THURSDAY, SEPTEMBER 15, 1892.

NEW CONTRIBUTIONS TO THE BIOLOGY OF PLANTS.

Beiträge zur Biologie der Pflanzen. Herausgegeben von Dr. Ferdinand Cohn. Band 5. Heft 3. 1892.

TO the new number of Prof. Cohn's publication Dr. Max Scholtz contributes an interesting paper on the nutation of the flower-stalk in poppies and of the terminal shoots in Virginian creeper. In both cases the nutation is dependent on the action of gravity, but has nothing to do with the weight of the bud. In the case of poppies the downward curvature of the stalk takes place with sufficient force to lift a weight equal to twice that of the flower-bud. If, however, the flower-bud be removed there is no longer any nutation; the stalk straightens itself. Vöchting had already shown that this is the case even if the amputated bud is tied on again with thread. Dr. Max Scholtz further states that if a weight three times as heavy as the bud is substituted for it, the stalk still straightens itself, and lifts up the weight. The state of the case then is this: the upper part of the flower-stalk, during a certain stage of growth, is in a high degree positively geotropic if it remains in connection with a developing flower-bud, but not otherwise. The author has further succeeded in determining the exact part of the flower-bud which governs the geotropism of the stalk. If the pistil is excised, nutation ceases, the stalk becoming negatively geotropic; but if all the other whorls of the flower are removed and the pistil left, then nutation goes on as usual. But beyond this, if the ovules are extirpated, but the wall of the ovary left standing, the nutation is stopped. Hence we arrive at the striking conclusion that the presence of developing ovules in the young ovary determines the reaction of the flower-stalk towards gravity. A certain analogy is obvious with the irritability of root-tips, investigated by Darwin. Dr. Max Scholtz's observations afford a good example of the extreme complexity of those phenomena of growth which a few years ago were thought susceptible of a simple mechanical explanation. The author thinks that the nutation is of advantage, inasmuch as the reversed position of the flower-bud allows a better access of light to the developing ovary. As is well known, the flower-stalk ceases to nod when the flower opens; in other words, as soon as the development of the ovules is completed the flower-stalk becomes as strongly negatively geotropic as it had been positively geotropic before.

Dr. Max Scholtz has made similar observations on the nodding ends of the main shoots of *Ampelopsis quinquefolia*. Here also the positive geotropism of the younger internodes only exists so long as the terminal bud is present and uninjured. Both here and in the poppies the same part of the stem which for a time shows nutation afterwards erects itself, reversing its reaction towards gravity, and also becoming for the first time positively heliotropic. This change in the mode of response to constant external influences is dictated by the embryonic organs at the growing point.

A paper by Dr. Paul Siedler on the radial sap-current in roots, consists essentially of an anatomical description of the cortex in a number of roots, and does not appear to add much to our previous knowledge. The author believes that in many cases the hypodermal layers act as a water reservoir; this is not improbable, but no experimental evidence is adduced, and the argument from structure alone is scarcely convincing.

Dr. F. Rosen writes on differences in staining between various parts of the nucleus, and between the sexual nuclei. His work is generally confirmatory of that of the zoologist Auerbach. He finds, on examining the vegetative nuclei of Scilla and Hyacinth that two kinds of nucleoli can be detected in the nucleus; the one has an affinity for red, the other for blue stains. The "erythrophilous" bodies are the true nucleoli; the "cyanophilous" granules form part of the chromatin framework. These are simply colour reactions, and are independent of the chemical composition of the stains employed.

The author's results are much more remarkable in the case of the sexual nuclei. He worked at Liliaceæ, and found that the generative nucleus of the pollen-grain takes up blue stains specially, while its vegetative nucleus is conspicuously erythrophilous. In the female organs, on the other hand, not only the nucleus of the ovum, but all the nuclei in the embryo-sac are erythrophilous, while those of the rest of the ovule give blue reactions on double staining. He believes, therefore, that he has detected a qualitative difference between the male and female nuclear substance. His statements apply to the chromatin framework of the respective nuclei.

These observations are curious, but their significance is very doubtful. The existence of a distinct male and female substance, distinguishable by reagents, is highly improbable in the light of our present knowledge of the phenomena of fertilization. It is noticeable that the author has not investigated the reaction of the sexual nuclei at the time of their fusion. Probably the differences which he has observed, like those recorded by some previous investigators, depend rather on the phase of development of the nuclei than on their sexual character.

Prof. G. Hieronymus is the author of two "Contributions to the Morphology and Biology of the Algæ." The former of these is on a curious freshwater Alga, Glaucocystis, hitherto placed among the blue-green forms. The author shows that it possesses a perfectly typical nucleus and chromatophores, and must therefore be removed from the Cyanophyceæ, and find a place among the higher Algæ, probably in the neighbourhood of the Bangiaceæ. The same applies to several other genera, which, on account of their colour, have hitherto been classed among the Cyanophyceæ.

The author's second paper is on the organization of the cells of Cyanophyceæ (Phycochromaceæ of Prof. Hieronymus). The existence both of chromatophores and nuclei in these plants has long been a subject of controversy.

As regards the former question, the author finds that the chlorophyll is contained in distinct granules, ranged in fibrillæ, which normally form a single or double layer in the peripheral protoplasm. The blue pigment, however, is dissolved in the cell-sap. He compares the green granules to the "grana" of Arthur Meyer, which, in typical chloroplastids, are the immediate seat of the colouring-matter. The colourless central portion of each "granum" may perhaps consist of a product of assimilation, such as paramylon. The fibrillæ formed by the grana are inconstant in number. They may sometimes become interspersed among the elements of the central body (nucleus?) of the cell. The author comes to the conclusion that, while the constituent elements of chromatophores are present in these plants, they have not become associated to form definite plastids.

Passing on to the supposed nucleus of Cyanophyceæ, Prof. Hieronymus confirms the observations of previous writers as to the presence in the middle of each cell of a comparatively large body of distinctly fibrillar structure. The tangled fibril is almost certainly a single one, and is moniliform, the granulations being the staining portions. Their substance has been called by Borzi cyanophycin. The author regards them as representing the chromatin bodies of a typical nuclear fibril, though not chemically identical with them. There is no nuclear membrane, and in the older cells the fibril frequently uncoils, so that its outer windings may even reach the periphery of the cell. The author therefore proposes to term the central body an "open nucleus" as opposed to the "closed nucleus" of higher organisms. The body differs then from a typical nucleus (1) in its chemical reactions, (2) in the absence of a limiting membrane, and (3) in the absence (so far as observed) of karyokinetic phases.

The cyanophycin, under certain conditions, is said to accumulate to an enormous extent, almost filling the cell, and sometimes assuming very definite crystalline forms. The author is disposed to regard it as a reserve substance, possibly the product of the direct assimilation of atmospheric nitrogen. His observations may be taken as establishing the existence in the Cyanophyceæ of a body agreeing in many respects with the nucleus of the higher plants, but much less sharply limited off from the other cell-contents.

D. H. S.

THE GEOGRAPHY OF LABRADOR.

The Labrador Coast: a Journal of Two Summer Cruises in that Region. With Notes on its Early Discovery, on the Eskimo, on its Physical Geography, Geology, and Natural History. By Adolphus Spring Packard, M.D., Ph.D. With Maps and Illustrations. New York: N. D. C. Hodges. (London: Kegan Paul, Trench, Trübner and Co., 1891.)

A LARGE part of this excellent work has already appeared in various journals published in the United States. These contributions are not known, we fear, so widely as they deserve to be—in this country at least—and therefore Dr. Packard has been well advised to gather the scattered fragments into a homogeneous whole, making, in the truest and widest sense, a geographical study of the greatest value and interest. Chapters vii. to xvii., with the exception of Chapter xiii., are entirely new, and contain the latest results of studies which the author has made peculiarly his own, with the result that his claim that the contents of this volume represent the state of our present knowledge of the coast and interior is perfectly well founded. The outstanding feature of the work is its wide scope, appealing as it does to the geographer, the geologist, the naturalist (to use the word in its more limited sense), the botanist, the ethnologist, and the historian. Each of these will find the subject in which he is interested treated with considerable skill, and, so far as opportunity for original research allowed, with minuteness and perspicuity. One fault we have to find with the style, and that is an occasional looseness in the use of nomenclature. This distracts the reader's attention, and, until he has gone back and re-read many passages, leads him to question several statements which, when their meaning is fully grasped, are seen to be correct but badly expressed. Should a second edition of the work be called for, revision in this respect would result in a very marked improvement.

