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DR. LAUDER BRUNTON'S "PHARMACOLOGY"

A Text-Book of Pharmacology, Therapeutics, and Materia Medica. By T. Lauder Brunton, M.D., D.Sc., F.R.S., &c. Pp. 1139. (London: Macmillan and Co., 1885.)

IT is nearly twenty years since Dr. Brunton, then a student in the University of Edinburgh, commenced, by his researches on the physiological action of digitalis, which were followed soon after by others on nitrite of amyl, a life of laborious work which has been marked at every stage by contributions which testify to his scientific acumen and his burning love for research, and which have enriched physiology and many branches of medicine with newly-discovered facts.

Now, when the second decade of his professional life is drawing to a close, he presents us with a work which stamps him as a teacher in the highest sense of the word.

It may appear to some that an apology is needed for introducing into the columns of NATURE a review of a work dealing with departments of medicine. To any such we would reply that it falls within the scope of this journal to review the progress of all departments of natural science, and that large sections of Dr. Brunton's book are full of interest to all biologists, and almost as much to the specialised physiologist as to the practical physician.

By the term "materia medica" it has long been the custom to designate the study of the agents, whether derived from the mineral, vegetable, or animal kingdoms, which are employed in the treatment of disease. By "therapeutics" we understand the study of the application of these remedial agents to the cure of disease. Until very recently the study of therapeutics was based entirely on pure empiricism, and under conditions where empiricism (*i.e.* experiment), uncontrolled by theory and unassisted by proper methods of observation, could not but yield misleading and contradictory results. The physician employed a drug because others had prescribed it before and found it useful in certain diseases, possessing but rarely any knowledge whatever of the mode in which the drug would affect a healthy subject, or of the manner in which it affected the diseased organism. All that was taught concerning the action of drugs was based upon successive individual experiences, accumulated by individuals who were of necessity destitute of the scientific knowledge, as yet unexisting, which alone could make them "empirics" in the best sense of the word.

These observations are not intended to disparage the work of those who, sometimes possessed of marvellous intuition, worked in bygone days, nor to lead to the inference that old therapeutical experience was barren of useful results. However great the knowledge otherwise acquired of the action of a new drug, however stringent the reasoning which leads us to surmise that it is likely to exert a valuable influence in the treatment of disease, yet ultimately it is by a rational empiricism—*i.e.* by a rational and cautious series of observations on actual cases of disease—that its value will be determined; and, further, he alone will be worthy of the name of a good physician who, irrespective of theoretical considerations, bases his use of remedial agents on the results of rational empiricism. To the older therapeutic studies we owe our knowledge of the usefulness of such drugs as iron, cinchona, and digitalis, a statement which of itself is sufficient to express our obligations to the empiricism of bygone days.

There were many causes which, until lately, stood in the way of a proper study of therapeutics. It was only when the natural history of disease came to be studied by men imbued with physiological knowledge and furnished with all the appliances which physiology has borrowed from chemistry and practical physics that it became possible to lay the foundations of sound therapeutics. From such studies it appears that a morbid process is not to be looked upon as a morbid entity to be destroyed, but usually as the resultant of complex deviations in physiological processes; often, it is true, associated with structural alterations of particular organs which stand more or less closely in the relation of proximate causes of the diseased phenomena. They have shown that, in general, in the treatment of disease, the scope of the physician must be to combat particular phenomena by the use of agents affecting specially the organ and function which are the principal factors in the production of the morbid process.

In order, then, to place medicine on a proper basis, it was needed (1) that the functions of the healthy organism (*physiology*) should be studied in the full light afforded by anatomy, chemistry, and natural philosophy; (2) that the exact deviations of the several functions from the normal standard which constitute particular diseases should be ascertained with the utmost exactitude, not only so as to permit of accurate recognition (*diagnosis*) and classification, but to furnish the elements for a philosophical treatment; (3) that alterations induced in the structure of organs by disease (*pathological anatomy*) should be minutely observed, and that by the light of *experimental pathology*, the course of these alterations and, if possible, their proximate as well as their more remote causes should be ascertained; (4) that the so-called physiological action of drugs and other remedial agents should be submitted to a searching investigation: to this study the vague and misleading term of *pharmacology*, previously employed by German writers, has, unfortunately as we think, been applied; (5) that the subsequent application of drugs and other remedial agents to treatment (*therapeutics*) should be studied not only with the object of showing their influence on particular diseases, but also the way in which individual phenomena of disease have been modified.

All the above branches of inquiry are now being pursued by men imbued with the scientific spirit and furnished with all the scientific knowledge of the day. As a result, in spite of the great difficulty of the task, the physician is acquiring more and more that power of anticipating and predicting events which springs out of a knowledge of principles and distinguishes science from mere empiricism.

Until a comparatively recent period the study of the physiological action of drugs and consequently of therapeutics remained in a backward condition, which contrasted unfavourably with that of other departments of medicine. The researches of Claude Bernard on carbonic oxide and curare were the first fruits of the application of physiology to the elucidation of the action of agents capable of modifying in a definite manner the functions of the body, and opened up the path which others were to follow. Thanks to the researches of such men as Schmiedeberg, T. R. Fraser, Sidney Ringer, and our author, the representatives of a host of active and successful workers, facts have been amassed, and the prospect is daily becoming clearer of the time when the physician shall rely less and less upon mere unsupported experience, and will be guided, as by an unerring compass, in the treatment of the diseases which come under his care. We realise as we read the fine work which lies before us how much has been done in a comparatively short time; we cannot help recognising that this very work places us on a higher platform than before, and thereby gives us a wider prospect towards all points of the compass. Yet we reflect and admit that at present we have only the title-deeds of the estate. We need still to go forth to possess the land.

Dr. Brunton's book contains an enormous amount of information. It is a work which will satisfy alike the student and the expert. Clear and logical it stimulates the student by constant reference to his previous work, and compels the expert to acknowledge that the whole bibliography of the subject has been ransacked to supply the innumerable facts which are so skilfully interwoven with the results of the author's own experience.

The book is divided into six sections. The first, entitled "General Pharmacology and Therapeutics," occupies nearly half the volume. It is a successful attempt to press the most recent and often apparently most abstract conclusions of science into the service of medicine. At the very outset the reader is surprised to find himself confronted with such questions as the unity of matter, Mendeljeff's law, chemical constitution and isomorphism, all placed in more or less direct relationship to pharmacology. It is a specimen of what must be expected throughout this section. Varied scientific facts are reproduced for the sake of overburdened memories, and then in a few pregnant sentences the author connects them with his subject, and, between the lines, opens out new avenues of research.

We would draw special attention to the remark of the author on the object, value, conditions, and objections to the study of experimental pharmacology (pp. 37-41). In the ordinary administration of any drug the difficulties in the way of a correct conclusion as to its action on the system are extremely great. The conditions are so complex that the most experienced physician will often hesitate between the "post" and the "propter." We must by experiment diminish the number of coincident phenomena in order that we may link the right antecedent and consequent. This may be accomplished in various ways, as the author indicates. A simpler organism and one more open to direct investigation may be employed; an organ or tissue may be isolated from the rest of the body, *e.g.* a muscle-nerve preparation; by ligature of blood-vessels, or otherwise, the drug may be excluded from part or parts of the body, and so comparisons instituted; or the normal mechanism of a part may be modified in a definite manner, and the action of the drug examined under these circumstances, as in experiments on drugs affecting the organs of circulation, and in which the vagus is cut or stimulated. Pharmacology is based on experiments thus made, and no one who reads Dr. Brunton's book can doubt their value. The observations of the author on objections to experiments appear to us so just that we cannot avoid reproducing them:—

"*Objections to Experiment.*—Some people object entirely to experiments upon animals. They do this chiefly on two grounds. The first is that such experiments are useless, and the second, that even if they were useful, we have no right to inflict pain upon animals.

"The first objection is due to ignorance. Almost all our exact knowledge of the action of drugs on the various organs of the body, as well as the physiological functions of these organisms themselves, has been obtained by experiments on animals.

"Their second objection is one which, if pushed to its utmost limits and steadily carried out, would soon drive man off the face of the earth.

"The struggle for existence is constantly going on, not only between man and man, but between man, the lower animals and plants, and man's very being depends upon his success.

"We kill animals for food. We destroy them when they are dangerous like the tiger or cobra, or destructive like the rat or mouse. We oblige them to work for us, for no reward but their food; and we urge them on by whip and spur when they are unwilling or flag. No one would think of blaming the messenger who should apply whip and spur to bring a reprieve, and thus save the life of a human being about to die on the scaffold, even although his horse should die under him at the end of the journey. Humane people will give an extra shilling to a cabman in order that they may catch the train which will take them to soothe the dying moments of a friend without regarding the consequences to the cab-horse. Yet if one-tenth of the suffering which the horse has to endure in either of the cases just mentioned were to be inflicted by a physiologist in order to obtain the knowledge which would help to relieve the suffering and lengthen the life, not of one human being only, but of thousands, many persons would exclaim against him. Such objections as these are due either to want of knowledge or want of thought on the part of people who make them. They either do not know the benefits which medicine derives from experiment, or they thoughtlessly (sometimes, perhaps, wilfully) ignore the evidence regarding the utility of experiment."

As protoplasm is the physical basis of life and the cell its unit, Dr. Brunton commences Pharmacology with the action of drugs on amœbæ, white corpuscles, infusoria, and the various forms of specialised protoplasm found in the higher animals. A section is also devoted to micro-organisms. The late extensive corroboration of the truth of the germ theory of disease throws special interest around the investigations which deal with their life-history and the manner in which they are affected by drugs. A short chapter on the pharmacology of the Invertebrata serves to reveal the comparative poverty of our knowledge in this branch, and suggests further inquiry.

We must pass over the elaborate and lengthy chapters on physiology, pharmacology, and pathology as applied to the various organs and systems of the body. It is the centrepiece of the book, and reveals the versatility, the learning and the scientific instincts of the writer.

Section II., entitled "General Pharmacy," contains a succinct account of the various classes of pharmaceutical preparations, with tables of doses of the individual members of each.

The rest of the book is chiefly taken up with an account of the preparation, characters, doses, actions, and uses of the various remedial agents. Here we find all that valuable empirical knowledge of the use of drugs which science has so far failed to analyse, but which in course of time will no doubt be incorporated with the first section. Section III. is concerned with the inorganic remedies, Section V. with those obtained from plants, and Section VI. with those derived from animals. Section IV., "Organic Materia Medica," requires special notice. It includes all the carbon compounds employed in medicine which are obtained by synthesis.

Pharmacology owes much to the enterprise of the chemist. In the first place, the extraction of definite active principles from the various vegetable structures used in the Pharmacopœia has been of inestimable value. It was formerly impossible to be sure that the preparations made year by year were of the same strength. The environment of the plant varies more or less each season, so that at one time it may manufacture more of its active principles than at another. Moreover some plants contain several powerful ingredients which are of more value apart than together. The extraction and isolation of these substances has therefore led to a correct dosage and their more definite application to the treatment of disease.

In the second place the chemist is making us by degrees independent of the plant world by producing synthetically the bodies thus isolated. Just as the manufacture of alizarine from anthracene made the dyer independent of the madder root, so the artificial production of salicylic acid has supplanted the willow. In course of time, no doubt, as Dr. Brunton suggests, this section of Materia Medica will develop greatly, whilst the number of animal and vegetable preparations will correspondingly diminish. We are not, however—thanks again to chemical research—limited merely to those principles already in the Pharmacopœia. Already we are supplied with a host of substances, the products of synthesis, amongst which many of the valuable drugs of the future will doubtless be found. Organic synthesis, apart from the valuable substances which it may yield us, as the bodies kairin and antipyrin, which have already found their use in medicine, is of extreme importance to the pharmacologist from another standpoint, for it enables him to form conjectures as to the molecular structure of compounds. So far but few definite relations have been established between chemical constitution and physiological action. Still, enough has been done to demonstrate the existence of such relations and to promise a fruitful harvest hereafter. It has been proved, for instance (Crum Brown and Fraser), that the introduction of the methyl group into the molecule of an alkaloid gives it the power of paralysing the end-organs of motor nerves. Similarly Drs. Brunton and Cash have found as a general rule that most of the compound radicals formed by the union of amidogen with the radicals of the marsh-gas series possess a paralysing action on motor nerves.

It is probable that just as in the members of homologous series we have a gradation of physical properties and a similarity of chemical reactions, so bodies having similar chemical constitution will be found to resemble each other in physiological action. Induction will then lead to deduction, and the paths in which we are to tread in order to find drugs endowed with certain properties will be indicated; in illustration of this we note that already we know where to experiment if we wish to add to the number of our anæsthetics and antipyretics.

This review could not well close without a reference to the many useful illustrations and to the elaborate indices (extending to 131 pages), which add materially to the value of the work. It will rank as the text-book on the subjects of which it treats, being at once the best exponent of existing knowledge and a powerful stimulus to further progress. ARTHUR GAMGEE

ELEMENTARY PRACTICAL PHYSICS

Lessons in Elementary Practical Physics. By Balfour Stewart, M.A., LL.D., F.R.S., Professor of Physics Victoria University, the Owens College, Manchester, and W. W. Haldane Gee, Demonstrator and Assistant Lecturer in Physics, the Owens College. Vol. I. (London: Macmillan and Co., 1885.)

IN this the first volume of what will evidently be an elaborate work on practical physics, the authors have treated of general physical processes only, *i.e.* of the methods employed in the laboratory for the exact determination or measurement of the geometrical and mechanical properties of bodies. It is impossible to over-estimate the importance of these fundamental measures, for upon them depends the accuracy of almost all physical work. That this is the view of the authors is made evident by their having devoted nearly the whole of the first volume out of a promised three to matters purely geometrical and mechanical. Throughout the volume the most minute attention to details is apparent, so much so that it is likely to weary those who read it only; but those who use it to guide them in making the measures given will certainly benefit by the completeness with which each subject is treated.

The first chapter, on the measurement of length, may be taken as a type of the whole volume. The metre and the yard are first defined and their absolute relation stated; the actual relation of metre and yard scales—slightly differing from the absolute owing to the fact that 0° C. and 62° F. are the two temperatures of reference—is next explained. A paragraph on "end measure" and "line measure" concludes what is in effect an introduction to the first chapter. Then the "Lessons" in this chapter begin. The first lesson is on the use of scales. In this instructions are given for measuring a length with a pair of compasses and an ordinary or a diagonal scale. Results are given showing the limit of accuracy by this method. The second lesson is on the straight Vernier, the third on the barometer Vernier, the fourth on the spherometer, and the fifth on the micrometer wire gauge. Lesson 6 is a description with figures of the dividing engine of M. Perreaux, the use of which is the subject of the next lesson. The next five lessons of this chapter explain the copying of scales, the cathetometer with its adjustments, the micrometer microscope, the Whitworth measuring machine, the eyepiece and stage micrometer, while a general review of the subject of length measurement, in which other instruments and tools, including the cathetometer microscope, are described, concludes the chapter.

This brief review of the first is sufficient to show the system on which each of the eight chapters is put together.

In the second chapter on angular measurement the circular Vernier, the mirror and scale, and the spirit level of course form the subject of lessons. There is also a lesson on that simple and easily-constructed instrument of M. Cornu, the optical lever.

The chapter on the estimation of mass is very complete, for, besides an explanation of the theory and use of the balance, there is a page headed "precautions in weighing," a copy of which might well be placed on the wall above every balance in a laboratory; there is an excellent paragraph on the sensibility of the balance, with a diagram showing the observed sensibility of an Oertling, a Bunge, and another short beam balance. There is, lastly, a lesson on the errors of weights, in which instructions are given for testing a set of weights.

In the chapter on measurement of area and volume a large amount of space is given to an explanation of the Amsler planimeter. This beautiful little instrument, as is well known, gives the area of a figure round which its point is traced. In a new edition it is to be hoped that the new "precision" planimeters which in accuracy and some other respects are superior to that of Amsler, will be described.

In Chapter V., on the determination of density, are to be found full instructions for finding the specific gravity of solids and liquids by a host of methods. The corrections for buoyancy are carried to such an extent that account is taken of the latitude and the height above the sea-level in calculating the density of the air from the barometer reading; further, the effect of moisture in lightening the air is guarded against. The hydrometers of Fahrenheit, Baumé and Twaddle are described, and instructions are given for making them. The exact determination of the density of a gas, being a problem of great difficulty, is considered unsuitable for imitation in the laboratory; however, an outline of Regnault's method is given.

The chapter on elasticity, tenacity, and capillarity differs from others in the book in that the theory of the subject is given at length, as well as instructions for performing experiments in the laboratory.

The chapter on the determination of atmospheric pressure contains a full account of the method of filling and using a standard mercurial barometer. The aneroid barometer is not mentioned.

The last chapter, on time, gravitation, and moments of inertia, is purely mechanical. The difference between the sidereal, solar, and mean solar days is explained, but instructions are not given for taking a transit. Clocks, chronometers, stop-watches, the water-clock, and the chronograph of Hipp, in which a reed vibrating 1000 times a second replaces the pendulum of a clock, are briefly described.

The determination of g by Borda's and by Kater's method is given. Several forms of electro-chronograph are described—among them one in which a primary circuit is broken at the beginning and end of the interval to be measured, while the induced currents cause a spark to pass between the style of a tuning-fork and a smoked drum, so that the number of waves between the two dots produced by the sparks measures the time.

As has been already said, completeness and attention to details are apparent in every chapter of the first volume, while the names of the authors are sufficient as a guarantee of accuracy. The only cause for regret is the fact that the public has to wait for the two volumes on real physics, for those who read the first, which deals mainly with measurements of geometrical and mechanical properties, and which is therefore essentially an introduction, are likely to be impatient to see the series completed.

OUR BOOK SHELF

The History of a Lump of Gold from the Mine to the Mint. By Alexander Watt. (London: A. Johnson.)

