acquired. The connection between the root tubercles and the acquisition of nitrogen, which was first pointed out by Hellriegel, is abundantly confirmed. In a number of these experiments, there was a loss of nitrogen instead of a gain. The loss occurred where there were no root tubercles; it was especially large with oat and corn plants, and largest where they had the most nitrogen at their disposal in the form of nitrates. This loss may probably be due to the decomposition of the seeds and nitrates through the agency of micro-organisms. In brief, the acquisition of large quantities of atmospheric nitrogen by leguminous plants, which was first demonstrated by experiments here, and has been since confirmed by others is still further confirmed by the experiments herewith reported. These experiments in like manner confirm the observation of the connection between root tubercles and the acquisition of nitrogen. There is scarcely room for doubt that the free nitrogen of the air is thus acquired by plants."

Chemists, as a rule, hesitate to accept isolated cell life as modifying and conditioning the action of those more differentiated; yet it seems that all circumstances point to the fact that most reactions taking place between nitrogen and plants are influenced by micro-organisms.

Let us hope that chemistry will, in the near future, score its greatest agricultural triumph, by unveiling the mysteries which still shroud the specific actions of these organisms, thus making it possible to supply the demands of a constantly increasing population.

[1] Z. Rub., xxv. I. 234. [2] *Bied. Cent., Bl.*, xvi. 787.
[3] Cr. cvii. 397. [4] N. Rd., iv. 201.
[5] *Bot. Ztg.*, xlvi. 725, 741, 757, 781, 797.
[6] Cr. cvii. 207, 852; cvi. 638, 1049, 1214. [7] Cvi. 754, 944, 1098, 1174.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A course of instruction (Lectures and Laboratory work) in sciences bearing upon Agriculture will be commenced in Cambridge this term; it will extend over two years and will include the following subjects:—Agriculture; Chemistry, elementary and agricultural; Botany, elementary and agricultural; some departments of Physiology and Geology; Agricultural Engineering, Surveying, and Mensuration. Arrangements will also be made for instruction in Book-keeping, and in Agricultural Law for those who desire it. The subjects taken this term will be Elementary Chemistry, by Prof. Liveing; and Elementary Botany, by Mr. Seward, of St. John's College. It is hoped that this course will prove useful to gentlemen intending to farm, or to manage their own land, and to those who are likely to beeome estate agents. Further information may be obtained from Mr. H. Robinson, at the University Chemical Laboratory, Cambridge Prof. Foster announces a new intermediate course in Physiology, with laboratory work, especially for medical students, to be given by Dr. L. E. Shore, on Wednesdays and Fridays at ten, during the Michaelmas and Lent terms.

Dr. Donald Macalister, St John's, has been appointed Assessor to the Regius Professor of Physic.

Mr. S. F. Dufton has been elected to a Fellowship at Trinity College, and Mr. A. Hutchinson of Christ's has been elected to a Fellowship at Pembroke College, in each case for distinction in Chemistry. Both gentlemen took first classes in each part of the Natural Sciences Tripos.

Mr. J. Y. Buchanan, F.R.S., University Lecturer in Geography will deliver a course of lectures on Oceanography during the present Term in the New Museums, on Tuesdays at 12 o'clock, commencing on Tuesday, October 18.

Mr. W. C. D. Whetham, B.A., Fellow of Trinity College, has been appointed Assistant Demonstrator of Physics in the Cavendish Laboratory.

Mr. W. B. Hardy, M A., Junior Demonstrator of Physiology, has been elected to a Drosier Fellowship in Gonville and Caius College.

Amer. Chem. Jour., xii. 526; xiii. 42.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 3. M. de Lacaze-Duthiers in the chair.—Observations of the new planet Borrelly, made at the observatory of Algiers (equatorial coudé), by MM. Rambaud and Sy, communicated by M. Tisserand.—On considerations of homogeneity in physics, and on a relation between the velocity of propagation of a current and the capacity and coefficient of self-induction of the line, by M. C. Clavenad.—On the coexistence of dielectric power and electric conductivity. A claim of priority advanced by Mr. E. Cohn over M. Bouty (see *Wiedemann's Annalen*, vol. xxviii. p. 454).—Comparative evaporation of the solutions of sodium chloride, potassium chloride, and of pure water, by M. Pierre Lesage. Within the limits of the experiments, pure water evaporates more rapidly than solutions of either chloride. The solutions of KCl have, with the same degree of concentration, a greater rate of evaporation than those of NaCl.—On a fossil piece of wood containing fluorine, by M. T. L. Phipson. This was found in the cretaceous sandstone of the Isle of Wight, and analysed thirty years ago. It yielded 32·45 per cent. of phosphoric acid and 3·90 per cent. of fluorine. It had a brown colour and a density of 2·71.—Identity of cascarine and rhamnoxanthine, by the same.—On a respiratory globuline contained in the blood of the chitons, by M. A. B. Griffiths. The yellow blood of the chitons contains a respiratory globuline which contains no metal. It is colourless, and possesses the same properties of oxygenation and deoxygenation as hæmoglobine, chlorocruorine, and other respiratory substances. Its empirical formula is