To the question as to who first sighted the inhospitable shores of Labrador, Dr. Packard has devoted considerable space, carefully examining the various claims that have been put forward. He comes to the conclusion that the honour belongs to the Norseman Biarne, or Bjarne, who, without doubt, made a landfall somewhere in North America in 990. We are strongly inclined to agree with the result arrived at on this point. The author's experiences of navigation in the region under discussion, gave him opportunities of observing and demonstrating the rate of sailing made by modern ships, and on this basis he builds up arguments which tell with considerable force against the theories advanced by Dr. Kohl and others regarding the early Scandinavian seaman, who may now be considered the almost undoubted discoverer of one of the wildest and most forbidding coasts in the world.

The derivation of the name is of interest. Coming from the Spanish and Portuguese word for a labourer, it was applied to this part of America after the visit of Cortereal in 1500, as the survivors of the voyage, on their return, held out the hope that the natives might easily be brought into a state of slavery and shipped to the Portuguese colonies to work in the fields and be, in fact, labourers for their self-appointed masters.

We have many interesting particulars regarding the ice and snow of this region. The floating blocks and bergs were carefully observed, and the conclusion, now almost universally held by geologists, confirmed that ice carried by winds and waves against the shores has had little direct influence on the configuration of the coast line. After Dr. Packard's careful investigation of this question, the statement, so frequently met with, that the sea lochs of the west coast of Scotland were formed by the action of glacial gouges, may for ever disappear from our school-books. The only instance of such glacial effect was observed at Little Mecatina Island in the Gulf of St. Lawrence, where there is no true Arctic floe-ice. An instance of the impotency of what was at one time regarded as a great eroding agency, is noted in the fact that the ship in which the author spent a considerable time amid ice-packs, presented no abrasion on her sides, the paint being as whole and unbroken when she came out of as when she entered the frozen sea. No boulders, gravels, or mud were observed on any of the icebergs examined, but as they were all of considerable age, as was indicated by the marks of frequent overturning, they had, in all probability, dropped their burdens before reaching the southern area where they were inspected.

The portions of the volume dealing with the fauna and flora, both of land and sea, are well done, and ought to prove of the utmost utility and service to naturalists. Dr. Packard has done the work of an explorer in a most masterly manner, not only setting before us the geographical skeleton of Labrador, but doing much, so far as his opportunities went—and no man's have gone farther—to clothe the bones with an array of many of the necessary facts for the building up of a complete account of the territory. To those who come after him may be left the task of filling in many details; the greater part of the work has already been accomplished, and the record is before us in these pages.

There is an excellent index, but the maps and illustrations are far from clear, and require much more distinctness than has been given them. A word of the highest praise must be accorded to the bibliography, which must have given the author a vast amount of trouble before it assumed its present admirable shape.

THE SANITARY INSTITUTE AND ITS TRANSACTIONS IN REVIEW.

The Transactions of the Sanitary Institute, 1891. Vol. XII. (London, 1892.)

THE Transactions of the Sanitary Institute cannot fail to interest a considerable section of the community now that the general principles of sanitation have become so generally appreciated, and fresh sanitary matter is so eagerly devoured—and generally assimilated—by the enlightened section of the public.

It may not be generally known that the Institute only dates its birth from the year 1876, and this fact will be the more difficult to grasp when one notes in the well-bound volume of which we write, the present scope of its transactions.

The headquarters of the Institute are in Margaret Street, W., in a building known as the Parkes' Museum, so-called to commemorate the celebrated Hygienist of that name. The whole purpose of this museum is to serve as a means of practical demonstration for the diffusion of knowledge in sanitary science, and at the present day it undoubtedly forms the best collection in Great Britain of all the various apparatus and material which can be claimed to have any connection with the public health. The value of such an institution does not need insistence upon here; but the remarks of the chairman, Sir Douglas Galton, in his recent address, may be aptly reproduced. "The evils," he says, "of our congested population meet us at every turn. If our progenitors had been properly educated in sanitary matters, our towns would not have been allowed to contain unhealthy localities; houses would not have been permitted to be built on damp unhealthy sites; buildings would not have been constructed so as to impede the circulation of air and incidence of light. Our town populations would not have been allowed to grow up herded together like the beasts of the field, without moral training or self-restraint; and our country population would not have been allowed to destroy the healthy conditions which surround them, by vitiating the pure air, and by contaminating the springs of pure water. The Sanitary Institute is thus the direct outgrowth of the public need for sanitary education!"

An excellent descriptive catalogue of the contents of the museum has recently been compiled, and those only among the 11,500 persons who have visited the building during the year ending March, 1892, who were acquainted with the museum so recently as eighteen months ago, can appreciate at its true worth the value of this addition, and can adequately testify to the improvement in the arrangement and grouping of the various sanitary appliances which has also been effected. This catalogue is bound up with the last volume of "Transactions," which, in addition, includes a lengthy list of Fellows, Members, and Associates of the Institute; a list of the contributions to the very valuable library during 1891; a very full report of valuable and able papers of hygienic interest, which have been read by Dr. Louis Parkes, Mr. Grantham, Prof. Wynter Blyth, and Sir Douglas Galton. The volume also contains a copy of the Annual Report of the Council, and a glimpse of this gives one a capital insight into the scope and work of the Institute.

In the lecture-room, in addition to papers such as those referred to above, a systematic course of lectures for sanitary officers is given throughout the year by a staff of exceptionally capable lecturers, including as it does such gentlemen as Sir Douglas Galton, Prof. Corfield, Dr. Louis Parkes, Mr. Shirley Murphy, Prof. Wynter Blyth, Prof. H. Robinson, &c. That the worth of these lectures is appreciated is sufficiently exemplified by the fact that 161 students attended them during the year; nor are they lacking attractions similar to that which insured the constant attendance of young Mr. Parker at the village choir-meetings, for they are regularly patronized by one or two female devotees of the Goddess Hygeia. There are, however, lectures provided entirely for ladies by Dr. A. T. Schofield, who treated the following subjects in his last course:—

"The Domestic Treatment of Disease."
"Microbes."
"Physical Culture."
"The Care of Old Age."

These have been well attended, and the Duchess of Albany recently presented the prizes gained by those who emerged successfully from a competitive class examination upon these subjects. The Institute holds examinations twice yearly for inspectors of nuisances and local surveyors. At these examinations 361 candidates presented themselves during the year, and 246 received "certificates of competency." Both lectures and examinations are now being provided in several large provincial towns, at a great saving of expense and trouble to aspirants for the "certificate of competency," and with the apparent effect of considerably stimulating local interest in sanitary matters. Finally, the annual Health Congress held under the auspices of the Institute is always an instructive and interesting feature in its proceedings, and is largely attended and much appreciated.

OUR BOOK SHELF.

Cooley's Cyclopædia of Practical Receipts. By W. North, M.A. Camb., F.C.S. Seventh Edition, revised and greatly enlarged. (London: J. and A. Churchill, 1892.)

THIS work is intended as a general book of reference for manufacturers, tradesmen, amateurs, and heads of families, and contains information upon all sorts of subjects, from a list of abbreviations usually employed in writing, to a description of the rare metal zirconium. Between these two articles we find notices of the methods of brewing, and the proper way of laying bricks and ventilating houses, the nature and treatment of broken wind in horses, the composition of digestive, aperient, and tonic pills, the practice of photography, the nature of infective diseases in man and beast, the destruction of caterpillars in plants, the best kind of clothes to wear, and the method of taking grease spots out of clothing. From these samples of the contents it will be seen that the book is really a most extraordinary work of reference and one which is not likely to lie idle on the shelves, but to be more or less in constant use. The work of revision has evidently been carefully done, and must have been one of no small labour, as it has been brought well up to date and many articles must be entirely new. The great practical utility of the work is shown by the large circulation it has enjoyed for many years, and the editor has done his best to maintain the well-deserved reputation of the book.

Traité Encyclopédique de Photographie. First Supplement A. Par Charles Fabre. (Gauthier-Villars et Fils, 1892.)

MANY of our readers are already thoroughly acquainted with this excellent treatise which we owe to M. Fabre. In the present volume we have the first of the series of supplements which will be issued in order to keep the book well up to date. The range of progress here shown is that accomplished during the years 1889-92. The same arrangement as to numbering the paragraphs is still presented, so that it will be quite easy for those having the original volumes to refer to any section in this supplement.