THE author has endeavoured to treat his subject so as to interest general readers, but he might have spared them such moralisations, suggested by the word "gold," as "With what silent rapture we receive it as our own, and how different is the feeling when it comes into our hands merely to convey to another." The compilation of facts connected with the history of gold and its manufacture into coin has, however, been carefully done. Considering that the superstructure of modern chemistry was built up on the labours of the "early alchemists," we object to their being described as "those remarkable imposters," and indeed the quotations from the writings of the early chemists which are given abundantly prove their claim to more respectful treatment. The metallurgy of gold is dealt with in the most slender way, but the chapter relating to the operations of coinage is more satisfactory, and is confessedly an abstract of a series of Cantor lectures recently delivered by the chemist of the Mint.

The important question of the amount of gold actually in circulation has not been lost sight of, and the author sums it up by quoting the following passage:—"The amount of gold actually in circulation is estimated to be 100,000,000*l*., but the coinage returns show that the amount of sovereigns and half-sovereigns issued since 1816, when their coinage began, is 247,521,429. What, then, has become of the one hundred and forty-seven millions not in circulation?" No doubt a considerable proportion has been exported never to return, but we do not think, with the author, that the operations of manufacturing goldsmiths and jewellers would account for a very large proportion of the deficiency.

There are some remarkable slips in the printing. For instance, the well-known historian of the coinage is called the Rev. Rogers Rudling, and Sir John Pettus appears as Petters; but viewed as a whole, the work may be commended as tending to disseminate information respecting the precious metal which it is desirable should be widely known.

Magnetism and Electricity. By W. G. Baker. (London: Blackie and Son.)

WITH the multitude of elementary text-books on magnetism and electricity already existing the production of a fresh one might well have seemed an unnecessary task. Nor is there anything in the little book now before us in the least degree new, either in matter or in arrangement. So far as it goes, however, it is quite satisfactory. It consists of 143 pages, and in this space the author has managed to give in a clear manner an account of so much of the subject as might reasonably be put before a school class for beginners. As it appears from his preface that this was the sole object of the author in writing the little book, he is entitled, we think, to consider that his object has been attained.

Bacillary Phthisis of the Lungs. By Germain Sée, translated by William H. Weddell. (London: Kegan Paul, Trench and Co., 1885.)

THIS is in many respects an unsatisfactory book. It is divided into seven parts. Of these the preliminaries and the first four parts comprise anatomical and histological notes, the biological study of micro-organisms generally, and the study of the bacillus tuberculosis especially, and all kinds of promiscuous notes on the causes of tuberculosis; but, owing to the dogmatic way in which these subjects are treated, the omission of details and the numerous mycological inaccuracies this portion of the book is very weak. The rest, treating of clinical, hygienic, and therapeutic subjects, is more within the author's proper domain, and will be found instructive to the medical practitioner.

Mineral Resources of the United States. By A. Williams. (Published by the U.S. Geological Survey, 1883.)

THIS book consists of a series of essays, of various degrees of importance, on the mining and metallurgic industries of the United States. The work has been mainly carried out by entrusting each subject, or a special branch of each subject, to a gentleman intimately acquainted with that branch. The thoroughness with which the subject is treated is shown by the fact that the natural history of so rare a substance as hiddenite is very fully discussed by the original discoverer, Mr. W. E. Hidden.

Naturally the most important and the most extensive essays are those on coal, iron, copper, and zinc. Silver, the position of which is at present one of the most difficult problems connected with the metals, was excluded by Act of Congress from the present investigation, and tables of the production of gold and silver in recent years are all the information given. Former publications of the U.S. Government have already made known the enormous wealth of the silver-mines, and have given fair means by which persons interested in mining may estimate the prospect of success in such undertakings.

Under iron, an account is given of the Bower-Barff process of protecting iron from rust by means of a thin film of magnetic oxide—a process which bids fair, if it stand the trial of some years' wear, to replace the process of galvanising.

To professional people who need accurate information as to the condition of the various industries, the book possesses great value. It is also full of interest to the scientific mineralogist who has mainly to depend on the opening of new mines for fresh discoveries in the mineral kingdom. One cannot help regretting, however, the space given to a history of the divining-rod, "natural magnets," and similar absurdities. The subject is as much out of place as an account of the astrological nonsense practised in the Middle Ages would be in a modern treatise on spherical astronomy.

LETTERS TO THE EDITOR

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

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

Pitcher Plants

PERHAPS you will allow me to set "W. C. M." right with egard to *Sarracenia variolaris* and pitcher plants generally (p. 295). I am afraid the sources from whence he obtained his information were not very reliable, as will be seen from the following:—

There are six species of Sarracenia found in North America, all of them characterised by the same trumpet-shaped leaves growing in tufts, and in several of the species attaining a length of a yard. In addition to these there is the *Darlingtonia californica*, which has long twisted trumpet-shaped leaves, the top of which is curved over, forming a sort of hood, and having a rather small aperture on each side. These constitute the whole of the pitcher plants of North America. "W. C. M.," whilst professing to describe the "curious characteristics" of the Sarracenia, really describes the leaf and pitcher of Nepenthes, which, as almost everybody knows, are tropical plants, mostly natives of the Indian Archipelago, and well known in this country as ornamental stove plants. The pitchers vary much in size, some of the species producing them quite eighteen inches long and capable of holding a quart of water, whilst others have pitchers no larger than a thimble. "W. C. M." is quite wrong in saying that the lids of the pitchers of Nepenthes, or indeed of any pitcher-plant known, close again after they have once opened. When the pitcher is about full-grown, the lid pushes open, widely in some species, only slightly in others, and remains quite stationary till the pitcher dies. When the lid opens, the pitcher is found to be about one-quarter filled with a sweetish watery liquid. Under cultivation it is necessary to keep the pitchers filled with water, or they soon shrivel; and it is found that, however frequently the water is renewed, it soon acquires a slight sweetness; so that the secretion of "honey" going on in the pitcher must be somewhat copious. If the water which is in the pitcher when it first opens dries up, there is no further secretion of liquid—at least such is the case with cultivated plants. At Kew the oldest pitchers on the Nepenthes attract insects as long as they contain moisture. The Sarracenias have their pitchers formed by the folding and joining of the edges of the leaves, so as to make a long funnel which is wide at the mouth and narrowed to almost a point at the base. Over the mouth the flap-like lid is fixed and in some of the species stands erect so as to admit rain-water into the pitchers, whilst in others the lid curves over in such a manner as to hinder the rain from falling into them. In 1815 the then President of the Linnean Society, Dr. James McBride, read a communication on the fly-catching propensity of Sarracenias, from which the following is worth quoting, as it describes accurately what we have repeatedly observed in the collection of Sarracenias cultivated at Kew. He says, writing chiefly about *Sarracenia variolaris*: "If, in the months of May, June, or July, when the leaves of these plants perform their extraordinary functions in the greatest perfection, some of them should be removed to a house and fixed in an erect position, it will soon be perceived that flies are attracted by them. These insects immediately approach the fauces of the leaves, and, leaning over their edges, appear to sip with eagerness something from their internal surface. In this position they linger, but, at length allured, as it would seem by the pleasures of taste, they enter the tubes. The fly, which has thus changed its situation, will be seen to stand unsteadily, it totters for a few seconds, slips, and falls to the bottom of the tube, where it is either drowned or attempts in vain to ascend against the points of the hairs. The fly seldom takes wing in its fall and escapes. In a house much infested with flies this entrapment goes on so rapidly that a tube is filled within a few hours, and it becomes necessary to add water, the natural quantity being insufficient to drown the imprisoned insects. The leaves of other species might well be employed as fly-catchers; indeed I am credibly informed that they are in some neighbourhoods. The leaves of *Sarracenia flava*, although they are very capacious, and often grow to a height of three feet or more, are never found to contain so many insects as those of other species. The cause which attracts flies is evidently a sweet viscid substance resembling honey, secreted by, or exuding from, the internal surface of the tube. From the margin, where it commences, it does not extend lower than one-fourth of an inch. The falling of the insect as soon as it enters the tube is wholly attributable to the downward or inverted position of the hairs of the internal surface of the leaf. At the bottom of a tube, split open, the hairs are plainly discernible pointing downwards; as the eye ranges upwards they gradually become shorter and attenuated, till at, or just below, the surface covered by the bait, they are no longer perceptible to the naked eye nor to the most delicate touch. It is here that the fly cannot take a hold sufficiently strong to support itself, but falls. The inability of insects to crawl up against the points of the hairs I have often tested in the most satisfactory manner" (*Trans.* Linnean Society, vol. xii.). I have again and again released blue-bottle flies after they have been trapped, and have never yet found them act in any way that would suggest an intoxicating property in the secretion which they had fed upon—this is contrary to the information of "W. C. M.," who says:—"After feeding upon the secretion for two or three minutes they [the insects] become quite stupid, unsteady on their feet, &c." To prevent the pitchers being injured by the large number of insects which are lured into them, we find it necessary at Kew to fill the mouths of the pitchers with cotton-wool; this prevents the insects from falling in. Before this precaution was taken many of our finest pitchers were lost, owing to the decay which was caused by the rotten mass of insects which had accumulated in the bottom of the pitchers. "W. C. M." will be surprised to hear that, in spite of this cutting off of the supply of insects to the pitchers, the plants were in no way affected as regarded growth or vigour, but that the length and general health of the pitchers were more satisfactory after the insects were not allowed to enter them, than before. The concluding sentence in his remarks is rather startling, as, so far as investigations conducted by physiologists have gone hitherto, the Sarracenias are not known to be carnivorous. Mr. W. H. Gilburt, of the Quekett Microscopical Club, says:—"The pitchers contain fluid, but nothing corresponding to a digestive fluid has been detected in them; so that, if the insects which perish in the pitcher are of any value to the plant and afford any nutriment, it must be simply by maceration, and the glands can be regarded as absorbent only." Of course it may be said that Sarracenias would not have been constructed with what appears to be a view specially to catching insects, if the insects were not to serve some useful purpose in the economy of the plant. Anyhow, at present it is only safe to say of Sarracenias that they allure and ultimately destroy insects, but we do not yet know that they obtain nourishment from them. Certainly under cultivation there is abundance of evidence to prove that these, and in fact all those plants which are considered to be distinctly carnivorous, grow and thrive at least as well when insect food is not allowed them as when it is.

Kew W. WATSON

Colourless Chlorophyll

IN his elaborate "Contributions to the Chemistry of Chlorophyll" (NATURE, vol. xxxii. p. 117), Mr. E. Schunck rightly observes that the explanation given by Mr. Tschirch for the curious fact discovered by Mr. Church is not based on sufficient proof. Indeed it could hardly be admitted that the action of metallic zinc is a process of reduction, since a similar result may be arrived at when zinc oxide is used instead of the metal. (A fact that I stated in 1869).

But quite recently I have had the opportunity to convince myself that the reaction that takes place when a chlorophyll solution is *treated by metallic zinc and an organic acid* is of an utterly different nature. Through the agency of nascent hydrogen generated in the reaction, *chlorophyll is* actually *reduced, the resulting substance being* not of a green colour, but perfectly *colourless*, and presenting no traces of the characteristic chlorophyll spectrum or fluorescence. It is only on coming in contact with the air that it gradually acquires both its green colour and specific optical properties. It is highly instructive to watch the phenomenon in a test-tube placed before the slit of a spectroscope and observe the first appearance and subsequent growth of the dark bands, the colourless substance regaining in the mean while its original splendid emerald green.

The physiological importance of this fact will be obvious to all botanists interested in the subject; for my part I consider that the discovery of this colourless modification of chlorophyll brings additional proof in favour of an hypothesis that I proposed in 1875 concerning the chemical nature of chlorophyll—viz. that the green colour of this substance is due to the presence of iron in the state of a $FeOFe_2O_3$ compound. In fact, all the changes that this substance undergoes, its production, its destruction, the action of acids, of metallic zinc and zinc oxide, might be easily accounted for by admitting this simple and very plausible hypothesis.

But whatever may be the ultimate fate of this "provisional" hypothesis, the fact just stated will lose nothing of its importance. Its chief interest lies in the establishment of the existence of a colourless substance, acquiring by oxidation all the optical properties of chlorophyll. It is evident that chlorophyll is generated in this case by a process similar to that which takes place in the living plant. (The existence of such a substance has been often announced, but continues to be a subject of doubt). At the same time we may see the reason why, admitting that chlorophyll undergoes a process of reduction when CO_2 is dissociated through the agency of light (this supposition is highly probable), this transformation may not be attended by a visible change of its colour, and other optical properties—the produce of reduction being colourless and having no dark lines in the spectrum. However, the change of colour that M. Sachs observed in a great number of leaves on exposing them to direct sunlight, and which is generally attributed to a migration of the chlorophyll grains, might, partly at least, be due to this process of reduction. C. TIMIRIAZEFF

Moscow, July 15

July Meteors

BETWEEN July 8 and 14, 111 shooting stars were recorded here in $11\frac{3}{4}$ hours of observation. The paths of these, reproduced upon an 18-inch celestial globe, enabled me to fix the radiant points of 12 showers with considerable distinctness:—

No.	Epoch. July.	Radiant. ° °	Notes.
1 ...	13–14 ...	11 + 48	Meteors long, swift with streaks.
2 ...	8–13 ...	245 + 52	Slow, yellow, max. July 8.
3 ...	13–14 ...	255 + 37	Slow, faint, near π Herculis.
4 ...	9–13 ...	265 + 63	Slow, faint, near ζ Draconis.
5 ...	9–14 ...	271 + 21	Slow, faint. In Cerberus.
6 ...	9–13 ...	280 – 14	Very slow, long paths.
7 ...	13–14 ...	285 + 42	Very swift and short, near α Lyræ.
8 ...	9–13 ...	289 + 31	Swift, faint, near γ Lyræ.
9 ...	8–13 ...	290 + 60	Slow, bright, near o Draconis.
10 ...	8–13 ...	303 + 24	Swift. In Vulpecula.
11 ...	13–14 ...	314 + 47	Very swift, short, bright, near α Cygni.
12 ...	9–14 ...	329 + 36	Swift, reddish streaks. S. of Lacerta.

Nos. 1, 7, 8, 9, 11, and 12 were well observed by Zezioli in 1867–68, and form Nos. 93, 90, 88, 89, 99, and 98 of the catalogue of radiants derived by Schiaparelli from his observations.

Generally the meteors observed here during the past month were small, but three were estimated as bright as Jupiter. The first of these appeared on July 8 at 12h. 1m., shooting rapidly along a course of 27 degrees a little west of ζ, η, θ Draconis. It left a brilliant streak, enabling the path to be very accurately noted. This meteor belonged to the radiant at 11° + 48°, and soon afterwards, at 12h. 10m., another fine one was seen pursuing a greatly foreshortened path near δ Draconis and throwing off a dense train of yellowish sparks. Its motion and appearance prove it to have been a Draconid and a member of the display from 290° + 60°. On July 9, at 13h. 50m., I recorded a fine meteor shooting upwards, just east of Altair, from a centre at 304° – 15° near α and β Capricorni; but I have not included this position in the list, as I only saw one other shooting star with a conformable direction during the period included by my observations.

On July 31 a few fine and early members of the August Perseids were seen, and on August 1, between 9h. 45m. and 9h. 50m., I noted three others, two of which were unusually brilliant, and projected vivid streaks upon their long, graceful flights through the Milky Way west of Aquila. This conspicuous and early appearance of the Perseids would seem to predicate a bright maximum on the night of August 10.

Bristol, August 2 W. F. DENNING

The August Meteors

LAST night at 9.32 a brilliant meteor crossed Cassiopeia's Chair from W. to E. parallel to the horizon. Its trail was visible for twenty-six seconds after the bursting of the meteor. During a five mile walk, lighted by many meteors, the summer lightning incessantly flashed from the northern horizon, but its brightness was never comparable to that of this meteor. It resembled most a magnesium rocket in the Crystal Palace fireworks. But even this comparison is hardly adequate.

Chatham, August 12 H. B. JUPP

A Possible Windfall for Science

Is not the better course for immediate action that the departments in England and the United States should first combine?

Let each apportion a part of the calculation, and then print it in an agreed form. The sterotype plates would be interchanged, and what a private firm does the Government can effect. In this way the English-speaking marine, including many Dutch and German captains, will be at once supplied, and part of the proposed economy and benefit be obtained without waiting for negotiations with France and Germany. HYDE CLARKE

Electrical Phenomenon in Mid-Lothian

I HAVE observed in a daily contemporary a communication quoted from your journal with reference to this occurrence on the 23rd ult.

For the information of those of your readers who are interested in such matters perhaps you will kindly allow me to observe that I also witnessed a similar, or the same, phenomenon that evening.

When driving home from a professional visit in the country, and a mile south of this town, about ten o'clock I was suddenly startled by a peculiar sensation or slight shock, and immediately perceived, ten yards in front, on the road, a bright opalescent luminosity which travelled deliberately away in a northerly direction. This cloud or wave of light covered the whole breadth of the road, and was distinctly visible for some seconds. It seemed to rest entirely on the ground, and in character reminded one somewhat of the illumination resulting from the electric light. I should imagine it was travelling at the rate of twenty miles an hour, as it was going much in the same direction I was, but of course much faster. The part of the road where it showed itself is lined by high trees on both sides in full foliage. I heard no thunder and saw no lightning or meteor to account for the strange and weird-looking light.

The interesting question then arises, What was the nature of this phenomenon?

It will be remembered that the thermometer was for several days at that time above 80° F. in the shade. Might it not be possible, therefore, for a certain volume of air to become electrified, and then, perfectly insulated by the dry surrounding atmosphere, show its existence in this manner as a luminous cloud rushing along the ground?

I may mention in conclusion that my groom, who was driving me at the time, also witnessed the occurrence.