$$C_{621}\ H_{814}\ N_{175}\ SO_{169}$$

It has been named β-achroglobine, to distinguish it from that of the Patella, which has been called acroglobine.—Influence of the electric light on the structure of herbaceous plants, by M. Gaston Bonnier. After his researches on trees carried out at the electric station of the Paris Central Markets, the writer experimented upon herbaceous plants under similar conditions. The plants were placed at distances varying from 1·5 to 4m. from arc lamps, whose light was kept constant for seven months. The excess of ultraviolet radiation was intercepted by glass shades. Under these circumstances, the majority of plants exhibited intense activity of assimilation. 12 gr. of leaves of *Ranunculus bolbosus* developed 1·05 of oxygen in one hour, the corresponding figure for diffused daylight being 0·52, and for full sunlight in midsummer 3·95. A certain proportion of plants died off, even in intermittent light, especially if no shade was used. Some plants showed an exuberant vegetation, the leaves a deeper green, and the petals more striking colours. Of these, however, the larger number soon began to suffer from excessive assimilation. Some were able to adapt themselves completely, such as bulb plants, grasses raised from seeds, arborescent species, and submerged aquatic plants. The latter also showed no difference in structure, whereas the leaves of crocuses, anemones, and ranunculi became almost unrecognisable owing to anatomical modifications. As a general result, if the continuous electric light through glass produces a great development in an herbaceous plant accompanied by an intense green, the structure of the organs is at first highly differentiated; but if the electric light is intense, and prolonged for several months without change, the new organs formed by the plant, which are able to adapt themselves to this kind of illumination, present remarkable modifications of structure in their various tissues, and are less differentiated, although always rich in chlorophyll. Further, the direct electric light is prejudicial to the normal development of the tissues in virtue of its ultra-violet rays, even at a distance of more than 3m.

GÖTTINGEN.

Royal Scientific Society, March to June.—The following scientific papers have appeared in the *Nachrichten* :—

March.—Bürger: Preliminary contributions to a systematic account of the Nemertean fauna of the Gulf of Naples.

April.—Wallach and Marmé: New chemical combinations of vegetable origin.—Hecht: Contributions to geometrical crystallography.—Hurwitz: On the theory of Abelian functions, generalising algebraic functions into multiplier-functions and stating the generalised "Roch" theorem.—Schönflies: Certain rectilinear portions of Riemann surfaces.—Fricke: Discontinuous groups whose substitution-coefficients are integral numbers belonging to a quartic "Körper."—Fricke: Modular correspondences.—Fricke: On the *s*-function (2, 3, 7).—Ritter: One-valued automorphic forms of deficiency zero.—Lindemann: Solution of equations by transcendental functions. (Second note. See Roy. Soc. of Göttingen, 1884.)

June.—Hallwachs: Velocity of light in dilute solutions.—Klein: *Real* relations in Abelian functions.—Bodländer: Molecular combinations in solutions.—Traube: The crystal forms of optically uniaxial substances.—Drude: The theories of light tested by practical physics.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Matriculation Chemistry: Temple Orme (Lawrence and Bullen).—Elements of Human Physiology: Dr. E. H. Starling (Churchill).—A Vertebrate Fauna of Argyll and the Inner Hebrides: J. A. Harvie-Brown and T. E. Buckley (Edinburgh, Douglas).—Le Léman Monographie Limnologique; F. A. Forel: Tome Premier (Lausanne, Rouge).—Epidemic Influenza: Dr. F. A. Dixey (Clarendon Press).—Das Photographische Pigment-Verfahren: Dr. H. W. Vogel (Berlin, Oppenheim).

PAMPHLETS.—Étude sur la Courants et sur la Température des Eaux de la Mer dans l'Océan Atlantique: General H. Mathiesen (Christiania, Larpent).—Jupiter and his System: E. M. Clerke (Stanford).

SERIALS.—Engineering Magazine, October (N. Y.).—Contributions from the U.S. National Herbarium, vol. i. No. 5 (Washington).—Himmel und Erde, October (Berlin, Paetel).—Veröffentlichungen aus dem Königlichen Museum für Völkerkunde, 2 Band, 3/4 Heft (Berlin, Spemann).

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