The matter which is chiefly treated of here refers to the various properties and kinds of lenses and to their combinations: thus some of the most important headings that have been considerably developed may be stated as follows:—Methods of measuring focal distances, Martin's objectives, simple objectives, calculation of objectives, rapid euryscopes, Zeiss' objectives, &c. Many other new discoveries, such as Lippmann's photography in colours, have also received attention.

With these supplements this encyclopedia will be found to be greatly enhanced in value, for at the present day photography is undergoing many and rapid changes the recording of which in this form is no light task.

LETTERS TO THE EDITOR.

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

The Mustakh Exploration.

MR. CONWAY'S march from our newly acquired district of Hunza into Baltistan (reported in the *Times*), up the Hisper glacier on one side and down the Biafo on the other to Askolay, is a splendid feat to have accomplished, a memorable achievement, and his account of it will be something to look forward to on his return to England. The total length of these two glaciers is certainly something between sixty and seventy miles measured upon the map, and over this distance the glacial forces in action are on the grandest scale. The view obtained of the Hisper glacier from the two points we ascended on either side of the Nushik La is hardly to be described, from thence the end of the Hisper glacier is not defined, and could only be indicated from the run of the spurs on the north side of the valley, and what information the guides could give. This made the total length sixty-four miles. By traversing this length of the two glaciers Mr. Conway has been able to get into ground never before visited, viz., that great ice field on the main range of the Mustakh, the full extent of which is quite unknown, and from which the Nobundi Sobundi branch of the Panmah glaciers also descends. Most interesting will it be to read the account of this glacial area from the pen of a man who knows the Alps so well, and has ascended so many of its peaks. He has gone direct and fresh from the one to the other—what an exquisite treat—and he has now seen glacial action on the vastest scale it is presented at the present time in a mountain chain out of Polar latitudes. My experience was the reverse of this, for I had not the opportunity of seeing an Alpine glacier until twenty years after I had been surveying those on the Yarkund and Hunza frontiers, and in the interval the vividness of their aspects and minor details had much faded. It is to be hoped that Mr. Conway has with him, and used, a plane table, properly projected on the four miles to the inch scale, with all the peaks fixed by the Trigonometrical Survey of India, correctly plotted on it, and will thus be enabled to add to and correct much of the previous reconnaissance work. There is no doubt, had Capt. Younghusband, who was another late explorer in this part of the world, worked with a plane table along his line of route towards Hunza, the results of his exploration would have been of tenfold value, and far more extended. The Indian Government should make it a rule that all officers permitted or selected to explore the unsurveyed territory beyond our Indian frontier, should, as a preliminary training, do a season's work plane-tabling with a Himalayan survey party. It would also be an admirable training for officers selected for the Quartermaster-General's and Intelligence Departments.

H. H. GODWIN-AUSTEN.

Nebular Spectrum of Nova Aurigæ.

NOVA AURIGÆ faded away so steadily in March and April as to give little promise of soon again attaining any considerable brightness. All the more startling, therefore, was Mr. Espin's announcement of Mr. Corder's discovery that it had reappeared and that he himself on August 21 had seen it as a star of the 9·2 magnitude with a monochromatic spectrum, presumably about 500 mmm. in wave-length.

Fortunately the 15-inch refractor of this Observatory is still in working order, and still more fortunately my old colleague in the observation of Nova Cygni, Mr. J. G. Lohse, is staying here. On August 25 and 26 we were able to examine the Nova with a compound prism in the Grubb stellar spectroscope. The spectrum thus seen evidently contained two bright lines, the positions of which we determined as follows:—

Chief Line: Brightness 5 to 10.

Date.	Wave-length.	Measures.	Observer.
Aug. 25	500·4	4	R. C.
26	500·4	3	,,
25	500·5	3	J. G. L.
26	499·9	5	,,

Second Line: Brightness 1.

Date.	Wave-length.	Measures.	Observer.
Aug. 25	495·3	2	R. C.
26	494·6	3	,,
25	495·9	3	J. G. L.
26	495·4	5	,,

From these we may derive the mean values of 500·3 and 495·3, which prove, as we think beyond doubt, that Nova Aurigæ is now mainly shining as a luminous gas nebula.

Once or twice on the 25th August, at the best moments, I had noticed feeble traces of a condensed luminosity in the spectroscope, far away on the side of less refrangibility. Our time, however, was fully occupied in observing the two brighter lines and the zinc-lead spectrum, with which we compared them, until daylight prevented further observation. On the 26th, haze and bad definition concealed everything but the chief lines, but on the very clear night of the 28th, continuing the observations alone, I examined the star with a power of 229 on the wire micrometer, and wishing to see if the spectrum had materially altered I viewed the star through an excellent direct-vision prism. In this way I at once saw a faint continuous spectrum in the green, together with a distinct line in the yellow. With the spectroscope the line was also readily perceived, but not having prepared the battery for the illuminations and comparisons, no reliable direct measures could be made. By introducing the D-line into the instrument, however, I found the stellar line to be distant from it towards the violet by a quantity equal to the interval between the nebular lines. This gives a wave-length of 580·1, which agrees closely with a bright line in Nova Cygni, in the Wolf-Rayet stars, and in γ Argûs (compare *Copernicus*, ii. p. 112, and iii. pp. 205 and 206). The continuous spectrum seemed to begin somewhat suddenly at 569·4, and faded away about 540.

On each night of observation the star was about 9·6 magnitude. RALPH COPELAND.

Dunecht, September 6.

Daytime Seeing at the Lick Observatory.

To some of the readers of NATURE it may be a matter of considerable surprise, as it certainly was to the writer, to find the marked superiority which a small telescope sometimes offers over a large one for the observation of solar prominences.

On numerous occasions during the last year, while adjusting the large star spectroscope of this observatory to the 36-inch refractor, I have improved the opportunity to examine the limb of the sun with a Rowland grating. At no time, however, has it been possible to get any definition in prominence. With the 6-inch equatorial, on the contrary, one gets very fair definition, even in the middle of the day; while in the early morning, from six to eight o'clock, the seeing is, as a rule, superb. Thinking these differences might possibly vanish if the larger glass were used earlier in the morning, I have recently made a systematic comparison of the three equatorials, viz., the 6-inch, the 12-inch, and the 36-inch. For this purpose a small grating spectroscope (kindly loaned by the Chabot Observatory) was used with an adapter which fitted all three telescopes, so that the whole comparison could be made in a few minutes. The third and fourth orders of a 14438-line grating were employed.

The result of a half-dozen mornings' observations was that no detail whatever could be made out with the 36-inch, however much care one might use in the adjustment of his instrument. One could form a rough estimate of the height and general outline of the prominence, but nothing more.

On the 12-inch the general features were considerably more distinct, but the fine delicate tracings of the various parts of the prominence could be seen only with the 6-inch. The capping down of the 36-inch and the 12-inch failed utterly, as might have been expected, to improve the definition on any occasion.

The large image of the sun given by the 36-inch (six inches in diameter), combined with the poor seeing during the daytime, makes the instrument act, *for sunspot observation*, very much like an integrating spectroscope. The lines affected by absorption, in spots of any considerable size, can be picked out readily, but one finds it quite impossible to compare the absorption of the nucleus with that of the penumbra. These three telescopes each give images of nearly the same brightness, and one does not find much, if any, difference in the amount of dispersed light in the field.

During the dry season, the sides of the cañons surrounding this observatory become intensely hot, and highly heated currents of air are continually rising from them. So that, probably, the conditions which make the order of efficiency of these telescopes in the daytime just the reverse of what it is at night, are purely local. HENRY CREW.

Lick Observatory, August 19.

Ridgway on the Humming-birds.