Dalkeith, N.B., August 10, 1885 ROBERT LUCAS

On a Radiant Energy Recorder

A FEW weeks ago I wrote a short article for NATURE under the above title, describing an instrument for the measurement of radiation in heat units which was based upon the principle of the integration of temperature by the distillation of water in vacuo. Since then Mr. Edward Vivian, M.A., has kindly written me a very interesting letter, in which he says that he had several forms of an instrument based upon essentially the same principles, made for him by Messrs. Negretti and Zambra many years ago, and that some of them are still in use in his garden at Torquay. Mr. Vivian's instruments were shown at the British Association (*B. A. Report*, 1856, p. 48) and at the Royal Institution of Great Britain (*Journal R. I.*, 1857, p. 438), but no description of them appears to have been printed, which probably accounts for their not being more generally known.

University College, Liverpool J. W. CLARK

Our Ancestors

THE number of "Our Ancestors" since "the time of the Norman Conquest," mentioned in your last issue by $\left(\frac{1}{2}\right)^n$, and the consequences to be deduced therefrom, have been very interestingly discussed already by Mr. Grove in his presidential address to the British Association at Nottingham, 1866.

Freiburg, Badenia, August 8 N.

THE INSTITUTION OF MECHANICAL ENGINEERS

THE Institution of Mechanical Engineers held their summer meeting at Lincoln last week, under the presidency of Mr. Jeremiah Head, who, in his inaugural address, treated of the relative advantages of iron and steel for the various purposes for which these metals are employed. The reasons why steel *rails* are now used almost to the exclusion of iron are that they can be produced more cheaply, can be manufactured of equally good quality by either the Bessemer or Siemens process with either acid or basic-lined vessels and of almost any iron ore, and they can better withstand abrasion, disintegration, or crushing under heavy rolling loads; for the same reasons steel tires are now almost universally employed. For *ship-building* steel is superior to iron, as, owing to its greater ductility, ships built of the former metal are able to outlive collisions and minor accidents that would be fatal to iron ships. As is well known, owing to the superior tensile strength of steel, Lloyd's Committee agreed in 1877 to allow a reduction of 20 per cent. in weight of scantlings over iron, and in the thickness of plates; Mr. Head argues that, considering a ship's plate is a broad girder, its strength diminishes as the square of the thickness, and that, therefore, although a steel ship would be superior to an iron one of equal weight, an iron ship is likely to retain its form better than a steel one built 20 per cent. lighter. As regards *bridges and roofs*, the employment of iron or steel depends mainly upon the size of the structure; for light edifices, owing to its greater cheapness, iron has hitherto been used, whilst for large spans, where the weight of the structure itself is an important function, steel has been employed in the erection of bridges of spans which could not have been attempted if the engineer had been dependent on iron alone. For *boilers*, except in the matter of corrosion, in which authorities seem to differ as to the resisting power of iron and steel, but appear to be rather favourable to the former, steel is much more advantageous than iron, both on account of its being as cheap, and on account of a steam boiler of the same weight being able to withstand much higher pressures if made of steel than if made of iron; hence boilers, and marine boilers particularly, are now scarcely ever built of iron. The President recommended the application of metal in the construction of the frames of rolling stock and for railway-sleepers. As regards the continued use of wooden sleepers, there can be no question that "it is a form of waste that should be reprehended in the public interest, just as should the use of coal for ballasting or other obviously wasteful purpose. The same timber which would become useless for sleepers in, say, nine years, would last at least a century in the roof or flooring of a house." Another argument advanced, and a most important one, is that the substitution of iron and steel for timber railway-sleepers would not only give an enormous impetus to these industries while the substitution was being effected, but would permanently maintain a population of 100,000, or 3 per cent. of the whole population of the country, for renewals.

Leaving special branches of industry, to refer to special forms in which iron and steel are supplied, the President drew attention to *bar-iron* still maintaining its position, because wherever implements are *made* they come sooner or later to the village blacksmith to be *repaired*, and these find steel harder to work, more difficult to weld, and requiring more care to smith; and therefore the original manufacturer has to adopt a material and construction within the compass of the ideas and resources of the rural repairer.

As regards *castings*, an urgent need has long existed for a material which could be cast in a mould, and which should yet have the toughness and tenacity of wrought iron; and steel, exactly supplying this want, has come very generally into use, more particularly as the cost of steel castings has been greatly cheapened latterly by the employment of the Bessemer and Open Hearth processes; still, steel castings are much dearer than iron ones, because the molten metal is dearer, and the higher melting point of steel compared with iron necessitates more costly moulds. But in a majority of cases in which cast iron has hitherto been used, mass and stiffness due thereto, are required, rather than great tenacity and ductility, and there is, therefore, likely to be a simultaneous demand for castings of both steel and iron. Concurrently with steel castings, steel *forgings* have gradually been coming more and more into general use for fine and delicate work, where cost is no consideration, and homogeneity and capacity to harden of the very greatest importance.

Steel has practically no grain, and is as strong in one direction as another; thus it is eminently suitable for such work, and is naturally superseding iron completely. The conclusion of the President on the subject of the employment of iron and steel in the arts is one in which upon full consideration all must agree—viz. that the laws of gradual change, and of the survival of the fittest, apply equally in the arts as in nature, and that in the long run the fittest material will prevail according to the peculiarities and necessities of each particular case.

The first paper read at the meeting was by Mr. J. Ruston, M.P., descriptive of Dunbar and Ruston's steam navvy.

This machine may be described generally as consisting of a strong rectangular wrought-iron frame mounted on wheels. On the back end is placed the engine; at the front end rises a wrought-iron tower carrying the top pivot of a crane jib, the lower pivot resting on girders fixed to the main frame. The jib is of twin construction, being composed of two sides united only at the post and at the outer end or point; between them is a long slot, in which swings an arm of adjustable length, depending from a fulcrum fixed on the upper member of the jib; and at the base of the post is a circular platform, on which a man stands to regulate by means of a hand-wheel the "reach," or length of radius of the arm. The scoop or bucket is fixed at the lower end of the arm, and is raised or lowered by the main chain passing over the extremity of the jib. The whole of the movements are controlled by two men, called the "driver" and the "wheelman." The driver raises the scoop while making its cut, swings it round into position for discharging, and back again afterwards, and lowers it down. The wheelman regulates the depth of the cut, releases the scoop from the face of the bank, and opens the door or bottom for discharging its contents.

Supposing the navvy to be in position, the mode of working is as follows:—The bucket having been lowered till its arm is vertical, the wheelman regulates the length of the arm by means of his hand-wheel, so that the cutting edge of the bucket shall get its proper grip of the soil. The driver throws the main chain-drum into gear, and the scoop is dragged forwards and upwards by the chain, describing a circular arc of about 80 degrees. By the time it reaches the top it is fully loaded, and the driver, throwing the drum out of gear, holds it with a footbrake; at the same instant the wheelman by easing his footbrake allows the bucket to fall back so as to clear itself from the face of the bank. The driver next swings the jib round till the bucket is over the waggon, when the wheelman releases the latch by means of a cord, and the door falling open, the contents instantly drop through. The driver then swings the jib back again, and at the same time lets go the footbrake of the chain drum, thus causing the bucket to descend through a sort of spiral course, until he brings it up sharply by the brake again. The wheelman at the same moment adjusts the fall by means of his brake, so as to lower the bucket to its first position with just the right reach of arm for the next cut. During the fall the door of the bucket closes and latches itself automatically by its own weight; and all is then ready for repeating the operation.

Upwards of a hundred of these machines are now in use, the majority in Great Britain, and the remainder in various parts of the world.

In the discussion of this paper the various speakers testified to the success with which the navvy did its work when excavating materials of various degrees of hardness and toughness.

Mr. John Richardson's paper on recent adaptations of the Robey semi-portable engine was an extension of a paper read in 1873. The engine is erected on a massive wrought-iron foundation plate, to which all the working parts are fixed, together with one of the drum-shaft bearings, and the brackets for carrying the brake-straps and levers. The whole of the strains due to the working of the machinery are contained within the base plate, and are brought, as they should be, near to the position of greatest stability—namely, the ground line; while the boiler is set free from all mechanical strain, and is left to its legitimate purpose of making steam. A specially light engine has been designed for use in countries where there is little facility for transport, wrought iron and steel have been substituted as far as possible for cast iron, with the result of a large saving in dead weight and consequent saving in cost of transport.

A paper on private installations of electric lighting, by Mr. Ralph Neville, is interesting as descriptive of an application in which existing engine power was utilised and modifications made in the governing of the engine to suit the purpose of driving a dynamo machine, in which, as is well known, the action on the engine has to be prompt, the electric lamps acting as visible instantaneous galvanometers. The dynamo employed was a Siemens S 9, the lamps being mostly 100 volt 20 candle-power of Edison and Swan make. The current generated is led from the dynamo to a set of switches, by which it can be distributed into five separate circuits, the first exciting the field magnets of the dynamo itself and the others furnishing current for lights in various parts. Certain points are taken as lighting centres, and the electromotive force between them is kept constant; for this purpose small wires are connected with the mains at the required points, and the current to actuate the governor is taken off there, instead of direct from the terminals of the dynamo. The original governor attached to the engine was found to have so great an inertia that its position would remain the same for a very considerable variation of speed, so the author set up an electrical governor.

The regulating part of this governor consists of a double solenoid magnet, placed vertically and wound with insulated copper wire, within which works a double core; and to the cross-piece at the bottom of the cores is linked the long arm of a lever, the short arm of which presses upon the spindle of a double-beat Cornish valve that controls the admission of the steam to the steam-chest. For incandescent lighting in parallel, the wire on bobbins is placed in shunt circuit between the main leads; and the size of wire used is adjusted according to the electromotive force which it is desired to maintain between the mains, so that when the electromotive force is at the right point the cores are suspended within the solenoids by their attraction. Inasmuch as the resistance of the solenoids is fixed, any increase in electromotive force causes an increased current to flow through them, whereby the cores are immediately attracted with an increased force, and are caused to move upwards, thereby acting through the lever to close the valve until the electromotive force has been brought down again to its normal amount. The required movement of the valve is exceedingly small; and this method appears to be the best suited for electric lighting. An automatic expansion-gear, on which the governor might be caused to act, has the disadvantage that, when but few lights are burning, the steam is cut off at so early a period of the stroke that, unless the fly-wheel is exceedingly heavy, a fluctuation occurs in the the light during the revolution of the fly-wheel. In an engine where economy of coal has to be considered. probably the best way would be to have an expansion-gear actuated by hand, which can be set approximately to the expansion required leaving the throttle-value to regulate the speed finally. But where perfect steadiness is desired it is probably better not to cut off much before half stroke, especially if a single-cylinder engine is used. The use of accumulators as regulators would of course prevent a great deal of the fluctuation, and would permit of the steam being cut off much earlier without causing any apparent unsteadiness in the light.

The electric governor was fixed on the engine and worked for the first time on January 13 last. The improvement was remarkable, the lights remaining steady, without the sudden alternations of brightness and dulness which had occurred before. But it was still found that with any considerable variation of boiler pressure or of load the electromotive force in the mains varied more than was thought conducive to long life in the lamps. As however it was found that, by augmenting or diminishing the weight suspended from the core bars, the electromotive force could be brought back to its normal amount, it occurred to the author to fix an upright cylinder in direct communication with the boiler, and to make its piston-rod press upwards on the core-bars: the diameter of the cylinder being experimentally determined by observing the weight necessary to be added or removed for certain variations in boiler pressure. This arrangement caused a very great improvement; and when the load was approximately the same it maintained the electromotive force constant under very considerable variation of steam pressure. When, however, the load was varied very considerably, say from one lamp to a hundred, it was found that more variation took place in the electromotive force than was desirable.

The arrangement was accordingly modified by causing the piston-rod to act upon a lever, and by introducing a second cylinder supplied with steam from the steam-chest, the second piston-rod acting not upon the same lever but upon the other side of the fulcrum. The end of the lever was furnished with a steel knife-edge, bearing against another knife-edge set at right angles to it upon the prolongation of the core-bars. The cylinders were also both of them made larger, and were placed so that they could either of them be moved nearer to or further from the fulcrum of the lever, whereby the resultant effect of their differential power could be easily adjusted. This arrangement answered very well indeed, and it was found that the lights could be varied from 1 to 100 and the boiler pressure from 30 lbs. to 60 lbs. with but very slight variation of electromotive force in the mains: provided of course there was sufficient steam to do the work required. It is also quite easy to cause the electromotive force to rise as the load on the engine increases—or in other words as more current passes through the main—by simply giving greater leverage to the piston connected with the steam-chest. In fact with this arrangement the electromotive force can be maintained practically constant, or can be made to vary in any desired manner with variations of steam pressure or of load.

Several experiments were made by Mr. Richardson and the author on the action of this regulator, the results of which were as follows:—When the load on the engine was allowed to remain constant, with only one lamp alight, it was found that while the steam pressure was allowed to vary between 31 lbs. and 55 lbs., the electromotive force remained constant at 90 volts. Afterwards, with the same extent of variation in steam pressure, and with the load also varying from 1 lamp to 91 lamps, the electromotive force varied only 2 volts—from 91 volts to 93 volts. The introduction of this governor has, in the author's opinion, contributed very largely to the duration of the lamps also. The discussion of this paper, which was very full, was mainly upon the governor described and the governing of engines for electric work, the necessity of an electric governor being maintained on the one side, whilst on the other it was held that all that was required was an ordinary mechanical governor of great sensibility.

The Rev. E. Venables, at the conclusion of the discussion, invited electrical engineers to advise the Cathedral authorities, as they should like to see, as a practical result of the visit of the Institution of Mechanical Engineers to Lincoln, the lighting of Lincoln Cathedral by electricity.

A VOLTAIC CELL WITH A SOLID ELECTROLYTE

I BELIEVE that there has never hitherto been made a voltaic cell with a solid electrolyte which was capable of generating the smallest sensible current—at least at ordinary temperatures. Sir William Thomson found that when warm glass was placed between plates of zinc and copper, the existence of an electromotive force was indicated by an electrometer in connection with the metals, and Profs. Ayrton and Perry extended the observation to the cases of paraffin-wax, gutta-percha, indiarubber, and shellac. But it is needless to say that with electrolytes of such enormous resistance no current could be generated of sufficient strength to be detected by any galvanometer, however delicate.

On June 27 I exhibited to the Physical Society a little cell consisting of plates of silver and copper, between which was contained a mixture of 1 part of copper-sulphide with 5 of sulphur. When this cell was connected with a reflecting galvanometer it produced a current by which the spot of light was at once deflected off the scale, copper being the positive pole. The electromotive force was found to be ·07 volt, and the internal resistance 6537 ohms. The current, therefore, though far more than merely sensible, was small. Attempts were made to reduce the internal resistance by diminishing the proportion of sulphur contained in the mixture, but it appeared that as the sulphur was diminished the electromotive force was also diminished, until, when there was no free sulphur at all, the cell failed to produce the smallest measurable current.

It occurred to me that the sulphur owed its efficacy to the fact that it formed a film of silver sulphide upon the surface of the silver plate by direct combination. I therefore made a cell thus:—A thin layer of copper sulphide was spread upon a copper plate and compressed into a compact mass against a surface of polished steel. A layer of silver sulphide was then spread upon the copper sulphide, and the cell was completed by pressing a silver plate upon the silver sulphide. The current which this cell produced through the shunted galvanometer was considerably stronger than that generated by the cell first described; but still the result was not quite satisfactory, and there seemed to be indications of short-circuiting, which I thought might possibly be due to the penetration of particles of copper sulphide through the layer of silver sulphide. The silver plate was therefore removed from the cell, and, having been brushed over with a weak solution of sulphur in bisulphide of carbon, it was heated over a gas flame, and soon became covered with a uniform and continuous coating of sulphide. The heating was continued until all the free sulphur was evaporated. When the cell was reconstructed with this prepared plate it produced a current of 6800 micro-amperes through an external resistance of ·2 ohm, and was able to deflect the pivoted needle of an ordinary coarse galvanometer.

The dimensions of the cell are as follows:—The copper and silver plates measure $2\frac{1}{2}$ inches by 2 inches; the thickness of the two layers of sulphide (strongly compressed) is about 1-20th inch; the E.M.F. is ·053 volt, and the internal resistance is therefore about 7 ohms.

This cell seems to be exactly analogous in its action to a Daniell cell in which plates of copper and zinc are immersed in solutions of copper sulphate and zinc sulphate. Silver is probably the best (or only) possible metal for the positive plate, but some other metal might perhaps be substituted for the copper with advantage.

SHELFORD BIDWELL

FORMOSAN ETHNOLOGY

RECENT political events in the East have directed public attention in Europe, more especially in France, to the large and important island of Formosa. They have shown how scanty our knowledge really is of everything relating to an island which has been known to Europeans for about three centuries, which has been actually held by an European power for twenty years, and in which for about a quarter of a century there have been three ports opened to the trade of the world. Such knowledge as we possess is derived from the works of Dutch writers of the commencement of the seventeenth century, and from fugitive papers published by one or two learned societies in Europe and the East, and especially by journals and magazines in various parts of the Far East, the names of which are hardly known beyond a limited circle of special students, some of them being extinct for years. This paucity of information regarding one of the most important islands in the world, which, moreover, lies in the fair way of a considerable portion of the trade of the world, is not due to lack of inquirers or of zeal, but to physical and ethnological obstacles in the way of research which will appear presently. Such information as could be obtained from the sources here indicated with regard to the ethnology of Formosa has been collected by M. Girard de Rialle, and arranged in two articles contributed to the latest numbers of the *Revue d'Anthropologie* (January and April, 1885). The value of these articles, besides collecting and sifting much scattered information not readily accessible, or accessible at all except in the most comprehensive national libraries, is that they contain a sound working theory on one of the perplexing problems of modern ethnology, viz. the origin of certain little-known tribes inhabiting for the most part the recesses of the chain of mountains running from north to south, but nearer to the east than the west coast of Formosa, and generally known as the Formosan aborigines.

Broadly, the population of Formosa may be divided into three classes—the immigrants from China, aborigines who have submitted to Chinese rule, and the independent tribes. It would be useless to attempt to decide which of the estimates of the number of the population is most likely to be correct, for they vary between ten millions and 300,000 souls. The Chinese immigrants may soon be dismissed. They come mostly from Canton and from the neighbouring province of Fokhien. They include amongst them large numbers of Hakkas, a people who are themselves the subject of an interesting ethnological question, which, however, we cannot discuss here beyond saying that by some students they are regarded as the representatives of pure-blooded Chinese who inhabited portions of the valley of the Yellow River before the dawn of history, while others speak of them as of Malay origin. The division of the aborigines into subjugated and free is obviously of no value for ethnological purposes, although it is convenient in certain cases. Two points which may perplex the discussion of the question can be cleared away at once. The aborigines have undoubtedly been head-hunters, like the Dyaks of Borneo and the Igorrotos of Luzon, but there is no modern authority in support of the charge of cannibalism made against them by Chinese writers, especially by Ma-twan-lin in his "Encyclopædia." M. de Rialle thinks that the allegation might have been correct at an earlier period, inasmuch as the practice is known among the Battaks of Sumatra, as well as in Borneo and the Celebes. But no traces of it have appeared recently in Formosa. Another difficulty has been raised by the statement of the early Dutch writers that there is a pure black race in Formosa, of great stature, inhabiting the mountains and speaking a different language to the rest of the inhabitants. This would apparently refer to Papuans, and M. de Rialle asks whether perhaps here, as in the Philippines, we may not perceive the existence of an old autochtonous race, or at any rate one so ancient that it may well be considered such. There would be nothing surprising in this, for in the Indian Archipelago an ethnic substratum of Papuans and Negritos has been discovered. But the statement has not been confirmed by modern explorers, some of whom have travelled through the island in order to settle the question. Neither the Chinese nor the natives have ever heard of this black race, and it is possible that a very dark tribe in the south were so called by the Dutch. But M. Paul Ibis, in his "Promenades Ethnographiques," thinks that when the Malays invaded Formosa it is not impossible they found a black race there, which they exterminated or absorbed, and other ethnologists have a theory that there was once an epoch of pure Negritos in the island. However this may be, there is now no trace of the tall black race of the Dutch writers of two hundred years ago.

The Chinese divide the aborigines of Formosa into three classes—the *Pepo-hoan*, or "barbarians of the plains," the *Sek-hoan*, or "ripe barbarians," and the *Chin-hoan*, or "green barbarians." The island, as already noticed, is divided into two unequal parts by a lofty range of mountains. On the western side, which is the nearer to China, and consequently that peopled by Chinese immigrants, the country consists for the most part of large and fertile plains. The aborigines were gradually driven back from the coast by the immigration from the mainland, and pressed towards the mountains. In course of time a considerable number submitted peacefully to the Chinese authorities and became civilised, or rather sinicised. These are the Pepo-hoan of the Chinese. They live on the plains and smaller hills bordering on the mountains. Here they form large villages surrounded by rich sub-tropical vegetation. In some places near the Chinese settlements they have adopted the language and habits of the conquerors, but they have preserved their ancient culture. They are fetish-worshippers. One traveller found in one of their houses a stake on which was placed the skull of a deer adorned with garlands of flowers and herbs. This he was told was the female fetish; the male, which was by its side, was simply composed of bamboos interlaced like a cradle. A jar of pure water below appeared to be the only offering made to the divine group at the moment. The women have charge of the fetishes. Dancing appears to be associated amongst them with religious ideas and rites, and from the description of their dances they appear similar to those of the Polynesians and Micronesians. M. Paul Ibis, who was present at one of these *fêtes*, states that young women, when dressed for it, presented the closest resemblance to Tagal women. In spite of the name "barbarians" given them by the Chinese, they are no less civilised than the peasants of the Celestial Empire; they are for the most part devoted to agriculture. In some places they act as intermediaries between the independent tribes and the Chinese, conveying the forest products of the former to the coast and obtaining Chinese goods in exchange. Their great stature has been noticed by all Europeans who have seen them. The hair is dressed amongst the men by being oiled and rolled around the head, and then covered with a large turban of coloured stuff. The women twist their hair into a large mat, interlaced spirally with a red ribbon. This is wound round the head, and appears above the forehead like a kind of natural diadem. The Pepo-Hoan, who have been least influenced by the Chinese, and who have preserved their ancient customs and dress, inhabit districts in the centre of the southern half of Formosa, especially in the valley of the Lakoli River, which, flowing almost due south, enters the sea at the harbour of Tan-Kiang. The Sek-hoan, the second of the Chinese divisions of the aborigines, inhabit part of the centre of the northern half of the island, as the

Pepo-hoan do the southern half. The Sek-hoan settlements are mainly in the neighbourhood of Chang-hua, slightly to the north of the 24th parallel, and in the hilly districts dividing the mountains from the plains in the west. They appear to have fully accepted the Chinese yoke, and even the village headmen are appointed by the Chinese authorities. These tribes are absolutely sedentary, and devote themselves wholly to the cultivation of rice, sugar-cane, and indigo, which they have learnt from the Chinese. They have adopted the dress and habits of their masters; they shave the top of the head and wear long queues. The women also dress like the Chinese, but they do not deform the feet. The type of these Sek-hoan appeared quite distinct from that of other Formosans to two travellers, Mr. Bullock and M. Ibis. The former describes them as tall, but feeble, with a comparatively clear skin, large bright eyes, the mouth extremely large, with thick lips, a projecting upper jaw, and teeth long and prominent. The lower part of the face is as ugly as the upper part is prepossessing. But although they bear little resemblance to the aborigines, they have still less to the Chinese and Loochooans, the only peoples amongst whom we should seek for their origin, if they are of different blood from the other Formosans. M. Ibis states that the Sek-hoan present a contrast to the Malay type in the case of the males, although a resemblance may be found among the females. He attributes their anthropological peculiarities to mixture with the Dutch two and a half centuries ago. He states that there are still old Dutch books and documents amongst them, and that the method of cultivating tobacco (which they call *tamako*, and not by a Chinese name) is similar to that of the Batavian colonies. In the extreme north, around Tamsui and Keelung, there are also groups of Sek-hoan. Driven from the coast by the Chinese, and prevented by the savage tribes in the mountains from penetrating into the interior, these have been almost exterminated. The remnants live in scattered communities among the sandy downs or in the rocky islets off the coast. M. Ibis visited one of their villages on a small island in Keelung Bay, where he found them in great destitution, but bearing evident resemblances to the Sek-hoan further south. He also noticed the Caucasian features, which they got from the connection between their ancestors and the Dutch and Spaniards of the seventeenth century. Around Tamsui the Sek-hoan are rapidly becoming extinct; absorption into the Chinese, and opium, alcohol, and small-pox will soon do their work. Many of their most prominent features are Malay, but the form of the skull is quite different, if we may rely on two specimens brought to Europe in 1868. Dr. Schetelig found the cephalic index of the living males to average 77, of the females 76; but, on the other hand, there were the Malay physiognomy and the language of these Sek-hoan to render difficult their ethnological classification. On his return to London, however, Dr. Schetelig saw the collection of Polynesian and New Zealand skulls in the Museum of the College of Surgeons, and he found amongst these remarkable analogies with the skulls collected by him in the north of Formosa. On the north-east coast, at Suwo Bay and the neighbourhood, there are other subjugated tribes called Kabaran, Sui-hoan, and the like. They are all of the Malay type, and appear to be rapidly disappearing through contact with the Chinese.

The whole mountainous region from the north to the extreme south, forming nearly the eastern half of Formosa, is inhabited by aborigines who have accepted neither the yoke nor civilisation of the Chinese. These are called the *Chin-hoan*, or "green, unripe barbarians," in contradistinction to the *Sek-hoan*, or "ripe barbarians." These live in a state of perpetual war with the Chinese, and it is alleged that the latter brought tigers to Formosa and set them loose in order that they should prey on their enemies; the latter, however, succeeded in exterminating them. They are determined head-hunters, the young warrior commencing his career by securing a certain number of Chinese heads. Under these circumstances it is not surprising that our knowledge of these tribes should be exceedingly limited. A Spanish priest visited some of them in 1875-6, and they have been occasionally visited by Europeans who have touched on the east coast. They are represented as like the Malays, but much fairer in colour than even the Chinese. More, however, is known of the tribes in the extreme south than of those on the east coast or in the mountains. They have been heard of in Europe chiefly by their various murders of shipwrecked seamen.

The various tribes are known as Kalis, Bhotans, Koaluts, &c., and their districts have been frequently visited by European officials desirous of obtaining from them some assurance of better treatment for mariners thrown on their coast. The late Mr. Swinhoe, who visited them for this purpose, states that some of them approached the Mongol type, while in others there was an enormous development of the lower jaw. After new observations he described them as resembling the Tagals of Luzon. In 1874 the massacre of the crew of a Loochooan junk by the tribes led to a powerful Japanese expedition being despatched for their chastisement. The Kalis and Bhotans suffered so severely that their subsequent subjugation by the Chinese was rendered easy, and the Chinese Customs established a station and lighthouse on the south cape. An account of the expedition despatched to arrange this latter enterprise was read before the Royal Geographical Society in January last by Mr. Beazeley, the engineer employed in the work. Soon after the Japanese expedition M. Paul Ibis visited the south of Formosa, and has described nine separate tribes differing in linguistic and anthropological details. He thinks their dialects are connected with the Tagal language; seven of the nine had little physical resemblance to the members of the other two. Several other tribes have been described by other travellers, and in most cases they are marked by important peculiarities. It would be impossible, even if it were likely to serve any useful purpose, to go into details of the habits of each of these. All that is necessary for our present purpose is to note that there certainly are numerous distinct tribes amongst these independent aborigines, and that in describing them various travellers refer constantly to their resemblance to Malays, Igorrotos, Tagals, Soolooans, Dyaks, and other peoples of the Malay Archipelago. The reader will therefore be prepared for M. de Rialle's conclusion that these aborigines belong to the great ethnic family known as Malayo-Polynesian. MM. Quatrefages and Hamy speak of them in the "Crania Ethnica" as "analogous to the Acheenese, Lampongs, and Eastern Sundanis. They are Indonesians, closely allied to Polynesians." But there are ancient mixtures with other anthropological elements. Whether these took place in regions from which the ancient immigrants came, or in Formosa itself, will probably never be known positively. The peopling of Formosa is probably due to successive invasions, doubtless far removed from each other in point of time, by Malayo-Polynesians, and this, M. de Rialle believes, is sufficiently proved by the great differences which, notwithstanding their common anthropological origin, have been observed by travellers amongst the various mountain tribes in the island. Whether a comparative study of the Formosan dialects with those of the Philippines, Borneo, the Celebes and other parts of the Malay Archipelago, will carry the solution of the problem any farther than this remains to be seen; but there appears no immediate prospect of any student being able to study the independent tribes of Formosa. They are as remote from us, for any purpose of accurate investigation, as ever they were, and far more remote than they were from the Dutch and Spaniards nearly three centuries ago.

THE AURORA[1]

II.

WE next come to the 11-year period. On this the following pertinent remarks are made:—

"It will be perfectly clear that it is chiefly observations from the Temperate Zone which have constituted the material for demonstrating the eleven-year period But as regards the Polar regions, it has been assumed that either the Aurora Borealis also follows the same laws in these parts, or that it appears with the same force and same manner all the year round. Neither of these alternatives seem, however, to be right, as a series of observations prosecuted with great care during fifteen years at Godthaab, in Greenland, have brought me to the somewhat remarkable conclusion that, as regards the varying frequency of the Aurora Borealis at Godthaab, *the law seems to be the reverse of that ruling in southern latitudes.*

"These researches, which were effected by Mr. S. Kleinschmidt, extend over a period from August 1865 to May 1880. The number of days with auroræ in the year, reckoned from August to May, were:—

1865-66	66-67	67-68	68-69	69-70	70-71	71-72	72-73	73-74
97	112	65	84	45	61	32	47	73

1874-75	75-76	76-77	77-78	78-79	79-80
97	97	104	69	100	75

"This series cannot, however, be accepted as giving the *exact* view of the relation between the varying frequency of the auroræ, because the state of the clouds would exercise a great influence on the visibility of auroræ. If thus the clouds vary greatly from one year to another, this circumstance would greatly reduce the number of auroræ. A closer study of the nebulous conditions at Godthaab, compared with the frequency of the auroræ, has caused me to consider that the number of auroræ decrease in proportion as the clouds increase in quantity. The above-recorded auroral totals must, therefore, be reduced to the same cloud unit, *i.e.* it must be calculated how great the number would have been had the nebulosity been the same every year. By this we obtain the values given under N. Under S. is given the relation between the sun-spots in the same year (July to June).

	1865-66	66-67	67-68	68-69	69-70	70-71	71-72	72-73
N.	86·2	91·3	67·4	80·9	51·7	56·5	32·0	46·0
S.	23·5	6·1	18·3	60·1	107·0	133·5	98·6	89·4

	1873-74	74-75	75-76	76-77	77-78	78-79	79-80
N.	78·4	97·0	95·0	102·0	73·0	85·2	83·3
S.	51·7	32·1	11·6	13·5	6·8	2·2	16·3

"If the two series be compared it will be found that *the law of relation between the frequency of sun-spots and auroræ is reversed.* This fact will be still more apparent from Fig. 4, where both series of auroræ and sun-spots are shown graphically.

"The few series of observations which we possess from other Polar regions, and which I have been able to analyse, indicate, though incomplete, similar conditions.

"As the greater part of the Godthaab observations were made in the morning, I have not only used the auroral days for my researches—reckoned from noon to noon—but also examined evening and morning auroræ separately. The evening and morning auroræ lead, as regards the eleven-year period, to the same conclusion as the auroral days, *i.e.* that *the Aurora Borealis is scarcest under sunspot maxima.*" . . .

"If we consider the relation between zenith and southern auroræ in the various years of the Godthaab researches, we obtain the interesting result that the percentages of zenith auroræ in the main follow those of the auroral frequencies, *i.e., that at the periods of maxima at Godthaab, the auroræ which fall in the zenith of this place or further north, are not only absolutely, but also relatively, more frequent than at the periods of minima.* And what deduction may be drawn from this? The deduction *that the auroral zone in the course of the eleven-year period makes a movement too, of such a nature that it lies further north when the sun-spots are in their minimum than in their maximum period.*

"If this result be compared with what I have already propounded as to the eleven-year period in the Arctic regions, the interesting explanation will be obtained of the phenomenon, that this period in Greenland and similarly-situated places shows a reverse course to that in more southern regions. *The auroral maximum, occurring in the temperate regions simultaneously with the sun-spot maximum, is due to the auroral zone being then in its southernmost position, which again causes an auroral minimum in the polar regions, and, in a reverse manner, the auroral zone has its northernmost position when the sun-spots are in the minimum, which then causes an auroral minimum in the temperate regions and a maximum one in those around the Pole.*"

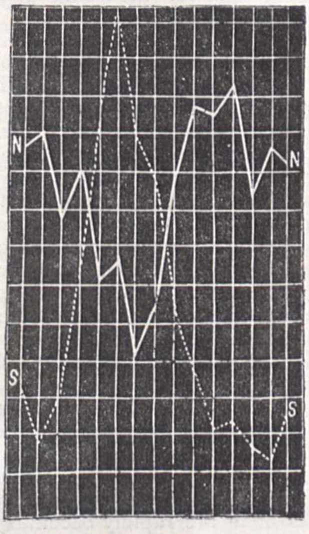


FIG. 4.—Comparison of auroral frequencies at Godthaab with sun-spots. N = Northern light frequencies; S = Spot frequencies.

These very beautiful results will show that there can be very little doubt about the movement of the auroral zone as a whole.

The next point on which much light is thrown by Mr. Tromholt's work is that the various appearances are in the main due to movements bringing auroral striæ in different relation to the spectator:—

"In one respect in particular my sojourn at Koutokæino was very instructive—viz. with regard to the understanding of the true shape and position, and the changes to which the aurora is apparently subjected when altering its elevation above the horizon. Partly through the frequency of the aurora, and partly by its appearance now in the north, now in the south, and now in the zenith, there were excellent opportunities of studying the modifications which the form suffered as it changed its position in relation to the observer.

"From this I came to the conclusion that the great many different forms referred to might certainly be reduced to a few fundamental ones. In most instances the aurora forms belts or zones, which stretch across the earth in the direction of the magnetic east-west, which zones are formed by a conglomeration of thin sheets of luminous matter ranged one behind the other, their direction being

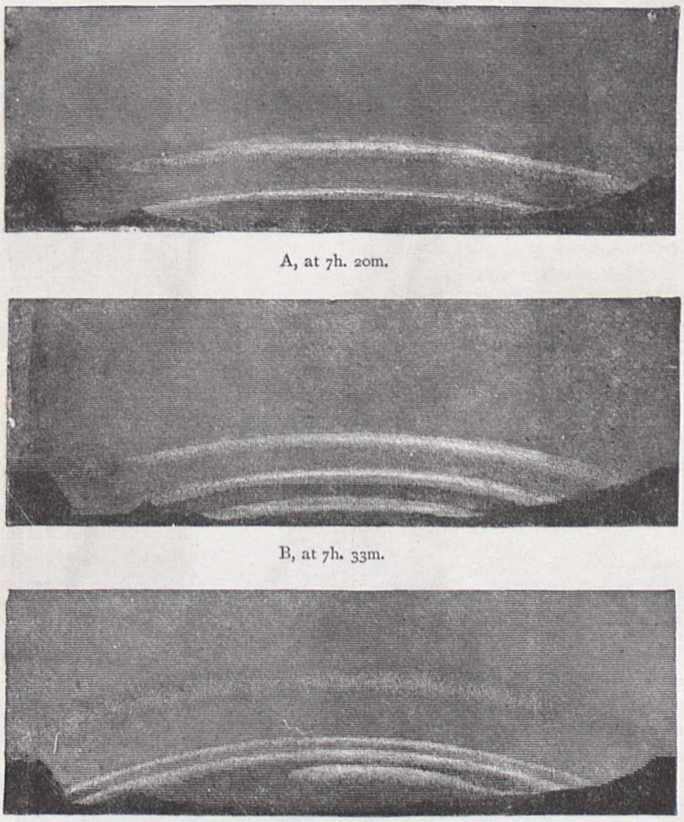
[1] "Under the Rays of the Aurora Borealis." By S. Tromholt. Edited by Carl Siewers. (London: Sampson Low and Co., 1885.) Continued from p. 276.

parallel with the inclination needle. The luminous matter in these sheets is either even, diffuse, or divided into streamers.