MR. ROBERT RIDGWAY, curator of the bird department of the U. S. National Museum, has just published (in separate form), in the report of that institution for 1890, his monograph of the Trochili. Coming from such an authority and essaying to deal with such an interesting group, this work will undoubtedly command the attention of ornithologists, and be studied with the care it no doubt merits. It makes its appearance in octavo form, of some 130 pages, being illustrated by 46 full-page plates, and has besides a number of cuts in the text. The plates give us many species of humming-birds and their nests; they being all of the "electro-process" variety, and chiefly copied from Gould's princely work upon the Trochili. As is usually the case, most of the figures given have suffered by the method of reproduction employed, and not being coloured, they offer us, at the best, with but a poor idea of the "living gems" they are supposed to portray. With more or less thoroughness Mr. Ridgway has touched upon the early history and the literature of his subject; upon the geographical distribution of the various species; upon their number, which he makes out to be about 500; upon their natural history in general (treated in various brief sections); and there are descriptions of their external characters and a short note upon a few of their internal ones. It is with the statements made in the latter that I chiefly propose to deal in the present connection, and, aware as I am of our author's knowledge of the literature of what we may call the natural history and classification of the humming-birds, as contra-distinguished from their morphology and affinities, I must confess my surprise at his ignorance of the latter part of his subject. Mr. Ridgway remarks (p. 290) that "the humming-birds possess nothing absolutely peculiar, although certain features, shared by other groups of birds, notably the swifts (*Micropodidæ*), are developed to an extreme degree; as, for example, the very high keel to the sternum and consequent excessive development of the pectoral muscles, the short armwing (humerus) and extremely long handwing (manus), and minute feet with relatively large, strongly curved, and sharp claws. The humming birds and swifts further agree in numerous anatomical characters, and there can be no doubt that they are more closely related to each other than are either to any other group of birds. In fact, except in the shape of the bill and structure of the bones of the face, the humming-birds and swifts present no definite differences of osteological structure." As the present writer has probably published double the number of accurate figures illustrating the *entire anatomy* of a great many species of humming-birds as compared with any other worker; and, further, has published correct accounts of the same to the extent exceeding that of any three living avian-morphologists, and those figures and descriptions having been very extensively accepted as correct, perhaps our author will consider me competent to criticize the statement which I have just quoted from his work. Notwithstanding the extensive and painstaking labour I have given to such matters, I reckon it but as little when compared with the opinions given us by Huxley and Kitchen Parker in the same premises.

As long ago as 1867 (P. Z. S., p. 456), Huxley expressed the view that "in their cranial characters the swifts are far more closely allied with the swallows than with any of the Desmognathous birds, the swift presenting but a very slight modification of the true Passerine type exhibited by the swallow;" and Parker has said in *The Zoologist* for March, 1889 (p. 2), "I agree with my friend, Dr. Shufeldt, that the 'swallow and the swift are near akin.' My opinion is not the simple judgment it was forty years ago. I have observed a good many things since then in the structure of birds of all sorts." Both of these high opinions I can confirm, and in support of them, and as contradicting every statement almost that my good friend and ornithologist, Mr. Ridgway, has made in his work touching the structure of swifts and humming-birds, I would invite his attention to many comparative figures and accounts published by me in the Proceedings of the Zoological Society of London at various times, and also to an extensive paper of mine which appeared in the Journal of the Linnean Society of London, in 1888 or 1889, having been read at the Society by W. K. Parker, F.R.S., who accepted, in the main, what I had stated in it. Therein I anatomically compare the *entire* structure of *every* species of United States swallow with the corresponding structures in a great many swifts and a great many humming birds, and I would invite Mr. Ridgway's attention to the synoptical comparisons given on pages 376-378, especially as off-setting his statement, as quoted, that "in fact, except in the shape of the bill and structure of the bones of the face, the humming-birds and swifts present no definite differences of osteological structure." And, unless as a true systemist and believer in *colours and measurements* rather than in structural characters as determining the real affinities of vertebrate forms, I would finally invite his consideration of my comparative figures and description of the humerus of a swallow, a swift, and a humming-bird given in the Proc. Zool. Soc., Lond., for 1887 (pp. 501-503), and then ask his candid opinion upon the question whether the humerus of a swift is morphologically more like that of a humming bird than it is like that of a swallow, and the humerus is one of the bones that has been so frequently dragged into the discussion to prove cypselo-trochiline affinities.

Washington, D.C., July 24. R. W. SHUFELDT.

"The Limits of Animal Intelligence."

IT is with much pleasure that I have read Prof. Lloyd Morgan's letter, wherein he tells us that "the power of cognizing relations, reflection, and introspection" appears to him to mark a "new departure" in the ascending scale of psychical activities. His term, "feeling of awareness of certain relationships," is new to me, however, and seems to demand a further distinction. I am generally aware, in a vague way, of what I may be doing—that is to say I have a certain consciousness of it. But every now and then I find that I have done, without consciousness, things which I could not have done without the exercise of my sensitive faculty, or without the guidance of bodily movement, by that faculty.

I most cordially concur in the Professor's desire that the investigations to which he refers should be accompanied by "calm, temperate, and impartial discussion" founded on observation and experiment. I, as well as Prof. Lloyd Morgan, have long carried on such observations and experiments, and it is on them that are founded what I have written on "Our lower and higher mental powers" in chapters xiv. and xv. of my book[1] "On Truth." To them I may perhaps be permitted to direct the Professor's attention, since he is engaged with a work on Comparative Psychology. I have as little wish to dogmatize as has Prof. Lloyd Morgan, and am perfectly ready and willing to recognize the true rationality of any animal whenever I obtain evidence thereof. My assertion of the exclusive rationality of man has been represented as due to other causes than what I deem to be the weight of scientific evidence. Such is an utter mistake. To admit that animals possess intellect would neither be repugnant to my feelings nor conflict with any other of my convictions. As yet I hold all animals to be irrational, simply because I have met with, in them, nothing inexplicable by what the Professor calls "simple awareness" and what I call related feelings. All prejudice should indeed be eliminated from scientific inquiry, but such can hardly be the case with any one who starts from an *a priori* "standpoint of evolution" in the sense that he holds discontinuities in nature—real "new departures"—to be impossible.

The Professor says: "In conclusion I must be allowed to say that the phrases 'differences in kind' and 'differences in degree' savour somewhat of mere Academic discussion." Nevertheless there really are differences of kind, and such differences are themselves different in kind from mere differences of degree. He would, of course, allow that the difference between the Binomial Theorem and the Bouquet of Chateâu d'Yquem is one "of kind," as also that between solving the *Pons asinorum* and riding *Equus asinus*. I am convinced there are also psychical differences of kind, and I have become so convinced (in spite of having started with a contrary opinion) through experiments and observations.

ST. GEORGE MIVART.

Hurstcote, September 6.

The Theory of the Telephone.

IN a paper in this month's *Phil. Mag.* I ventured to publish an explanation of the fact that in the telephone it is necessary for the diaphragm to be situated in a permanent magnetic field.

Since then my attention has been called to a paper (*The Electrician*, Feb. 11, 1887, p. 302) by Mr. Oliver Heaviside, in which he has given a very complete theory of the question at issue.

I hasten to express my regret that I had not met with this paper in time. FRED. T. TROUTON.

Physical Laboratory, Trinity College, Dublin.

Crater-like Depressions in Glaciers.

IN the note on the St. Gervais Catastrophe (NATURE of September 1) I read that a crater-like depression had been found in the Tête Rousse Glacier. As such depressions are quite exceptional occurrences in European glaciers, it may be of interest to note that I found several holes of a similar kind in the great Tasman Glacier in New Zealand. One of these reached—like the Tête Rousse one—apparently to the bottom, the others, which were from 150 feet to 300 feet deep, did not. The walls of these "craters" were not vertical but above only 45°, the incline increasing below. Till now I have considered these funnel-shaped depressions as immensely widened "Glaciermills," but after the observation on the Tête Rousse it seems to me not improbable that these holes on the Tasman were also originally caused by subglacial collapse.

R. VON LENDENFELD.

[1] Referred to on p. 266 of NATURE for July 21, 1892.

CHOLERA: PREVENTION AND VACCINATION.

THE epidemic of cholera with which this country is threatened seems likely to test very completely the means for the prevention of its spread which have been devised as the result of the extended experience of some of the ablest hygienists. The working out of the history of an epidemic disorder must necessarily be extended over a prolonged period of time, for it is dependent on the researches not only of the clinical observer, but of the pathologist and the bacteriologist and of those who devote themselves to the difficult study of the march of epidemics. The development of such researches is closely allied to the advance of science generally, and although there is at any one period a large admixture of "fashion" in the opinions held by experts, yet in time this fades, and the truth is established. It cannot be too clearly stated that the best measures for the prevention of an epidemic disorder can only be devised when we possess an accurate knowledge of the infective agent of the disease (bacillus or not, as the case may be), of its life-history, of its varying degrees of virulence, and the mode of entrance into the body, of the conditions under which it multiplies, and of the changes which it produces in the human body.