"Everything now depends on the position of the observer in relation to such a zone in order that it may appear in one form or the other. If he be very far from the aurora he will see an arc, diffuse or radiating, according to the nature of the luminous matter. If he approaches he will most probably see several distinct arcs, the phenomenon gathering more force and the colours more life; and when still nearer, the aurora will appear as a band, and, if the luminous matter be radiating and passes the magnetic zenith of the observer, he will behold the auroral corona."

He thus holds that a "band" is a near arc occupying a higher position in the sky:—

"The auroral band is oftenest seen in those parts of the globe which are considered to be the true home of the Aurora Borealis, but seldom, or hardly ever, in southern latitudes. What is chiefly characteristic of the band in opposition to the arc, although no sharp line of distinction can be drawn here either, is its great height above the horizon, but at what elevation it ceases to be band and becomes arc is naturally an arbitrary determination. The band, as well as the arc, may consist of equi-luminous matter, of streamers, and of so-called luminous clouds, and it is, to a higher degree than is the case with the arc, subject to the most violent changes of position, form, and motion. Particularly when the band consists of streamers it displays the richest variations and greatest beauty, the folds of the streaming drapery, the prismatic play of colour, and the light-waves, which with marvellous rapidity course through the graceful undulating rays, forming a spectacle of light, colour, and form which makes this variety of the Aurora Borealis the most charming of all.



A, at 7h. 20m.

B, at 7h. 33m.

C, at 8h. 10m.

FIG. 5.—Phases of an auroral arc, December 1, 1878.

"The perspective fundamental form of the arc, and also the band, may, in my opinion, be explained by the aurora forming one or several rings, or fragments of such, which, with the magnetic pole as centre, or, more correctly, with a point in the magnetic axis of the earth—viz. the straight line between the two magnetic poles—lie at a certain height above the earth's surface. On account of the great circumference of the earth, in proportion to the height of the aurora, only a small portion of such a ring would be visible at one time, and each observer only see his own portion, the situation of which in relation to *his* horizon and the zenith will depend on *his* position in relation to the auroral ring."

The auroral streamers are closely associated both with arcs and bands, an arc or band composed of streamers often forming the basis for a colonnade of streamers.

Before we proceed to the consideration of the corona, the following extracts concerning streamers and their apparent motions will be read with interest:—

"The streamers embrace a number of varieties, which have only one peculiarity in common—viz. that the direction is very nearly vertical, and that the length is always greater than the width. The length differs greatly, from 2° and 3° to 30° and 40° or more. The width is very difficult to estimate, on account of the constant motion; a single streamer thus may form only a slender thread of light, while others may have a width of from 10′ to 1°, or more. Short streamers form often, as I have mentioned above, bands or arcs. The long streamers gather generally in bunches, which may either remain isolated, or particularly when the aurora has previously formed an arc, stand parallel, in such a manner that the lower, intensest, ends nearly follow the track of the former arc. Bunches of streamers, standing high in the sky, are often fan-shaped, the broadest part pointing downwards. The intensest streamers have very clearly defined edges, but from these there are all sorts of variations down to the streak of light hardly visible. At the side of, and between very intense and defined streamers, the sky seems, by the contrast, unusually dark, and this may, perhaps, explain the *black* streamers which some observers claim to have seen.

Fig 6.—Aurora (Koutokæino).

Fig. 7.—Streamers (Koutokæino).

Fig. 8.—Bands and streamers (Koutokæino).

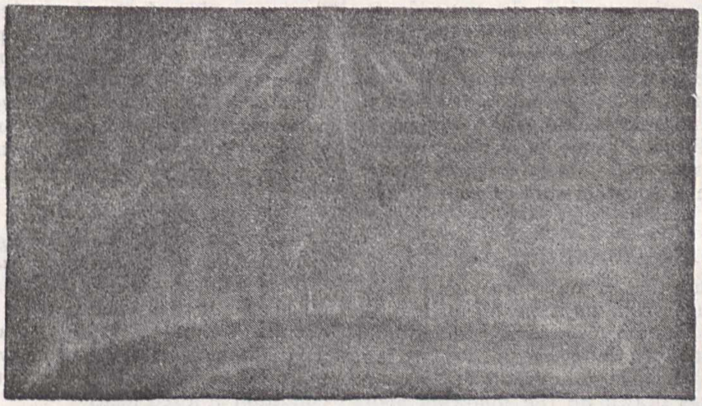
"The points of the streamers are usually faint and with no sharp line of demarcation. The stars shine through the streamers as through all other forms of the aurora, and it may, indeed, be a matter of doubt whether the strength of light of the aurora is ever great enough to outshine a bright star." . . .

"The motion of the streamers is twofold. First, longitudinally, as they strike upwards or downwards; and secondly, laterally, as they travel parallel either to the left or right. Sometimes this motion is slow, sometimes very quick, and particularly in the latter case the observer obtains the impression that the colonnade of streamers is furrowed transversely by waves of energy following in rapid succession, under the influence of which the streamers momentarily flare up. If this be the case, or the streamers really move, it is impossible to tell.

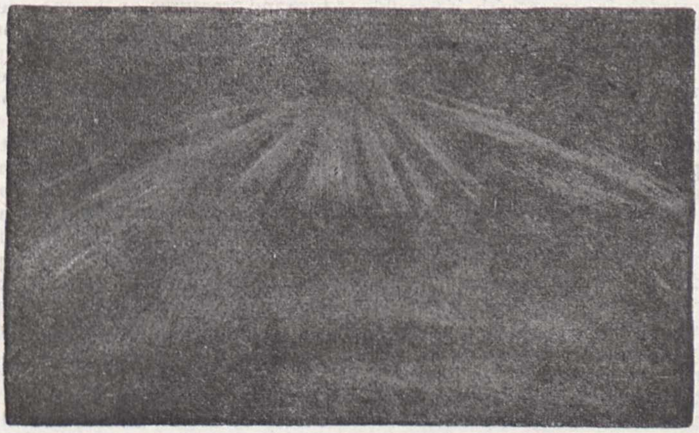
"The longitudinal course of the streamers is not apparently only, but in reality, very nearly vertical, as several facts prove that they point in the same direction as the magnetic inclination needle." . . . "In regions near the magnetic pole, where the magnetic inclination is greater, the streamers stand more perpendicularly than in more southern latitudes, where they form a smaller angle with the surface of the earth.

"Some students, as, for instance, Baron Nordenskjöld, have advanced the theory that the streamers do not occupy this position, but lie more parallel with the earth; and, indeed, when observing an apparently perpendicular streamer in the north, it may in reality form any angle with the horizon, and still seem to the eye to stand perpendicular. But from various circumstances it is clear that the direction of the streamers is, as I have stated above—viz. parallel with the inclination needle. This is, in fact, demonstrated not only by the streamers high in the sky, which form the upper part of the corona, but also by those which, under intense auroræ, stand either in the east or west, and which are then seen '*from the side*,' so to speak, *i.e.* they stand very nearly perpendicularly, as indicated to all appearances by the streamers seen to the north '*in front*.'"

The auroral *corona*, the grandest sight of all, is found at the instant a band or broken band forming a colonnade



A



B

FIG. 9.—Coronas (Koutokæino).

of streamers reaches the magnetic zenith in its progress from the north:—

"Quick as lightning streamers break forth at the same moment on the southern side of the magnetic zenith, and as the aurora travels further and further southwards, the corona becomes more and more complete. In northern regions, where the aurora frequently appears high in the sky, in a northerly or southerly direction, there is often an opportunity of seeing this form of the phenomenon, when a band of streamers passes the magnetic zenith in its course north or southwards. It is, however, not always that the aurora's passing of the zenith has the effect of producing the corona; it is seldom the case when a band constituted of diffuse luminous matter passes this point. It is, in fact, the streamers which create the corona." . . .

"If it be borne in mind that the course of the auroral streamers is identical with that of the magnetic inclination needle, it is easy to perceive the origin of the ordinary radiating aurora as well as the corona." . . .

"This form of the Aurora Borealis, which generally indicates, at all events in southern latitudes, the culmination of the aurora as regards splendour, colour, and development, is produced by the streamers shooting from every part of the sky towards a common point—viz. the magnetic zenith. With this point as centre they seem to radiate in every direction; some are very long, others short, while some form rays or bands one above the other. The heaven thereby assumes the appearance of a huge cupola, or tent of fire. In reality the streamers are all parallel; their appearance of radiating in all directions from a central point with various angles being due to perspective causes—viz. by the points of the streamers being further distant than the bases. It is the same perspective peculiarity which causes the lamps in a street or the trees in an avenue to appear to meet in the distance.

"The centre of the corona is sometimes dark—that is to say, the sky is seen between the streamers, at other times the central part is filled with luminous matter.

"It is not only the streamers which contribute to form the corona; on the contrary, all the forms of the aurora lend their beauty to produce this magnificent display. If to this is added that the Aurora Borealis in such moments develops its greatest strength, richest colour, and most intense light, it will be understood that the corona is that form of the phenomenon which possesses the greatest magnificence and most striking beauty."

With regard to the height of the aurora, a preliminary examination of the observations made in the plane Koutokæino-Bossekop gives from 50 to 100 miles, an average of 18 measurements giving 70·2 miles or 113 kilometres.

From this long article on auroræ, the reader must not think that our author is exclusively occupied with them. His two volumes are admirable examples of what books of travel should be, and it falls to the lot of few travellers to have such an interesting region to explore, or to have such an important piece of scientific work to accomplish.

THE BRITISH ASSOCIATION

OUR readers are aware that at the approaching meeting of the British Association it has been arranged to have discussions in Section A on kinetic theories of gases and on standards of white light. Prof. Crum Brown has consented to open the discussion on the kinetic theories, and has drawn up the following short abstract of points to which he proposes to allude. It would be convenient if persons desiring to take part in the discussion would forward their names, with, if possible, a short abstract, to the recorder, Prof. W. M. Hicks, Firth College, Sheffield.

Difficulties connected with the Dynamical Theory of Gases.—Prof. Crum Brown.

The Dynamical Theory of Gases appears at first sight to furnish a very complete explanation of all the properties of gases, both physical and chemical. When, however, we come to details, difficulties and apparent contradictions make their appearance. These difficulties have been pointed out from time to time, and some attempts have been made to show that they are not really fatal to the theory as usually stated; but it may be useful that some of them should be brought at this time before the section and regularly discussed.

I shall here merely mention some of these difficulties, as the explanations which have been given of them will be better supplied by others in the discussion.

1. *The difficulties connected with the doctrine, that energy communicated from without to a gas is equally shared among the whole of the degrees of freedom of the molecules.* This leads to a relation between the numbers of degrees of freedom and the ratio of the specific heat at constant pressure to that at constant volume. This ratio is for mercury gas almost exactly 5:3, from which it would appear that the molecules of mercury gas have not more than three degrees of freedom—in other words, that the whole energy of mercury gas is kinetic energy of translation of the molecules. But even if we assume that the molecules of mercury are spheres, perfectly smooth and perfectly rigid, the fact that mercury vapour has a spectrum points to some form of energy of a vibratory kind. Again, the gases, the molecules of which are supposed to consist of two atoms, have the ratio of the specific heats nearly equal to 7:5 (it seems always to be a little greater than this, which increases the difficulty). This points to five degrees of freedom of the molecule, which would be consistent with the hypothesis that these molecules consist of two smooth, undeformable spheres at a constant distance from each other, the five degrees of freedom being three of translation and two of rotation about two axes, any two at right angles to each other and at right angles to the axis of the molecule, that is, the line joining the centres of the two atoms. But here also we have spectra, and in addition the phenomena of dissociation lead to a belief that the firmness of the union of the two atoms diminishes as temperature rises, and it is difficult to reconcile this with a constant distance of the two atoms from one another in the molecule. Any variation in this distance would be a new degree of freedom in addition to the five allowed by the theory.

All attempts to reconcile chemical action and chemical equilibrium with dynamical conceptions seem to require the assumption of vibrations of the atoms in the molecule, under the influence of forces depending on the distances of the atoms from each other, and perhaps in addition to these, vibrations of the atoms as parts of the molecule, vibrations of the atoms themselves. In molecules, even of a comparatively simple kind, such considerations imply many degrees of freedom, certainly far more than the dynamical theory of gases as usually understood will admit.

2. *Difficulties connected with the doctrine that energy of each kind is distributed among the molecules according to some form of the law of probability.*

This implies that in a gas at any temperature there are molecules in the condition as to energy which is the average condition of the gas at any other temperature. That, for instance, at the ordinary atmospheric temperature there are molecules in the condition which is the average condition at a red heat.

This seems inconsistent with what is usually regarded as true, viz., that there are limiting conditions of temperature and pressures, on the one side of which certain chemical changes occur, while they do not occur at all on the other side. Thus at ordinary atmospheric temperatures and pressures, hydrogen and oxygen show no tendency to combine. At a red heat they combine almost completely. At ordinary temperatures phosphorus combines slowly with oxygen if the pressure of the oxygen is below a certain limit (dependent on the temperature), but apparently not at all if the pressure of the oxygen is above that limit. Many other cases might be mentioned, but these may suffice as instances. It is difficult to understand the existence of such definite sharp limits, if the energy is distributed among the molecules according to any asymptotic law. In such a case the rate of chemical action might be expected to diminish, but not to become zero.

I have brought forward these instances of apparent contradiction between the conclusions of the dynamical theory as usually stated, and observed facts in the hope that they may be cleared up. This may conceivably be done in two ways—either by showing that the facts have not been accurately observed, or that the conclusions have not been legitimately drawn from the theory.

NOTES

THE Iron and Steel Institute holds its summer meeting in Glasgow on September 1-5. The programme includes excursions down the Clyde and a visit to the Forth Bridge Works. The following is the list of papers down for reading:—On the iron trade of Scotland, by Mr. F. J. Rowan, Glasgow; on the rise and progress of the Scotch steel trade, by Mr. James Riley, Glasgow, Member of Council; on the present position and prospects of processes for the recovery of tar and ammonia from blast furnaces, by Mr. Wm. Jones, Langloan Ironworks, N.B.; on the structural features and working of the South Chicago blast furnaces, by Mr, F. W. Gordon, Philadelphia, and Mr.

E. C. Potter, Chicago, U.S.A.; on certain accessory products of the blast furnace, by Mr. T. Blair, Wingerworth Ironworks, Derbyshire; on a new form of cupola furnace, by Mr. James Riley, Glasgow; on a new form of pyrometer, by Mr. A. von Bergen, Middleton Ironworks, Darlington; on the ancient and modern methods of manufacturing tin-plates, by Mr. Philip W. Flower, Melyn Tinworks, Neath; on the manufacture of basic steel on the open hearth, by M. Pourcei, Bilbao, Spain; on the Forth Bridge, by Mr. Benjamin Baker, M.I.C.F., London.

THE International Telegraph Conference was opened at Berlin on Monday by Dr. Stephan, German Postmaster-General. No fewer than 33 States and 17 telegraph companies are represented, and about 72 delegates had already assembled to day. Dr. Stephan opened the sitting with an address, in which, in the name of the German Emperor, he bade the delegates welcome, and made some general observations on the rapid development of telegraphic science and communication, as well as on the desirability of placing the advantages of this science still more within the reach of all classes. On the motion of the English delegate, Mr. Patey, Dr. Stephan was elected President of the Conference, which then proceeded to appoint two committees—one for the consideration of tariff questions, the other for matters of technical administration. Dr. Stephan then thanked the Swiss Government for presiding so successfully over the International Telegraph Bureau (of Berne), and the British Government for duties it had undertaken since the last Conference at London (1875). He also adverted to the memory of several deceased members of that Conference, including Sir William Siemens.

AMONG those on whom the degree of LL.D. was conferred at the recent Graduation ceremonial of Edinburgh University are Prof. John Anderson, M.D., F.R.S., Superintendent of the Imperial Indian Museum of Calcutta, Professor of Comparative Anatomy in the Medical College of Calcutta, Fellow of Calcutta University; Dr. Johann Georg Bühler, Ph.D., C.I.E., Professor of Sanskrit in Vienna University; and M. Antoine d'Abbadie, Member of the Institute of France, well known for his writings in geology, astronomy, and Oriental matters.

ON any Tuesday, Thursday, or Saturday, until the end of September, persons of archæological tastes may visit the rooms of the Royal Archæological Institute, Oxford Mansions, near Regent Circus, to see the large and most interesting collection of antiquities which Mr. W. M. Flinders Petrie, working under the auspices of the Egypt Exploration Fund, has discovered at the Nebireh Mound, which is now established to be the site of the famous Greek City of Naucratis, and the cradle of Greek art. The thorough exploration has resulted in laying bare what was the earliest Greek settlement in Egypt, and in bringing to light archæological treasures beyond price. Innumerable objects of purely Greek art, statuettes, terra-cotta figures, painted vases, votive offerings, bronzes, sculptures have been found, together with an immense quantity of pottery in considerable variety. Naucratis was a city of potters, and Athenæus states that her ceramic productions were in great vogue around the shores of the Mediterranean. In the mound which covered the city potsherds were found in well-defined layers of different centuries, susceptible of exact classification, and as such forming an interesting chapter in the history of Greek art. The collection is particularly rich in the archaic variety of white faïence pottery, of which, prior to Mr. Petrie's labours, only three or four pieces were known to exist. He found bowls by the hundred. The connection of Greek pottery with that of Egypt is shown at every step, showing how the one descended by gradual steps from the other. The scarabœi, amulets, pictorial ornaments, deities, tiles, and other articles found in early Greek tombs all around the Mediterranean have been found amid the ruins of Naucratis in the very workshops where they were produced. The sites of several factories were brought to light, each containing many samples of their products. One of these was a Greek manufactory of scarabs for exportation, full of such blunders as foreigners would make in the hieroglyphs. In another part of the city what had evidently been a flourishing iron manufactory was unearthed, where every stage of production was carried on by Greek workmen, for ore, slag, and finished tools have all been found. The tools are principally chisels for working in wood, but there were also an axe, a hoe, a sickle, knives of various kinds, bodkins, and, what is a total novelty in archæological discoveries of this kind, fishhooks. There is satisfactory proof forthcoming that this scene of early Greek iron-working was in full vigour in the sixth century before Christ.

AT the monthly meeting of the Entomological Society of London, held on August 5, J. W. Dunning announced that a Royal Charter of Incorporation had been granted to the Society. It bears date July 20, 1885. The Ethnological Society was founded in 1833.

WE are glad to know that there is now a chance that the teaching of geography, which has been one of the blots of our ordinary English education from the many colleges downwards, will be put upon a proper scientific basis. At present it is usually made a task for the memory rather than an instrument of education. Messrs. Macmillan, in announcing a new series of Geographical Text Books, have the courage to state that "the first principles of geography, however, cannot be effectively taught from books. They must be enforced practically from familiar local illustrations." In a preliminary volume, therefore, the teacher is taught how to lay a solid geographical basis, founded upon the pupil's own personal experience. Throughout the series the fundamental idea will be to present the essential facts in such a way as will show their relationship to each other. The physical features will be connected with the climatology of a country, and both will be shown to affect the distribution of life, while the bearing of all these influences upon human history and commercial progress will be constantly kept in view. The boundaries of parishes and countries, the positions of towns and the diffusion of population, will be linked with their geographical explanation. A knowledge of the topography of a country, and of the local names by which it is expressed, will be shown to be the necessary accompaniment of an adequate knowledge of the history of the inhabitants. In short, it should be a constant aim to represent geography not as a series of numerical tables or a string of disconnected facts, but as a luminous description of the earth and its inhabitants, and of the causes that regulate the contrasts of scenery, climate, and life. Messrs. Macmillan have placed the editorship of the series in the hands of Mr. Archibald Geikie, F.R.S., Director-General of the Geological Survey of the United Kingdom, and have already secured the co-operation of Mr. H. W. Bates, F.R.S., Mr. Clements R. Markham, C.B., F.R.S., Mr. John Murray, Ph.D., F.R.S.E., Mr. E. B. Tylor, D.C.L., F.R.S., Mr. A. R. Wallace, LL.D., F.R.G.S., Rev. Edmond Warre, D.D., Head Master of Eton, Rev. J. E. C. Welldon, M.A., Head Master of Harrow, and others.

IT has been decided to withhold from publication the Report of Drs. Klein and Gibbes upon Dr. Koch's discoveries in relation to the germ theory of cholera, until the conclusions of a committee appointed by the Secretary of State for India with reference to that Report are also ready.

WE have received from Mr. Lawton, of Hull, a communication with regard to preventing collisions with icebergs. He has had frequent opportunity of noting the phenomena of echoes by means of steam-whistles, guns, fireworks, &c., and has received distinct echoes from various surfaces, some of which were not very promising. The sails of vessels and an approaching tug-boat, referred to by Prof. Graham Bell, are additional sources of sound-reflection, but Mr. Lawton thinks that the echo in the case of the latter must have come from some other surface than the bows of the boat, which, unless very bluff or square, would have a tendency to reflect the sound at right angles. If it be true that in Atlantic voyages the sound of the steam-whistle is echoed back by the fog itself, then, Mr. Lawton thinks, the echo from an iceberg enveloped in the fog would be much sharper, more abrupt, and easily distinguished from that returned by the fog, which, from its varying density and elasticity, would more resemble a prolonged rumble. The importance of this subject, the number of lives and amount of property at stake would point to the importance of having every reasonable theory tested by [those most interested—viz. shipping companies, captains of steamers and sailing vessels crossing the Atlantic and those going to Australian and New Zealand by the Cape. In the present case this can be very easily done by means of the steam-whistle, ship's bell, guns, &c., in broad daylight near an iceberg; the circumstances, such as its size, bearing, and distance, the direction and force of the wind; and then it should be noted whether an echo is perceptible or not. Mr. Lawton appears to have gone to some trouble in bringing the subject to the notice of shipping companies concerned, and of describing the method of carrying out the few simple experiments needed to demonstrate the value of his theory, but adequate attention does not appear to have been given to his suggestions. We give them in a brief form here, in the hope that they may be fairly tested in the presence of an iceberg in daylight in such a manner as to enable shipmasters to estimate the practicability of the theory. He found that, during artillery practice near Hull, the opposite Lincolnshire coast, two miles off, returned echoes. There are no objects of greater height than a few cottages there, and it occurred to him the phenomenon of echoes might be utilised by vessels in iceberg regions with more safety than the temperature test, especially if the wind and current be from the ship towards the berg. Most icebergs will present numerous reflecting surfaces at right angles to any passing ship, and it is anticipated that these surfaces would echo a short but full blast of the steam-whistle at a sufficient distance, say one or two miles, for the ship's course to be slightly altered in case the berg was right ahead. If such a blast is blown in daylight in the presence of a berg for purposes of experiment, the distance and bearing of the berg, and the force and direction of the wind should be noted. If at the time a high sea or swell prevailed, the whistle should be blown when the ship is on the crest of the wave. As fog is a better conductor of sound than dry air, it is when an iceberg is enveloped in fog, as is often the case on the banks of Newfoundland, that Mr. Lawton's theory, if true, would be of any value, as it could not only indicate the distance of the berg approximately, but also its bearing from the ship.

THE Sadlers' Company have established four studentships, each of the annual value of 30*l.*, and tenable for two years, at the Finsbury Technical College of the City and Guilds of London Institute. The studentships will be competed for at the entrance examination, to be held at the college on October 1, and are open to pupils above fourteen years of age who are attending or who have attended any public elementary school in the United Kingdom. The Court of the Salters' Company has agreed to raise their annual subscription to the Technical Institute from 525*l.* to 1000*l.*

DR. TRIMEN, director of the Royal Botanical Gardens of Ceylon, has just published a systematic catalogue of the flowering plants and ferns indigenous to or growing in Ceylon. The list gives the botanical, Singhalese, and Tamil names, and is a complete index to Thwaites's "Enumeratio Plantarum Zeylaniæ," but it differs from the latter work in the sequence of the families or natural orders. In addition to the flowering plants and ferns, Dr. Trimen has added five natural orders—viz. Rhizocarpeæ, Lycopodiaceæ, Isoeteæ, Selaginellaceæ, and Characeæ. The catalogue includes 156 natural orders, 1071 genera, and 3249 regular species, with 408 varieties, some of which may prove to be distinct species. The catalogue is issued as a number of the *Journal* of the Ceylon Branch of the Royal Asiatic Society.

THE weather in Southern Norway in June has been very remarkable, and we must go back to the year 1869 to find anything similar. The weather, early in the month, was very cold, the average being only 56°·5 F., while on the 11th the temperature fell to 35°·8 F., a temperature which has not before been registered in Christiania in June, at all events not since 1867. Towards the end of the month the temperature in Christiania was abnormally high, reaching, on the 28th, 79°·3 F. in the shade. The rainfall was only half of the normal quantity. As well in May as June, the weather was below the average for the whole country. At Röraas the temperature fell on June 2 to 26°·6. The information received of the weather in the north of Norway to the middle of July shows that the weather had till then been very cold, the highest temperature being only 44°·6 to 46°·8 F. in the day and below freezing-point at night. It is popularly supposed that this is due to the enormous ice masses which have this summer descended from the Polar regions on the American side right into the Gulf Stream, which has thereby become greatly cooled, a circumstance immensely influencing the weather in Norway. Seal-hunters returning to Tromsö from the White Sea and adjacent waters report that large masses of drift-ice are in motion towards the Norwegian shores; but there are as yet no reliable news from the Spitzbergen seas. On the other hand, we learn from captains who have returned from seal hunting on the east coast of Greenland and the sea north of Iceland that hardly any were caught, owing to the enormous ice-masses which are descending along the east coast of Greenland this summer, greatly in excess of previous years. It may be remembered that last year the reverse was the case here. Lieutenant Holm, who has been wintering on the east coast, reported that the sea was very free from ice even at the troublesome glacial promontory of Tuisortok, which has only once before been passed by Europeans, viz., Graah. It seems indeed that abnormal conditions prevail this summer throughout the Polar seas, and it will be of interest to learn what the state of the ice actually is north and north-east of Spitzbergen.

A VERY interesting exhibit at the Inventions Exhibition is that of "Brin Frères" for the illustration of their method of extracting oxygen and nitrogen from atmospheric air by the agency of barium oxide and peroxide. A description of the process is given in a small pamphlet, but the English requires a little correction in places to be clearly understandable. The process of oxygen extraction by means of baryta is now very old, but has never yet been made real practical use of, the baryta becoming inactive after some time. This is no doubt due to the absorption of carbonic acid by the baryta from the air. In this process air freed from carbonic acid and water by caustic soda is passed over barium oxide heated in iron retorts to a temperature not exceeding 600° C. The temperature is regulated by a pyrometer which regulates at the same time the supply of gas to the furnace. Under these conditions the oxygen of the air is absorbed by the baryta, peroxide of barium being formed. The nitrogen, which appears to be very pure, is collected separately for use in the production of ammonia. On heating the peroxide of barium to full redness pure oxygen is given off. At this stage of the process the retorts are evacuated by a powerful pump, so that the operation takes place in a vacuum or nearly so. The operations are continuous, and as long as the baryta is kept anhydrous and free from carbonic acid the same quantity will apparently last an indefinite time. The most interesting and perhaps the most useful part of this invention, or application, is the production of ammonia by a very direct process. The nitrogen obtained as above is passed over a mixture of baryta with carbon—charcoal—heated to some unknown temperature, about 300° C., certainly not higher. It is necessary, however, that the nitrogen be moist, a condition which is attained by passing it through water before it comes in contact with the mixture of baryta and charcoal. The product is really a carbonate of ammonia and not free ammonia, the water becoming decomposed under the conditions named, its hydrogen combining with the nitrogen and its oxygen forming carbonic acid. The ammonium compound seems to be formed in considerable amount, and the process should, when carried out on a large scale, be a valuable one.

A USEFUL summary of anthropological work accomplished during the year 1884 has just been issued by Prof. O. T. Mason, curator of the ethnological department, National Museum, Washington. Besides a copious bibliography of the subject, special notices and even extracts are given of the more important papers on ethnology, archæology, and other branches of anthropology that have appeared in the scientific periodicals of Europe and America. Thus detailed reference is made to the work of the British Association Anthropometrical Committee; to Prof. W. H. Flower's paper in the *Journal* of the Anthropological Institute on the size of the teeth as a racial characteristic; to Prof. A. H. Keane's ethnology of Egyptian Sudan, contributed to NATURE; to E. F. im Thurn's articles in *Timheri* on the natives of British Guiana; to Dr. Charles Rau's paper on "Prehistoric Fishing," in vol. xxv. of the Smithsonian Contributions to Knowledge; and to A. Chavero's great work on "Mexico à traves los Siglos," the first volume of which is completed, bringing the subject down to the arrival of the Spaniards. It is satisfactory to notice that the Philadelphia Academy of Sciences has created a chair of ethnology and archæology, to which Dr. Daniel G. Brinton has been appointed. The field of anthropology is now so extensively cultivated in the Old and New World that annual summaries of this sort have become indispensable.

THE Swedish Professor Warming has proceeded to Finmarken in order to study the Arctic flora on the Norwegian coast.

ON July 20 and 21 two terrible cyclones passed over the central part of Sweden, followed by rain and lightning. In several places hundreds of old trees were uprooted, and a clear road made in forests upwards of fifty yards wide. In one place a large wooden snowplough lying by the road was smashed to atoms. Fortunately no one was injured.

AT the University examination just concluded in Copenhagen there were seven lady candidates, all of whom passed, four gaining *precæteris*, two *laudabilis*, and one *haud illaudabilis*. Five of these ladies took the mathematics and natural science degrees, and only two the philological.

DURING the last two years several Celtic tumuli in the district of Geinberg, in Upper Austria, have been opened and found to contain valuable relics of prehistoric times. A few days ago a similar tumulus was discovered near Mattighofen, in the same neighbourhood, and among its contents was found a diadem of pure gold, richly carved in the well-known style of old Celtic art.

MR. DAVID DOUGLAS, of Edinburgh, has issued a new edition of the late Charles St. John's "Tour in Sutherlandshire," a fitting companion to the author's well-known "Wild Sports and Natural History of the Highlands." There is an interesting sketch of the author's life by his son, and a long appendix on the fauna of Sutherlandshire, by Mr. J. A. Harvie-Brown and Mr. S. E. Buckley.

MESSRS. CASSELL & CO. have issued the second part of vol. iv. of their "Encyclopædic Dictionary," extending from "Interlink" to "Melyris." As there is no editor's name on the title-page, we presume that Mr. Robert Hunter, who devised the work, and edited the early parts, is not now connected with it. A work of such minuteness as this ought to have had "Laramie" as a well-known geological term.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. S. G. Coles; a Persian Gazelle (*Gazella subgutterosa* ♂) from Persia, presented by Mr. John Stanley Cater; two Madagascar Porphyrios (*Porphyrio madagascariensis*) from the Gold Coast, West Africa, presented by Mr. E. North Newenham; a Cockateel (*Calopsitta novæ-hollandiæ*) from Australia, presented by Mr. J. Ward; four Martinican Doves (*Zenaida martinicana*), a Moustache Ground Dove (*Geotrygon mystacea*), five Dominican Kestrels (*Tinnunculus dominicensis*), a Violaceus Night Heron (*Nycticorax violaceus*), two —— Colins (*Ortyx* —— ♂ ♂) from St. Kitt's, West Indies, presented by Dr. A. Boon, M.R.C.S.; a Common Viper (*Vipera berus*), British, presented by Mr. C. Smallman; a Ring-tailed Coati (*Nasua rufa*) from South America, a Golden-crowned Conure (*Conurus aureus*) from South-East Brazil, a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, deposited.

OUR ASTRONOMICAL COLUMN

OCCULTATIONS OF VESTA.—The minor planet Vesta will be twice occulted by the moon during the next autumn, and though observation of such a phenomenon is more a matter of curiosity than of astronomical utility, we may note the circumstances of each case. The first occultation will take place on October 27; the planet disappears before the moon is above the horizon at Greenwich and reappears at 7h. 50m. at 204°, less than ten minutes after the moon has risen. The second occultation occurs on November 23, the disappearance at 9h. 25m. on an angle of 28°, the reappearance at 9h. 46m. at 347° from north point, reckoning the angles as in the *Nautical Almanac*. At this time Vesta is near aphelion, and therefore will not be brighter than a star of the seventh magnitude.

ANTHELM'S NOVA OF 1670.—Mr. G. Knott has lately had under observation the small star situated close to the position of the star in Vulpecula discovered by Anthelm in June 1670; the star is No. 1814 of the Greenwich Catalogue for 1872. From comparisons made between July 10 and 20, Mr. Knott found it about $10\frac{3}{4}$ or 11 mag., and equal to a star following it 12 seconds, and 4'·5 to the north. It was estimated of the same brightness in August 1872, but a magnitude brighter in April 1852. In 1861, when it was 12m., Mr. Baxendell remarked that "no adjustment of the focus would bring the star up to a sharp point on the night of June 1," and a week earlier Mr. Hind had noticed "a hazy ill-defined appearance about it, which is not perceptible in other stars in the same field of view."

A rigorous reduction of Picard's observations of Anthelm's star, which are printed in Lemonnier's "Histoire Céleste," gives its place for 1670·0—

R.A. 19h. 34m. 5·33s. ... Decl. + 26° 31' 41"·5,

the right ascension being the more uncertain element and liable to an error of quite two seconds. Bringing this place up to the beginning of 1872·0 we have—

R.A. 19h. 42m. 21·60s. ... Decl. + 26° 59' 45"·4,

which differs − 3·81s. in right ascension and − 33"·1 in declination from the Greenwich catalogued position.

In the *Journal des Savans*, 1671, the new star is said to have followed β Cygni on the meridian by 16m. 44s., which would give its right ascension in precise agreement with the Greenwich observations of the small star No. 1814.

THE CINCINNATI OBSERVATORY.—The eighth part of the publications of this Observatory has been circulated, and contains the observations of comets made in the year 1883. It is noteworthy as presenting a pretty complete report on the phenomena of Pons' periodical comet of 1812 at its reappearance: the features of the tail were particularly studied, and the discussion of the observations, based upon the theory of Dr. Bredichin, has been found to add confirmation to that theory; they are best satisfied with a value of $1 - \mu$, a little less than 2·5, corresponding to his second type; and this value nearly accords with that inferred by Dr. Bredichin himself in his memoir, "Les syndynames et les synchrones de la comète Pons-Brooks (1883-84)," from a large number of observations by different observers. Thirteen plates form part of this publication, affording highly interesting details on the physical aspect of the comet from October 30, 1883, to January 26, 1884. The drawings were partly made with the 11-inch refractor, and partly with the finder of 2½ inches aperture, and an opera glass. On January 13 the comet was equal in brightness to α Pegasi.