In the case of cholera our knowledge is not yet complete. Clinical observers many years ago showed that the infective agent was present in the peculiar evacuations passed by the cholera patient, and it was further found that these evacuations were the means of contaminating the water supply of a locality, and so causing the spread of the disease in the community. These two facts have been established beyond doubt. The exact nature of the living infective agent is not, however, so well ascertained. It was in 1884 that Koch described the *Vibrio Choleræ Asiaticæ* as constantly present in the evacuations of cholera patients, but he was unable to prove that it was the cause of the disease, owing to the insusceptibility of animals to cholera. It was shown that the vibrio was present also in the intestinal walls, but it was never found in the organs of the body. The work of subsequent observers has brought forward fresh facts of importance. It is now known that the cholera vibrio (the comma bacillus) is allied to several other forms which are pathogenic, and that there are several varieties (perhaps twelve) which have been described by Dr. Cunningham. The cholera vibrio is also known to vary greatly in virulence; it is so susceptible to its surroundings that a slight change will diminish its activity and certain conditions will increase its virulence. One method of increasing its activity is by passing it through a series of animals (guinea-pigs); after a certain time the vibrio becomes extremely active and will kill animals very quickly, it is said in even eight hours. With these virulent cultures symptoms have been produced in animals closely resembling those of Asiatic cholera; in the exudation of liquid into the intestines, in the cramps, in the suppression of urine, and in the collapse so well known in the disease in man. There are therefore certain grounds for considering Koch's vibrio as the cause of Asiatic cholera. But the question is not settled: it is not as clear that the vibrio is the cause of Asiatic cholera as that the bacillus anthracis is the cause of anthrax. The probabilities are greatly in favour of this presumption, but the slight doubt existing must be borne in mind when the question of vaccination for cholera is to be considered practically. The doubt that rests on the vibrio as the cause of cholera may be stated shortly in the fact of the existence of allied forms of bacteria which produce similar symptoms, such as the vibrio Metschnikovi. We know, too, that in man cholera is produced by what is drunk, and yet animals fed with the vibrio do not get any of the symptoms which have been mentioned, unless they are "prepared" by a course of treatment, either by neutralizing the acidity of the contents of the stomach, and subsequently giving a dose of opium to quiet the intestines, or by giving a dose of alcohol with the vibrio. This vibrio cannot get through the acid stomach alive. The answer to the question as to how it gets through the human stomach rests partly in the fact that in the early part of digestion, or in between meals, the stomach is not very acid, and so there may not be a sufficient degree of acidity to kill the vibrio. Such remarks would, however, equally apply to the guinea-pig stomach; and the question as to why in animals the swallowed vibrio does not produce choleraic symptoms unless the animal is "prepared" is still unanswered; although such animal may be killed by an injection of the virulent preparation of the vibrio into its veins. This difficult point can only be settled by investigations along new lines, probably chiefly chemical.

One point suggested by the investigations of the cholera vibrio which we surmised previously to 1884, is that the infective agent in the disease not only primarily attacks the intestines, but grows there, producing the symptoms of the disease by its chemical products, without itself entering the blood stream This has an important bearing on the question of vaccination for cholera. The experimental investigation of vaccination against infective disorders is a product of modern bacteriological research. It is too long a question to deal with in a short article; it is sufficient to say that it is based on the fact that a mild form of the disease may be produced in an animal, which will then be protected from the virulent disease. As in Pasteur's historical experiments, the attenuated or weakened anthrax bacilli were found, when injected into a sheep, to prevent the animal dying when it received a dose of virulent bacilli, which would undoubtedly kill it in ordinary circumstances. This vaccination, when put into practice, was found to diminish the amount of natural anthrax in sheep in France. Similar results have been obtained with the vibrio of Asiatic cholera by some of Koch's assistants, and latterly by M. Haffkine, in the Institut Pasteur in Paris. Haffkine attenuated the virulent vibrio by means of a current of air and other means, and obtained a culture which did not kill animals, but protected them against a subsequent injection of the virulent vibrio itself. The vaccine was also injected into human beings (who lent themselves for experiment), and was found to produce a local inflammation associated with some degree of fever, all the symptoms passing away in a short period. It is probable that the majority of "vaccines" would produce these symptoms. It is, however, a great step to apply vaccination experiments in animals to human beings when the etiology of the particular disease is not completely worked out, and there is, perhaps, too great a tendency in modern research to extend "vaccination" experiments in infective diseases before a correct knowledge of the mode of action of the infective agent has been obtained. It has been pointed out that doubt rests on the vibrio choleræ Asiaticæ as the true cause of Asiatic cholera. It may be; but to impartial observers it has not been proved to be. Vaccination for cholera on a large scale would therefore at present be a mistake, as it might possibly lead to carelessness in the carrying out of better tried preventive measures, which depend not only upon the State but also on the private individual. As a promising field of research, it might be applied to man, since the vaccination itself appears to do no harm. But it requires a long time to decide so difficult a question, and in the meantime the community is face to face with cholera. It is therefore more practical to consider preventive measures than vaccination.

Preventive measures against cholera are of two kinds, those taken by the State to prevent the importation of the disease from cholera-stricken districts, and those which ought to be practised by individuals when cholera is prevalent in the community. Both sets of measures depend upon two well-ascertained facts, viz. that each cholera patient acts as a focus of the disease, and that the disease is spread by the evacuations contaminating the water supply. The State can prevent the importation of cholera by quarantine, but this method has been abandoned in England for many good and obvious reasons, and another substituted for it which is considered as likely to be more effectual, but which can only be applied with an efficiently working sanitary organization. In this country we get cholera by ships bringing cholera-stricken people, who are landed. At all the ports, in times of cholera, the ships are boarded by the medical officer, and if any cases of the disease are present they are taken to isolation hospitals, whilst those who are well are allowed to land after leaving their names and destinations. The medical officer of their district is communicated with, and keeps them under surveillance for some days. The cholera ship is moored to a special buoy and disinfected. If no cases of cholera are present on the ship, the passengers and crew are allowed to land, the taking of the names and addresses being left to the discretion of the medical officer who inspects them. It is possible that no better method than this could have been devised, which, with the least inconvenience to the individual, would at the same time keep under surveillance all the imported cases of cholera, and thus check the spread of the disease. It is evident that such a method is quite impracticable without efficient sanitary officers; it would, for example, be useless in a country like Turkey, where the system of quarantine and sanitary cordons exists as in most other European countries. And in our country the application of this method of isolation and surveillance is surrounded by practical difficulties and dangers which may become serious, and which are in any case worthy of discussion. It is quite possible that the medical officer of the port will have too much to do. At present the cholera epidemic at the Continental ports, even in Hamburg, appears to be diminishing, and it may disappear when the cold weather comes, to reappear with unabated virulence next spring. As this is probable, no decrease of vigilance of medical inspection is permissible during the winter months; and it is to be hoped that the sense of security felt by the community at the diminution of cholera on the appearance of cold weather will not extend to the medical officers in whose keeping the general health of the nation lies. If, next spring, cholera becomes disseminated along the Channel on our opposite shore, the medical officers of our ports may be exercised to their utmost in providing accommodation for patients on cholera-stricken ships, and some, apparently well, may proceed to their homes and develop the disease before the medical officer of their district has been advised of their advent. This is, no doubt, a danger which might come even from a ship which has been passed by the port medical officer with a clean bill of health.

The personal measures to be taken when cholera is in our midst are important, but need only be mentioned. Since cholera spreads by the evacuations, these must be disinfected with hydrochloric acid, carbolic acid, or corrosive sublimate as soon as they are passed; and all linen soiled by a cholera patient must be rigidly disinfected. Since the water supply may become contaminated, all water used for drinking, washing utensils, &c., must be boiled, and all articles of food, such as milk, likely to be contaminated with unboiled water, should also be subjected to the heat of boiling water. When these and similar measures for personal protection are rigidly observed, it is not too much to say that cholera will not spread.

THE PLANET VENUS

M. E. L. TROUVELOT has published a most important and extensive paper on some observations of the planets Venus and Mercury, which for many years past have been occupying his attention. The physical features of the other planets have been treated on previous occasions in like manner, and have extended our knowledge very considerably, so that the reader of this work will be sure to find something really new in the great number of observations that are here recorded. Up to the month of April, 1882, the observations were made at Cambridge, United States; but since then Meudon has been the seat of operations; the air at the latter place did not prove so pure as that in the States, and the horizon not being so open, the number of observations of course was somewhat reduced.

In the work which we have before us the author divides this subject up into nine sections, and we cannot do better than treat of each of them in turn, commencing with the visibility of Venus to the naked eye in full daylight. The best way is, he says, to use the telescope as a pointer, directing it to her by means of the circles; by then looking along the telescope tube he has been able to see her at every point of her orbit, when her angular distance from the sun towards inferior conjunction was not less than 10°, and also towards superior conjunction when she was not less than 5°. Her visibility depended to some extent on the phase she represented, for it is known that the eye can distinguish more easily a disc small and distant than a comparatively larger and nearer crescent. At Cambridge it seems to have been more or less the rule, while at Meudon it was the exception, to see Venus in the daytime, the atmospheric conditions at the latter place being comparatively very bad.

With regard to the general aspect of Venus nothing very striking has been noticed; the part of the limb turned towards the sun, as recorded by other observers, always appeared more brilliant than the more central portions extending towards the terminator. Sometimes the limb was not so bright as usual, being observed to be "dull and without brilliancy," one very noticeable time occurring on April 15, 1878.

Under favourable conditions, whitish and greyish spots can be seen on the surface of Venus, which, at any time, are very difficult to observe. These different-tinted spots give, according to M. Trouvelot, indications of being at different levels. The whitish spots, situated near the terminator, produce on it slight deformations, and seem to so alter it as to suggest that these spots are at a higher level than the other parts. The greyish spots, on the other hand, when situated in about the same positions, also deform the terminator to a small extent, but in an opposite way to those just mentioned, suggesting that these spots lie at a lower level than the parts near them. These two kinds of spots have another peculiarity which has been particularly noticed, and that is their size; the white ones seem to assume a round or slightly oval form, and are nearly always small, but the grey spots are generally of an elongated shape, and are of very large proportions, forming sometimes straight bands. The interval between the appearance and disappearance of these spots is not long; in their formation they are analogous, as M. Trouvelot says, "avec ces taches diffuses des couches nuageuses continues de notre atmosphère précèdent les pluies, et qu'un simple jeu de lumière fait naître ou disparaître." Their contours are always very vague, the whites being a little less brilliant, and the greys a little less dark.

One of the largest spots that has been diligently observed was that which appeared on the 3rd September, 1876. Its size, as will be seen from the figure, was, comparatively speaking, enormous, occupying nearly a third of the illuminated visible surface. At its north and south extremities it was separated from the terminator by a large white band, the north one being considerably larger than the southern one. Up to the 10th of the same month this spot was still visible, but after that date no trace of it at all could be found. Curiously enough, on February 13th, 1891, another large grey spot (Fig. 2), bordered with white, made its appearance, and was very similar to the one we have just mentioned, both with regard to its position and form—indeed, the resemblance was so striking that the spots were considered the same.

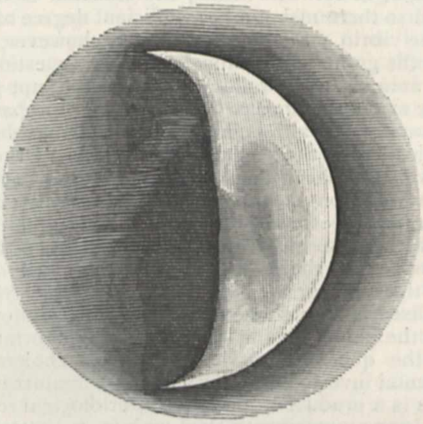

Fig. 1.—Showing the large spot on September 3, 1876.

Why it should have disappeared so soon in 1876, and become visible again in 1891, is a mystery which is hard to fathom.

Perhaps one of the most interesting features visible on the surface of Venus are the two snow caps (Figs. 3 and 4) at the extremities of her poles. These spots, as M. Trouvelot says, surpass in brilliancy and importance all that he has ever observed. In 1877, on November 13th, a white spot was seen at the north limit of Venus; its brilliancy attracted considerable attention, resembling

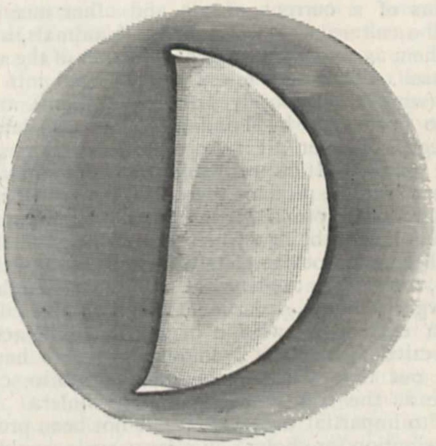

Fig. 2.—Large spot visible on February 18, 1891.

very much those situated on Mars. On the following day, another spot, also very striking and of the same character, diametrically opposed, was observed. The question then arose as to the cause of these spots, and we may here quote an entry that was written in the observer's book on the 17th of the same month:—"Est-ce que Vénus aurait des taches blanches semblables aux taches polaires de Mars?" The seeing of these spots was by no means a difficult task, and it seemed certain that if they were snow caps as suggested, perhaps they had been previously observed. This was the case. On June 9 and 17, July 20, August 1 and 27, 1876, and February 5, 1877, observations of these spots had been recorded in the notebook, but owing to their not having attracted very great attention at the time, they were regarded as ordinary spots. That they are analogous to the white spots on Mars is now undoubted: they have the form of a uniform white segment of a circle, which, when seen edgeways, appear as simple lines; they are always exactly 180° apart; sometimes only one is seen because the other is not lighted up by the sun; they are always approximately near the terminator, and seem to oscillate backwards and forwards, balanced, so to speak, around the axis of the planet; and, lastly, they are of a permanent nature, their disappearances being due not to their annihilation, but simply to the fact that they cannot be seen when receiving no light upon them. One main feature in which they differ from the spots on Mars is that they neither increase nor decrease with the seasons, at any rate to a sufficient extent to be sensibly noticed.

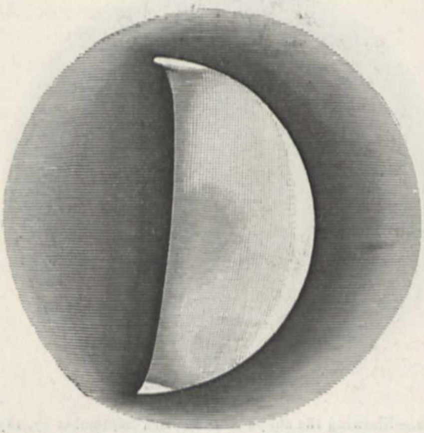

FIG. 3.—The snow caps, February 20, 1891, 10h. 45m.

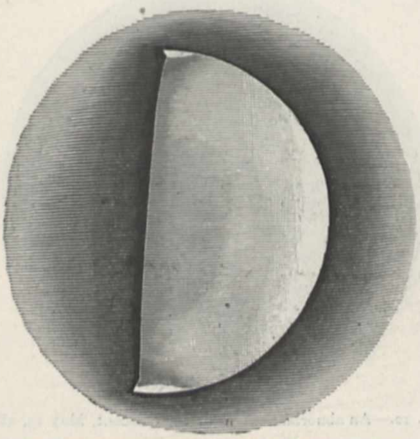

FIG. 4.—The snow caps, February 25, 1891, 10h. 15m.

When Venus is in a favourable position for observation many details on these spots have been recorded. M. Trouvelot mentions here some bright spots (Figs. 5 and 6), which seem to be very numerous, and resemble the bright specks which are seen on the terminator of the moon, "sinon qu'elles sont plus brillantes, surtout sur leur bord interne, et qu'au lieu de petits cratères, elles sont entièrement couvertes et hérissées de pics et d'aiguilles, qui, parfois, réfléchissent la lumière avec une si grande intensité, que ce bord apparaît tout constellé d'étoiles alignées comme les grains d'un collier de pierres précieuses, sans quelques irrégularités dans cet alignement." The whole appearance seems to suggest that the spots are at a higher level than the contiguous parts of the planet situated at the edge. This idea is also further borne out when the phase of the planet is a small crescent, for then much more of the polar cap is found to be visible than should be the case if the form of the phase was an exact crescent. In many cases a penumbra has distinctly been seen, and in one of them it was so strong and distinct on that part of the terminator lying between the two polar caps, that it lasted for a month, the spots remaining clear and brilliant throughout their entire length. Ever since the year 1700, observers of Venus have remarked these two spots that occupy the polar regions. La Hire and Derham, observing the inequalities of the surface at the extremities of the crescent, believed that they could be produced by mountains higher than those on the moon. Bianchini at Rome, Schroeter, Gruithuisen, and several others, all have reported the existence of such markings, but they were never led to conclude that they were snow caps analogous to those on Mars.