The Cincinnati Observatory is now under the direction of Mr. J. G. Porter. The observations contained in the publication last issued were made by Mr. H. C. Wilson while in temporary charge.

TEMPEL'S COMET, 1867 II.—Dr. Schur searched for this comet unsuccessfully with the great refractor at Strassburg on many evenings in March and April: M. Gautier's calculations showed that the chance of observing the comet at this return to perihelion was but small. The next return, in the spring of 1892, will take place under much more advantageous conditions.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, *AUGUST* 16–22

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on August 16

Sun rises, 4h. 49m.; souths, 12h. 4m. 1·0s.; sets, 19h. 19m.; decl. on meridian, 13° 37′ N.: Sidereal Time at Sunset, 17h. 1m.

Moon (at First Quarter on August 17) rises, 12h. 3m.; souths, 17h. 10m.; sets, 22h. 10m.; decl. on meridian, 12° 21′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	7 18	13 30	19 42	1 32 N.
Venus	7 24	13 50	20 16	4 25 N.
Mars	0 46	9 4	17 22	23 38 N.
Jupiter	6 27	13 12	19 57	8 15 N.
Saturn	0 32	8 41	16 50	22 28 N.

Occultations of Stars by the Moon

August	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
20	B.A.C. 6287	6	23 39	0 35*	165 272
21	B.A.C. 6292	6	0 8	1 15	115 328
22	ρ' Sagittarii	4	0 35	1 39	157 291

* Occurs on the following day.

The Occultations of Stars are such as re ible at reenwich.

August	h.	
19	11	Mercury stationary.

GEOGRAPHICAL NOTES

THE Dutch journals contain an account of the Dutch scientific expedition, in March and April last, to examine the upper course of the Surinam River. The members are well satisfied with the result. Their success was due in great part to the rainy season not setting in till towards the end of the journey. They were thus enabled to examine the rocks along the course, which in periods of high water are hidden from view. Their first station was Phaedra on the left bank of the Surinam; the next the Tafra Rocks which lie in the middle of the stream. Here they were forced to leave their steamer and continue in a fishing-boat. At Bergendal they took the height of the neighbouring Blue Mountain, which they ascended, and from which they had a view of the various mountain chains of Surinam. In general the mountains of this region are covered with trees, but the Blue Mountain is quite bare. Near the mouth of the Sara creek the travellers first met some villages of the bush negroes. At Toledo, a negro village, they came to the end of their forward journey. On the return they visited gold fields near Broko Pondo, where they made themselves acquainted with the native methods of washing the gold. From a geological point of view the expedition was fortunate; but the rapid travelling and short stoppages prevented much being done by the zoologist. Professor Martin has made a collection of the rocks in various parts of the Surinam.

WRITING from Ciudad-Bolivar in May, M. Chaffanjon continues his report to the Paris Grographical Society (the first party which we have already referred to) on his exploration of the Orinoco. Since the date of his last letter he made a journey with two Indians of the Arigua tribe up the Caura River to its source. He passed freely through the territory of various tribes, such as the Arebatos, Panares, and others who are notorious for their cruelty, and he obtained from their chiefs a mass of curious information respecting their manners and religious beliefs. In an endeavour to obtained a complete skeleton, he was surprised by a band of Indians, who attacked himself and his followers. He escaped with great difficulty, and accompanied only by one of his guides reached the Caura, and continued his journey, in which he was much impeded by the rains. He was also able to visit and study the Yaruros and Mapayes tribes.

THE last *Bulletin* of the Royal Geographical Society of Belgium (1885, No. 3) contains a paper by the secretary on the Congo question, describing the explorations made in the basin between 1485 and 1877, the formation of the International Association, the creation of the Free State, and finally a description of the basin. M. Lancaster continues his notes on four months' journeyings in Texas, and M. Fontaine contributes a general paper on the geography, productions, trade, &c., of Dutch Guiana.

DR. HAACKE and Dr. Bernays are zoologist and surgeon respectively to the Australian expedition to New Guinea, to which we have already referred. The main objects of the expedition are stated to be to ascertain and fix the geographical features of New Guinea, and the nature of its fauna, flora, geology, and climate. It has been decided to make if possible the Aird river the base of operations.

AT a late meeting of the Geographical Society of Rio de Janeiro M. Alcenar Œraripe read a paper on geographical neology and neography. He referred to the necessity of introducing into geography reforms consisting mainly of the creation of new names and of uniform orthography. His remarks, though of universal application, had especial reference to Brazil. He concluded by suggesting the appointment of a commission to examine the following questions:—(1) Should there be a geographical neology for Brazil—that is to say, a nomenclature for places in the empire in which the repetition of the same name for different places would be avoided by substituting other names? (2) Should there be a geographical neography, or correction of the orthography of geographical names in such a way that the spelling would in all cases be uniform? (3) Assuming these two questions to be answered in the affirmative, how would these reforms be best carried out? The questions were referred to a commission for its report.

THE current number of *Petermann's Mittheilungen* contains a project for a new political map of Africa, with some observations on the principles of political geography, by Prof. Ratzel. This is accompanied by a double map of Africa. In one part the continent is coloured according to the prevailing occupations of the population—agriculture, agriculture with cattle-breeding, pastoral, and the chase; in the second it is coloured according to the people who form states—*e.g.* Arabs, independent Negroes, Zulus, &c. Dr. Stange writes on the orometry of the Thüringer Wald. The most important paper in the number is that by Dr. Radde, entitled "A Physico-Geographical Sketch of Talysch in the North-Western Elburz," which was originally written for an entomological work being brought out by the Grand Duke Nicholas.

THE last number of the *Mittheilungen* of the Geographical Society of Vienna contains a statement by Dr. Le Monnier with regard to the arrangements for the Austrian Expedition to the Congo; a sketch of the results of Danish explorations in Greenland by A. Rink; the conclusion of Dr. Breitenstein's paper on Borneo, and the recent letters of Colonel Prjevalsky. Dr. Breitenstein's account of Borneo is of great interest. He points out that in this great island may be studied in succession almost every stage of human development from the lowest to the highest. It is not sixty miles, for example, from Pengaron, where European machinery is employed in the coal mines, to Punun or Olo Ott, where the people are almost quite naked, and where their only protection from the weather is a grass hut here and there. It is hardly a hundred miles between Banjermassin, where Eurpean war-vessels and Krupp guns keep the Dyaks in check, and the kampong of the Prince of Murong which is protected by a thin palisade, from the top of which the heads of those captured in raids look down on the traveller. In this narrow district we have a kaleidoscopic picture of all the steps of human civilization.

AT the last meeting of the Geographical Society of Paris, M. du Caillaud read a note on the fortress of Camlo in Annam, to which the attack on the French at Hué has just given some importance; M. de Lesseps referred to soundings recently made at Gabes with a view to establishing a fort there; M. Rouire, who has recently returned from a scientific mission to Tunis, recounted his explorations in the regions between Kairwan, Susa, Hammanet, and Lake Felbiah. M. Delaplanch also read an account of a journey which he made through the centre of Persia, from Resch on the Caspian to Teheran.

DR. P. L. SCLATER suggests "Torresia" as an appropriate name for British New Guinea.

IN the *Bollettino* of the Italian Geographical Society for July, Sig. Buonfanti publishes a reply to the doubts of Herr G. A. Krause on his journey from Tripoli across the Sahara and Western Sudan to the coast of Guinea. The writer, whose letter is dated May 6, on board the *Corisco* at Banana, states that documentary proofs of the trip cannot be given till his arrival in Brussels, where the papers lie under lock and key in charge of Prof. du Fief. They include, he says, correspondence already forwarded to two American journals from Tripoli, Murzuk, &c., besides translations of safe-conducts and firmans received from the Sultans of Bornu and Socoto, and of a letter from the Sheikh [*sic*] of Timbuktu, the originals of which will be forthcoming. There are also accounts, invoices, &c., of Maltese dealers, certificates of sea-captains, certificates of missionaries, and so forth. He explains that Herr Krause heard nothing of his movements at Lagos, because he reached the coast not at that place, but at Portonuovo, some 45 miles further west. For the same reason nothing was known of him in the Yoruba country, which lies 200 miles to the east of Dagomba, Bagouza, Dahomeh, and the other districts through which he travelled.

THE Vienna Geographical Society has received good news of Dr. Oscar Lenz's African exploring expedition, which, on July 17, had reached Monrovia, the capital of Liberia. The next news will be from the Cameroons.

THE death is announced from Sydney of Thomas Boyd, the first white man to cross the Murray river, and the last surviving member of Hume and Hovell's exploring party. He was eighty-eight years of age, and had lived in great poverty for some years prior to his death.

MEASUREMENT OF EVAPORATION

I SEND a brief sketch of an instrument which I have just made for the measuring of evaporation from a water surface. The figures and letters refer to the accompanying drawings:—

Fig. 1, A.—Tank-mine, 20 in. × 10 in., standing in a large tank 60 in. × 40 in. The sides are double, a space one-tenth of an inch being between the walls and opening all around inner wall (*a*) with an outflow-pipe (Figs. 3, 4, G) let into bottom. Tank filled as Fig. 4, and refilled every three or four hours, the amount poured in being carefully measured.

Fig. 1, A, B, C.—Complete instrument. A, evaporating-tank; B, reservoir filled with water to (*n*); (*h*) a graduated glass coil, by which water pouring out through tap (*l*) is registered. Pressure upon tap regulated by (*i*) a tube and funnel buoyed up by (*k*). Water flows from B to A through a perforated, semi-circular chamber (*e*), which makes water spread over the entire surface of tank. Overplus flows over at (*f*) down (*c*, *d'*) into reservoir C, similar to B in fittings. Then loss from B − gain in C = the evaporation from A. This arrangement intended chiefly for experimentation upon running water, removes the necessity for refilling the tank, although good results can be attained even then.

Fig. 2.—Tank from above. (*a*) space between walls; (*b*) inflow-pipe from B; (*e*) perforated chamber or rose; (*d*) outflow-pipe.

Fig.1

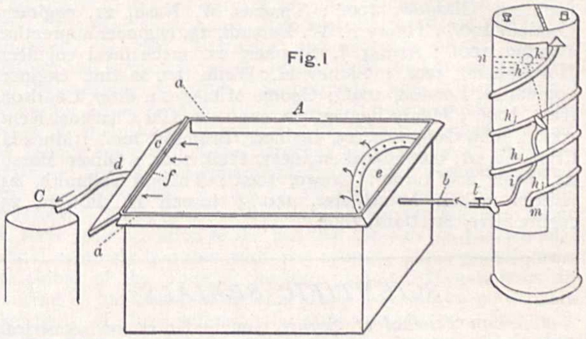
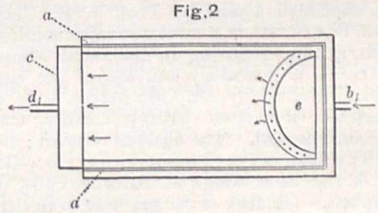


Fig. 3.—End of tank; letters as before. The outer wall in part cut away to show chamber (*a*) with emptying-pipe (*g*).

Fig. 4.—Transverse section: (*o o*), walls; (*a*), space; *g*, pipe; *p*, strengtheners. Height of water also represented.

The following points are worthy of notice:—

Fig.2



(1) The level of the water can be kept constant by regulating the flow from the tap *l* (Fig. 1, B).

(2) Error arising from splashing out of water, when heavy wind blowing, removed, the displaced water flows down (as Fig. 2), and through pipe *g* (Fig. 3), and is collected in a small measured vessel.

(3) Error arising from rainfall similarly corrected; rain falling

Fig.3

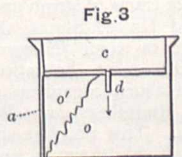
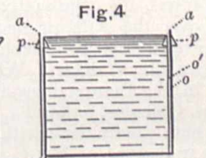


Fig.4



into tank A, for greater part flows off at *f*, and is collected in C; when very heavy, flows also into *a*, and is collected as mentioned above. Then, the amount of rainfall being known from the rain-gauge, the following simple process gives the evaporation:—x = rainfall in cubic cents.; y = water in reservoirs; $x - y$ = evaporation in cubic cents. GEORGE HASLAM

Trinity College, Toronto

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE following candidates have been successful in the competition for the Whitworth Scholarships, 1885, in the Science and Art Department, South Kensington:—Thomas Clarkson, age 20, engineer, Manchester, 200*l*.; Hugh O. Bennie, 20, engineer, Glasgow, 150*l*.; Robert H. Unsworth, 20, engineer, Pendleton, near Manchester, 150*l*.; Harold M. Martin, 21, engineer, Gateshead, 150*l.*; William T. Calderwood, 25, mechanical draughtsman, Glasgow, and John Richards, 22, blacksmith, Cardiff, equal, 150*l.* each; Ernest R. Dolby, 23, engineer, Leeds, 150*l.*; James Rorison, 21, engine fitter, Paisley, 150*l.*; Arthur J. Moulton, 20, engineer apprentice, Preston, 150*l.*; William McNeill, 22, mechanic, Birmingham, 100*l.*; George W. Moreton, 24, fitter, Crewe, 100*l.*; Stephen E. Mallinson, 24, assistant analyst, London, 100*l.*; Henry C. Jenkins, 23, engineer and millwright, London, 100*l.*; Robert Smith, 24, engineer, Glasgow, 100*l.*; Thomas W. Nash, 21, engineer, London, 100*l.*; Henry F. W. Burstall, 19, engineer apprentice, London, 100*l.*; Arthur J. Stopher, 22, mechanical engineer, Nottingham, 100*l.*; Sidney H. Wells, 19, marine engineer apprentice, London, 100*l.*; George Milnes, 24, fitter, Charlton, Kent, 100*l.*; Henry Begbey, 22, engineer, Old Charlton, Kent, 100*l.*; John Goodman, 23, engineer, Brighton, 100*l.*; Mark H. Crummie, 21, mechanical engineer, Hull, 100*l.*; Oliver Marsh, 22, fitter and turner, Crewe, 100*l.*; Thomas Galbraith, 23, pattern maker, Manchester, 100*l.*; Joseph H. Bowles, 23, engine fitter, Stratford, 100*l.*

SCIENTIFIC SERIALS

American Journal of Science, June.—Notes on American earthquakes, with a summary of the seismic disturbances recorded in North and South America and adjacent waters during the year 1884, by C. G. Rockwood, jun.—Taconic rocks and stratigraphy (continued): V. metamorphism and mineral constitution in the Taconic region, gradational from west to east and from north to south, by James D. Dana.—Notes on the possible age of some of the Mesozoic rocks of the Queen Charlotte Islands and British Columbia, by J. F. Whiteaves.—Crystallised Tiemannite and metacinnabarite, by Samuel L. Penfield. To the paper is appended a note by Prof. J. E. Clayton on the occurrence of Tiemannite in a mine 200 miles south of Salt Lake City.—On the gahnite occurring in the Davis Mines of Rowe, Massachusetts.—The genealogy and age of the species in the southern Old Tertiaries, by Dr. Otto Meyer.—On some specimens of meteoric iron from Trinity County, California, by Charles Upham Shepard. The analysis yielded: iron, 88·810; nickel, 7·278; cobalt, 0·172; phosphorus, 0·120.—The Potsdam group east of the Blue Ridge at Balcony Falls, Virginia, by H. D. Campbell.—Geology of the sea-bottom in the approaches to New York Bay, by A. Lindenkohl.—Additional notes on the Kettle-Holes of the Wood's Holl region, Massachusetts, by B. F. Koons.—Cause of the apparently perfect cleavage in American sphene (titanite), by G. H. Williams.

American Journal of Science, July.—Contributions to meteorology. Twenty-first paper: direction and velocity of movement of areas of low pressure, by Prof. Elias Loomis. The paper is accompanied by numerous tables showing the average direction of storm tracts, the comparative tracts of storm and atmospheric currents over the Atlantic and United States, the progress of storm centres in Europe.—Note on some Palæozoic Pteropods, by Charles D. Walcott. With some hesitation the writer includes in the Pteropod group such organisms as Conularia, Hyolithes, Coleolus, Salterella, Pterotheca, as well as Matthevia, which is here chiefly dealt with. This peculiar shell, which he so names in honour of Mr. G. F. Matthew, is, however, so distinct from all described forms of Pteropoda that a new family Matthevidæ, is proposed to receive the one genus now known.—A determination of the B.A. unit in terms of the mechanical equivalent of heat, by Lawrence B. Fletcher. The experimental work here described was completed in 1881, and forms the subject of a thesis submitted to the Johns Hopkins University in that year. In the present paper a more accurate method of calculating the currents from the deflection-curves is used, and some of the other calculations have been revised. But in other respects the results of the two papers are substantially the same. The experiment consists of simultaneous thermal and electrical measurements of the energy expended by a current in a coil of wire immersed in a calorimeter. The result depends upon the values of the mechanical equivalent and the unit of resistance, and gives a determination of either in terms of an assumed value of the other.—Cause of irregularities in the action of galvanic batteries, by Hammond V. Hayes and John Trowbridge. Here is investigated the phenomenon known as "endosmose," that is, the action by which the electric current carries whatever comes in its way from the positive to the negative electrode.—On the sensitiveness of the eye to colours of a low degree of saturation, by Dr. Edward L. Nichols.—A study of thermometers intended to measure temperatures from 100° to 300° C., by O. T. Sherman.—Notice of a new Limuloid crustacean from the Devonian formations of Erie County, Pennsylvania, by Henry Shaler Williams. This specimen, provisionally identified with Prestwichia, would appear to throw back the range of that group to an earlier period than hitherto reported. The earliest previously-discovered Prestwichia occurs in the Carboniferous formations.—Gerhardtite and artificial basic cupric nitrates, by H. L. Wells and S. L. Penfield. The mineral here described under the name of Gerhardtite was first identified as a new species by Prof. Geo. J. Brush, who found it among a lot of copper minerals from the United Verde Copper Mines, Jerome, Arizona. Its specific gravity is 3·426; hardness, 2; colour, dark green; streak, light green; transparent; crystals, orthorhombic.—On the occurrence of fayalite in the lithophyses of obsidian and rhyolite in the Yellowstone National Park, by Joseph P. Iddings.—The genealogy and age of the species in the Southern Old Tertiary. Part 2. The age of the Vicksburg and Jackson Beds, by Dr. Otto Meyer.—On the probable occurrence of the great Welsh Paradoxides (*P. davidis*) in America, by Geo. F. Matthew. This largest and most remarkable species of Paradoxides occurring in the primordial fauna of Europe was first discovered about twenty years ago by Dr. Henry Hicks near St. David's, Wales, and subsequently (1869) in Sweden. But its presence has only recently been suspected in America, where specimens of large species appear to occur both in the Cambrian slate at Saint John, New Brunswick, and in a hard silico-calcareous shale at Highland's Cove, Trinity Bay, Newfoundland.