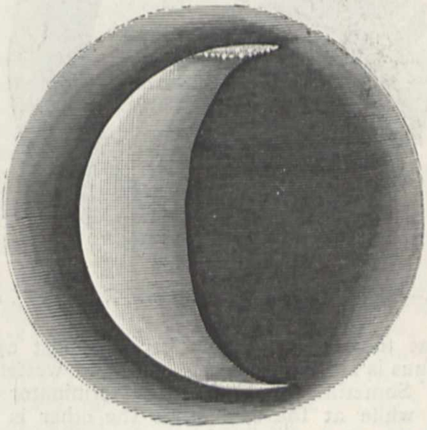

FIG. 5.—Details on the snow caps, January 19, 1878.

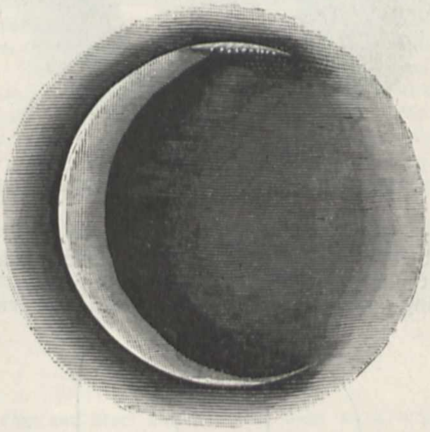

FIG. 6.—The snow caps, February 5, 1878.

To obtain a general idea of the ruggedness and smoothness of the planet's surface, the terminator has helped to considerably distinguish the high and low elevations and depressions respectively. The surface of Venus from such observations as these has been found to be considerably studded not only with small, but with great differences of configuration, the terminator varying greatly in many phases of the planet. M. Trouvelot's results

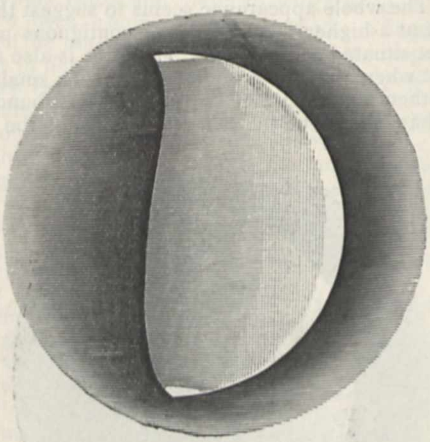

FIG. 7.—Showing irregularity of Terminator, November 23, 1877.

show that these deformations become most apparent when Venus is at her greatest eastern and western elongations. Sometimes one half of the terminator is seen concave, while at the same time the other is convex

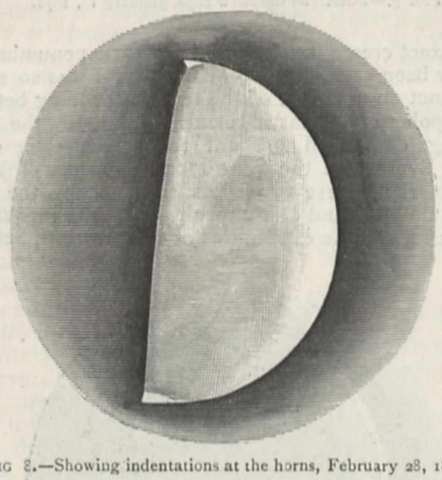

FIG 8.—Showing indentations at the horns, February 28, 1891.

(Fig. 7); small indentations at the horns (Fig. 8) also seem to be of common occurrence, and occasionally the curve of the terminator is perfect, no trace of any irregularity being noticed. Not only then does the terminator

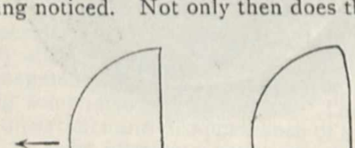

FIG. 9.—February 5, 2h. FIG. 10.—February 5, 5h. 43m.

change in form, but changes are found to occur very rapidly in intervals of only a few hours. To take one case out of many, we may quote the instance recorded in 1881 on February 5 at 2 p.m. (Figs. 9 and 10). At this time the terminator appeared as a straight line showing Venus then in apparent quadrature, but at 5h. 43m. this line was quite gibbous, and its curve regular. A very important point about the repetitions of the same deformations is that they do not occur at exactly the same time each day, but appear to change the hour of observation, "the periodicity of these phenomena, if periodicity there is, not being exactly twenty-four hours."

From a long series of observations, the most striking irregularities were found at the extremities of the ter-

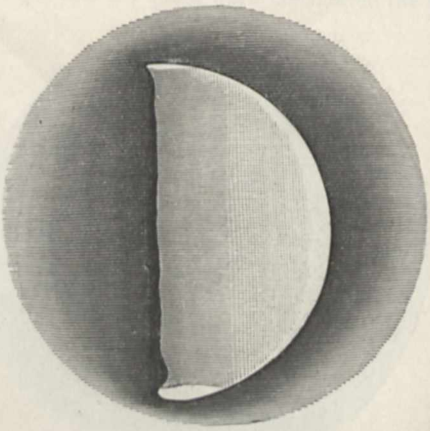

FIG. 11.—Showing the shape of the horns, September 27, 1876.

minator close to the edge of the pole caps, where deep niches were often recorded. These indentations were noticed to be generally of different sizes and shapes, sometimes the north one being larger than the southern one, and *vice versâ*. They also underwent very rapid changes even in the space of a few hours, a case occurring on September 27, 1876 (Fig. 11). "At one time the extremity of one of the horns would be more or less truncated, when the other would be sharp, and some hours later the

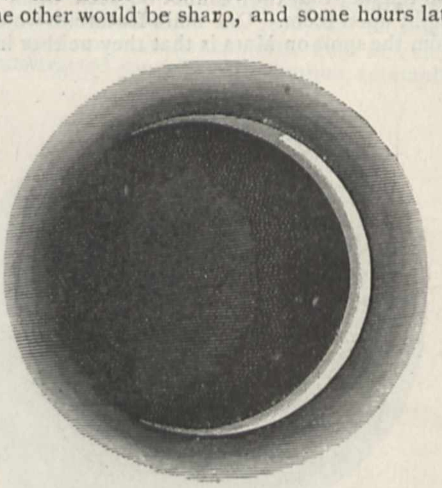

FIG. 12.—An abnormal extent of the crescent, May 13, 1881.

reverse would be the case, that which was sharp being truncated, and that which was truncated being sharp." M. Trouvelot concludes that his observations bring out a very important fact—"qu'il a une relation très étroite entre les déformations les plus importants subies par le terminateur et par les cornes, et les taches polaires de la planète"

When Venus approaches inferior conjunction with the sun, its crescent gradually diminishes until the illuminated surface is turned exactly away from us. Just before this position is reached, the crescent has been found to present many curious features. The most prominent of them is that this fine crescent is sometimes observed to extend to a greater angular extent than 180° (Fig. 12), 260° of the limb of the planet having once been recorded. Sometimes, by adopting special precautions, the whole circumference has been observed, the obscured disc being completely surrounded by a pale and thin luminous ring. This, as M. Trouvelot says, is of very rare occurrence, for it has happened that although the greatest precautions have been taken, no trace of the planet could be found.

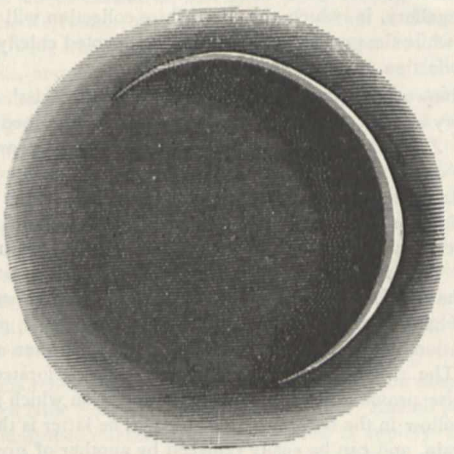

FIG. 13.—Showing the bulging out of the crescent as seen on February 24, 1878.

When the crescent is extremely fine, great irregularities have been noticed to mar the continuity of its curve; they differ also not only at different but at the same conjunctions according as the planet is to the east or west of the sun.