Bulletin of the Philosophical Society of Washington, vol. vii.—Besides the usual reports of the officers of the Society, this volume contains a learned address by the President (Mr. James C. Welling) on the atomic philosophy, physical and metaphysical; abstracts, among other, of papers by Mr. W. H. Dale, on recent advances in our knowledge of limpets; by Mr. Russell, on the existing glaciers of the High Sierra of California; by Prof. Kerr, on the mica mines of North Carolina; by Mr. Riley, on recent advances in economic entomology, in which the part which insects play in the economy of nature, and particularly their influence in American agriculture, were discussed. Mr. Burnett explained why the eyes of animals shine in the dark. It is not due, he says, to phosphorescence, as has been commonly supposed, but to light reflected from the bottom of the eye, which light is diffused on account of the hypermetropic condition that is the rule in the lower animals. Mr. Johnson writes on some eccentricities of ocean currents, compiled from the records of the Lighthouse Board; Mr. Clarke on the periodic law of chemical elements; Mr. Hazen, on the recent sun-glows; Mr. Russell, on deposits of volcanic dust in the great basin; Mr. Gilbert, on the diversion of water-courses by the rotation of the earth; Mr. Doolittle, on music and the chemical elements; Mr. Bates, on the physical basis of phenomena (which is printed in full). Mr. Gilbert presented a plan for the subject, bibliography of North American geological literature; Mr. Matthews, in a paper bearing the title of natural naturalists, combated the notion that savages are versed only in the knowledge of animals and plants which contribute to their wants. The writer found that Indians have a comprehensive knowledge of animals and plants; as a class the Indians "are incomparably superior to the average white man, or to the white man who has not made zoology or botany a subject of study." The Indian also is as good a generaliser and classifier as his Caucasian brother. Several speakers who followed agreed in this conclusion.—Mr. Dutton has a paper on the volcanoes and lava fields of New Mexico.—The following are among the principal papers in the Mathematical Section: Mr. Gilbert, on the problem of the Knight's tour; Mr. Farquhar, on empirical formulæ for the diminution of amplitude of a freely oscillating pendulum; Mr. Hall, on the formulæ for computing the position of a satellite (which is printed in full); Mr. Kummel, on the quadric transformation of elliptic integrals, combined with the algorithm of the arithmetico-geometric mean.

Bulletin de l'Académie Royale de Belgique, May.—M. Ch. Fievez, on the influence of magnetism on the characters of the spectral rays. The increase of the luminous intensity of the spark and its spectrum is attributed to the action of magnetism on the luminous rays themselves. To elucidate this question the author limits his attention to the effect of magnetism in presence of the luminous and caloric movement apart from the electric spark and through the medium of the ponderable matter alone. For this purpose he studies the effect of magnetism on the spectra of the flames of sodium, potassium, lithium, and thallium raised successively to increased temperatures by the introduction of oxygen. From the results of his experiments he concludes that magnetism acts directly on the luminous rays, but abstains from any theory to explain the identity of the effects of magnetism and heat on the rays.—M. A. Swaen, on the development of the first blood corpuscles in the blastoderm of *Torpedo ocellata*. The results are given of studies made last year at the zoological station of Naples on the evolution of the folicules and the formation of the blood-vessels of this organism. —Note on the geology of the Tristan da Cunha islands, by A. F. Renard. A summary description is given of the typical rocks collected by the naturalists of the *Challenger* expedition.—State of the vegetation at Spa and Liége on April 20, and at Longchamps (Waremme) on April 21, 1885, with comparative tables, by G. Dewalque and Baron E. de Salys Longchamps.—Essay on the mechanical theory of the surface-tension of the evaporation and ebullition of liquids, by G. Van der Mensbrugghe. In this first communication on the subject the author restricts his remarks to the question of the probable cause of surface-tension.—On the movements of the brain in the dog, by Léon Fredericq. Three distinct pulsations, corresponding respectively to the beating of the heart, to the respiratory action, and to the vaso-motor periods, are determined and illustrated with numerous tracings and diagrams.—Note on the carboniferous formations of Morvan, by A. Julien. The carboniferous schists, in contact with the older quartzose and azoic schists, run mainly north and south with a thickness ranging from 150 to 300 metres. Fossiliferous beds are rare, and the fossils, a list of which is given, generally in a very imperfect state.—A Royal Library in Assyria in the seventh century B.C., by M. Lamy. A detailed account of the explorations at Nineveh since the discoveries of Layard and Botta, including a description of the Royal Library, concludes with a history of the successful efforts made by Assyriologists to interpret the cuneiform writings.

Rendiconti del Reale Istituto Lombardo, June 25.—The conflict between Julius Cæsar and the Senate (B.C. 51–49), by Prof. J. Gentile.—The Italian Criminal Code: preventive justice and offences against the police, by Dr. Raffaele Nulli.—On the conditions of resistance of elastic bodies, by Prof. E. Beltrami.—On the floral dimorphism of *Jasminum revolutum*, Sims, by Prof. R. Pirotta.—Integration of the differential equation $\Delta^2 u = o$ in any of Riemann's areas, by Prof. Giulio Ascoli. —Meterological observations made at the Brera Observatory, Milan, during the month of June.

Gazetta Chimica Italiana, Palermo, 1885.—Note on diamidoximethyltriphenilmethan, by G. Mazzara and G. Possetto.—On the relations existing between the refrangent power and chemical constitution of organic compounds, by B. Nasini and O. Bernheimer.—Synthesis of phenilcinnamenilacrilic acid and of diphenildiethylene, by O. Rebuffet.—Relation between the atomic weight and physiological functions of the chemical elements, by Fausto Sestini.—On the monobromo- and bibromopyromucic acids, by H. B. Hill.—Reply to the foregoing, by F. Canzoneri and V. Oliveri.

Rivista Scientifico-Industriale, June 15–30.—The total eclipse of the moon, October 4–5, 1884, by Prof. Carlo Marangoni.—Experiments on the extraction of the juice of tobacco and of other plants, by A. Pezzolato.—On the fossil land Articulata of the Palæozoic formations, by P. Bargagli.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, July 27.—M. Daubrée in the chair. —Discussion on the great gyratory movements of the atmosphere (continued), by M. H. Faye. The question whether these atmospheric movements are ascending or descending was compared by the author to the old astronomical argument regarding diurnal motion. Attribute it to the earth, and all becomes clear; attribute it to the stars, and you become involved in the contradictions by which the progress of science was retarded for twenty centuries.—A reply to M. Faye's communication, by M. Mascart. To the objection that the hypothesis of an ascending volume of air fails to explain the rotation of cyclones and tornadoes the author replies that if the wind in the northern hemisphere converges towards a centre of attraction it must turn to the right in consequence of the known influence of the earth's motion; hence the mass of air brought into play must revolve to the left. Thus the direction of the phenomenon is easily explained, and it follows that for a descending column of air the rotation must be reversed.—On isomery in the aromatic series: the oxybenzoic acids, their heat of formation and transformation, by MM. Berthelot and Werner.—Note on the anatomy and nomenclature of Dental, by M. de Lacaze-Duthiers. For the meaningless terms "Scaphopod" and "Cirribranch" the author proposes to substitute that of "Solenoconch" for this group of mollusks.—Observations of Barnard's comet made at the 14-inch equatorial of the Bordeaux Observatory, by MM. G. Rayet.—Elements and ephemerides of Barnard's comet deduced from the observations of July 12, 16, and 20, made at the Observatory of Nice, by M. Charlois. On presenting this paper M. Faye drew attention to the fact that the axis of the planet's orbit lies nearly in a line with the ecliptic, consequently with the planes of the orbits of the large planets. Hence, notwithstanding its inclination of 80° this planet may still be periodicaly like most of those offering the same peculiarity.—Summary of the solar observations made during the second quarter of the year 1885, by M. P. Tacchini. From these observations it appears that the solar spots and protuberances were more numerous in the second than in the first quarter of the year. In June protuberances were observed eight times which attained or reached a height of two minutes.—Observations regarding M. E. Hénard's note on the sixteen systems of the planes of the regular convex icasohedral, by M. Em. Berbier.—Note on Riemann's function $\zeta(s)$, by M. Bourguet.—On the equilibrium of a fluid mass animated by a rotatory movement, by M. H. Poincaré.—Note on the differentials of the functions of several independent variables, by M. E. Goursat.—New condensing hygrometer; its use in regulating capillary hygrometers, by M. G. Sire.—Note on the reciprocal transformation of the two varieties (prismatic and octahedric) of sulphur, by M. D. Gernez. —On a new method of volumetric analysis applicable for testing the bioxides of manganese, by M. Paul Charpentier. This method is based on the use of the alkaline sulphocyanides, and avoids certain tedious processes and sources of error presented by the methods of analysis hitherto employed. Its chief advantage is the extreme sensibility of the reaction, which enables the analyst to detect the presence of 1-3,000,000th part of iron.—Heat of formation of the alkaline alcoholates, by M. de Forcrand.—Note on the peptonate of iron, by M. Maurice Robin.—On three new compounds of rhodium, by M. Camille Vincent. These substances are:—(1) chlororhodate of mono-methylammonium, which takes the form of long, slender prisms grouped around a common centre; (2) chlororhodate of dimethylammonium deposited in the form of large efflorescent prisms of a deep garnet-red colour; (3) chlororhodate of trimethylammonium precipitated by slow evaporation in the form of long garnet-red prisms very soluble in water.—Origin and mode of formation of certain ores of manganese; their fundamental relations to the baryta associated with them, by M. Dieulafait.—On a new phase in the evolution of the reticular rhizopods, by M. de Folin. In this new state these organisms assume the appearance of small, hard pebbles, from which it is often difficult to distinguish them. The circumstance suggests the creation of a new genus, Lithozoa, of which there would appear to be several species.—Note on Megaloscopy, by M. Larrey. The author explains the optical principle by which he has been guided in the construction of a series of instruments for the inspection of the stomach, vessica, and other internal parts of the system.—Observations of the solar corona made on Mount Etna early in the month of July; reappearance of the crepuscular lights, by M. P. Tacchini. The author observed in a deep blue sky the sun encircled by a white aureole concentric with a magnificent copper-coloured corona, which near the horizon was transformed to a larger but less clearly defined arc. Since July 2 he noticed the reappearance of the red crepuscular phenomena and of the great arc at sunset and sunrise. Although less intense than those of 1883–84, he considers that their reappearance after such a long interruption shows they cannot be referred to the Krakatoa explosion.—On the cosmic origin of the crepuscular lights, by M. José L. Landerer. The author argues that these effects are due more probably to the Biela-Gambart comet than to Krakatoa. The longitude (246°) of the ascending nucleus nearly coincided with that of the earth on June 1, when the afterglows again began to acquire great intensity.

August 3.—M. Bouley, President, in the chair.—The death of M. Henri Milne-Edwards, who died on July 29, was announced by the President, who remarked that a great loss was sustained by the Academy in the person of the illustrious Member of the Section for Anatomy and Zoology, one of the greatest *savants* who had shed lustre on French science.—Discourses pronounced at the obsequies of M. Milne-Edwards, by M. A. De Quatrefages, in the name of the Academy of Sciences, by M. Fremy, Director of the Museum of Natural History, by M. de Lacaze-Duthiers, in the name of the Paris Faculty of Sciences.—On the oxalic acid present in vegetation; methods of analysis, by MM. Berthelot and André.—Researches on the effects of direct electric excitation on the glands, by M. Vulpian.—Frictionless reflection, on a plane, of the elastic displacements in a body of any form and contexture, by M. X. Kretz.—Letter addressed to the Perpetual Secretary on the subject of vaccination against cholera, by Dr. J. Ferran. In reference to this letter M. Vulpian expressed his regret on the part of the Commission that the writer had misunderstood the meaning of the note inserted in the last issue of the *Comptes Rendus*. What was asked was not Dr. Ferran's statistics now promised, but the official returns of the Spanish authorities. In a question of this sort, affecting as it did all humanity, it was hoped that the Spanish Government would consider it a point of honour to give forthwith all possible information regarding the value of Dr. Ferran's method of preventive vaccination.—Note on an asymptotic law in the theory of numbers, by M. Stieltjes.—On the "herpolhodie" in the case of any surface of the second degree, by M. de Sparre.—On the employment of alternative electric currents for the measurements of the resistance of fluids, by MM. Bouty and Foussereau.—Note on the formation of the crystallised hydrate of zinc, by M. J. Ville.—On the hexabromide of benzine, by M. J. Meunier.—Heat of formation of the picrates. From the tables accompanying the paper the author shows that the anhydrous picrates of magnesium and copper are formed with an insignificant loss of energy in the components, while the picrate of zinc even absorbs a little heat. Hence the latter will yield more useful results than the former under the influence of the same oxydant.—Note on the essence of citron, by MM. G. Bouchardat and J. Lafont.—On the form of the larva of *Dorocidaris papillata*, by M. Henri Prouho.—On the digestive tubes, the corpus Bojani, reproductive organs, and eggs of Fissurella (*F. gibba* and *F. reticulata*), by M. L. Boutan.—On the hydrocarbonated reserves of mushrooms, by M. Léo Errera. The author's researches show an unexpected parallelism, from the standpoint of physiological chemistry, between the germination of mushrooms and that of the higher order of plants.—On the comparative evolution of sexuality in the individual and the species, by M. F. Laulanié.—Influence of sunshine on the vitality of various species of Micrococcus, by M. E. Duclaux.—Comparative studies of leprosy; its pathological anatomy, by M. Henri Leloir.—Researches on poisoning by sulphuretted hydrogen, by MM. P. Brouardel and Paul Loye.—Note on a Cetacean (*Hyperoodon rostratus*) stranded at Rosendael, near Dunkirk, on July 24, by MM. Pouchet and Beauregard.—Remarks on some electric lights constructed by M. G. Trouvé for the purposes of naturalists, chemists, microscopists, &c. (one illustration), by M. de Lacaze-Duthiers.

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Physical Society, June 26.—Dr. König produced a new apparatus for the measurement of the modulus of elasticity, which was constructed according to the suggestions of Herr von Helmholtz, and was utilised in the Institute for measurements of elasticity. The modulus of elasticity was determined by loading in the middle a bar of the substance to be examined, resting both ends on firm supports. The flexion which set in was measured by means of the cathetometer, and, its value being introduced into the formula of the elasticity theory, furnished the modulus of elasticity. A source of error in these measurements arose from the circumstance that the bar resting on edges was in part pressed in and sank, as a whole. This depression was the greater as the loading was greater, and it added to the magnitude of the flexion. To avoid this disturbance in the account Prof. Kirchhoff, in 1859, placed horizontal mirrors on the two ends of the bar, and, by means of telescope and scale, observed at each side the change in situation of each mirror, a change which occurred in consequence of the flexion under the loading in the middle, and which produced on both sides an opposite displacement of the scale. The sinking of the bar on account of the pressure on the edges, and even a slanting position on the part of the whole bar exercised no influence in these measurements. The apparatus suggested by Prof. von Helmholtz developed this principle still further. It had two perpendicular mirrors with the reflecting surface directed inwards at the two ends of the bar; on one side stood a scale, on the other a telescope. The image of the scale fell on the opposite mirror, then on the second mirror, and thence into the telescope. If now the bar were loaded so that flexion occurred, then the image in the telescope became displaced to the extent corresponding with the angular changes of the two mirrors. By glancing therefore into the telescope the whole amount of flexion might be very rapidly and conveniently measured and the loading altered at pleasure; the commencement of the elastic after-effect might likewise be directly observed with great facility. In the Institute a series of measurements with this apparatus had been executed by two experimenters, measurements which yielded values agreeing with a fair degree of precision. In the case of cylindrical bars differences presented themselves according as the bar was examined in one direction or in the direction perpendicular thereto. In the case of rolled brass the difference amounted to as high as from 2 to 2½ per cent.; in the case of cast brass the difference was inappreciable. Bars of cast iron likewise showed differences of only ½ per mill. Dr. König followed this up with a proposal to measure Poisson's constants—that is, the relation of the longitudinal increase to the decrease of the transverse section. The measurement should be carried out as in the experiments of Prof. Kirchhoff, only, instead of the horizontal mirrors and two telescopes, two parallel mirrors inclined at an angle of 45° should be used at the two ends of the bar with one telescope, thus enabling the moduli of elasticity and of torsion to be measured, the relation of which furnished Poisson's constants.

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