Another fact that has been observed relates to the bulging out of the planet (Figs. 13 and 14) at some parts of its visible limb. This was especially noticed in the month of February, 1878; while the crescent was being

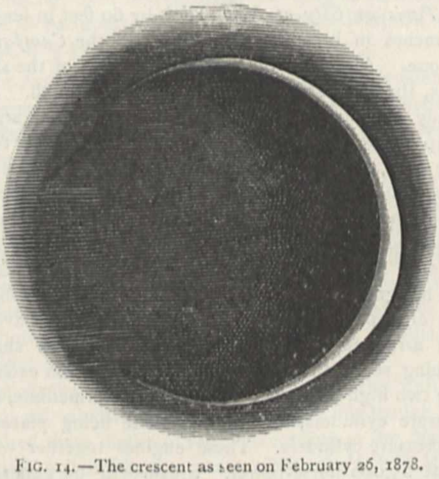

FIG. 14.—The crescent as seen on February 26, 1878.

looked at, the south-south-east portion seemed to suddenly appear thicker than the remaining part. In fact, the observer in the first instance thought it might have been due to some optical defect in the instrument; but subsequent observation showed that this was not the case, a real change of form having taken place. Two days later this deformation was still more noticeable, the thickness of the visible section being about double what it would have been had it been in its normal condition.

Perhaps one of the most important points referred to in this work is the determination of the period of rotation by means of the spots. This question of rotation is one that has baffled many observers, for the difficulty that has presented itself lies not only in the proper motions of the spots themselves, but in the identification of the same spots after brief periods of time. Glancing over some of the periods already obtained, we find that Schroeter deduced from his observations a rotation of about 24h., basing his value on the movement of a small isolated spot situated in one of the horns. Fritsch's value of 23h. 22m., and P. de Vico's 23h. 21m. 21s., are both also of about the same length. From observations by D. Cassini and F. Bianchini, we have a very wide deviation, the periods of rotation being reckoned in days, the former arriving at a value of 23 days, and the latter at a somewhat larger one of 24 days 8 hours. Coming now to Schiaparelli's value of 225 days, we have here altogether a new departure, the planet rotating on its axis in the same time as it revolves round the sun.

With such values as these it will be at once seen that there is something radically wrong with the spots or their positions on the planet's surface; in some cases, of course, there might have been instances of mistaken identity, but with such an observer as Schiaparelli, who very definitely settles upon a 225 daily period obtained from direct observation, it is hard to conceive that any such sources of error would not have been remarked.

The observations which we have now before us bear out Schroeter's view of a short rotation, Prof. Trouvelot telling us that they were made during the years 1876–78 under exceptionally good conditions. One very interesting point which is of great importance is the fact that these observations were made at the same period, "souvent dans la même journée, sous un ciel également propice et précisément sur la même point de la planète."

The value nearest to 24 hours that Prof. Trouvelot obtained was 23h. 49m. 28s., and in giving this period he remarks that it is founded on the supposition that the spot had no proper motion. In referring to the period deduced by Schiaparelli he says, "La cause probable de l'erreur de M. Schiaparelli semble résulter de ce fait que les taches *h* et *k*, qui ont servi de base à ses conclusions, faisaient partie de la tache polaire méridionale qui, étant située centralement sur l'axe de rotation de la planète, semble rester stationnaire, comme cela se voit sur la tache polaire de Mars, quand elle se trouve réduite à de faibles dimensions." Taking into account many of the general features visible on the planet's surface, such as the rapid deformations of the horns and of the terminator, all these point to short periods of rotation, which, as Prof. Trouvelot points out, is "inconciliable avec la période de rotation, si lente et si inattendue, déduite par l'éminent astronome de Milan."

In concluding our remarks we cannot help mentioning the very complete way in which Prof. Trouvelot has taken into account the prior work in this interesting field of inquiry.

W. J. L.

NOTES.

THE Iron and Steel Institute will meet at Liverpool from Tuesday, September 20, to Friday, the 23rd. Sir Frederick Abel will preside. The following papers will probably be read and discussed:—(Tuesday) on the condensation of ammonia from blast furnaces, by Sir L. Bell, F.R.S.; on alloys of chrome and iron, by R. A. Hadfield; on the Liverpool overhead railway, by J. H. Greathead: (Wednesday) on the engineering laboratories in Liverpool, by Prof. H. S. Hele-Shaw; on the Siemens-Martin process at Witkowitz, Austria, by P. Kupelwieser; on failures in the necks of chilled rolls, by C. A. Winder: (Thursday) on a new process for the elimination of sulphur, by E. Saniter; on the elimination of sulphur from iron, by J. E. Stead. On Tuesday evening the members and their friends will dine together, and on Wednesday evening there will be a conversazione in the Walker Art Galleries, offered by the Mayor of Liverpool and Mrs. James De Bels Adam. A part of each of the first three days will be devoted to the inspection of various works, and on Friday there will be excursions, one party going to Chester, another to Stoke-on-Trent. If a sufficient number of names are given in, there will also be an excursion to the new Water Supply of Liverpool at Lake Vyrnwy.

THE Sanitary Institute, whose Transactions for 1891 are reviewed elsewhere, is holding its thirteenth annual Congress this week at Portsmouth. About 400 members are attending the meetings. The proceedings began on Monday, when Sir Charles Cameron, the president, delivered an address on "The Victorian Era, the Age of Sanitation." He presented a very interesting sketch of the good results which have sprung from the improved sanitary methods of modern times. The frightful mortality of London and other cities in the last century he described as an evil due to insanitary conditions. By the earlier part of the nineteenth century the grosser defects had been remedied, and the death-rate had been greatly reduced. For about half a century no further improvement took place, but with the passing of the Public Health Acts of 1872 and 1875 an era of active sanitation ensued, with the result that the death-rate fell sensibly in nearly all the towns. Sir Charles urged that the success of past sanitary work ought to encourage us to redouble our exertions to reduce the urban death-rate to at least that of the most healthy of our towns.

THE International Congress of Orientalists finished its scientific labours on Friday last, and every one connected with it agreed that the meetings had been most successful. On Saturday a good many members visited Oxford, while others went to Cambridge. Both parties were cordially received by representatives of the Universities. A meeting held on Monday for the despatch of business brought the proceedings to a close. At this meeting a number of reports and resolutions were read by the secretary, Prof. Rhys Davids. The first resolution proceeded from the Semitic section, and recommended that the Government should be urged to subsidize the study of modern Arabic. The Assyrian and Babylonian sub-section, and also the Egyptian section, passed a resolution in favour of holding at least one combined meeting of the Assyrian and Egyptian sections. The anthropological section expressed its sense of the political as well as the scientific importance of the anthropometric investigations now being conducted in Bengal. The same section also expressed its view of the desirability of forming a collection of Oriental folk-lore on a scientific basis. In the Semitic section a committee had been formed, consisting of men of science from different countries, for the purpose of preparing an Arabic-Mahomedan encyclopædia. At the head of this committee was Prof. Robertson Smith. The Australasian section desired to express its sense of the immediate necessity of pressing forward research into the physical character, languages, arts, customs, and religion of New Guinea. Count Angelo de Gubernatis moved a resolution, which was seconded and carried, in favour of the establishment of an International Institute of Orientalists, with its headquarters in London. It was decided that the next meeting of the Congress should be held at Geneva in 1894—the meeting to be postponed until the following year if circumstances should render such postponement necessary or desirable. On the motion of Prof. Ascoli, seconded by Prof. Drouil, a vote of thanks to the President was cordially passed. In the evening a dinner was given at the Hôtel Métropole by the Organizing Committee to the foreign members.

THE Perthshire Society of Natural Science is one of the most enterprising of British local societies, and we are glad to hear that it is about to give fresh proof of its energy by extending its museum. This includes two excellent collections—the one a general or index collection, intended, by means of carefully-selected specimens, to act as a guide to the study of natural science; the other, a Perthshire collection, intended to give a complete view of the fauna, flora, and geology of the district. These collections have grown so rapidly that there is not now sufficient accommodation for them. It is proposed that the deficiency shall be met by the erection of a supplementary museum hall and gallery, in which the Perthshire collection will be displayed, while the present building will be devoted chiefly to the index collection.

AN improved spherometer, constructed in Zeiss' optical laboratory at Jena after Prof. Abbe's design, is described in this month's *Zeitschrift für Instrumentenkunde*. It is made to measure down to 0·001 mm. To eliminate errors due to the indefinite nature of the base circumscribed by the three legs of the ordinary spherometer, the surface to be measured is laid upon a circular ring, and the contact rod is screwed up from below. This ring has two sharp concentric edges 0·5 mm. apart, the one for convex and the other for concave surfaces, made of hard steel and ground down to the same level, giving a combination which is less liable to be damaged than a single edge. The ring rests without fastening on a perforated horizontal disc provided with a cylindrical projection which just fits into a hollow in the bottom of the ring. The latter is thus free from strain, and can be easily replaced by another of greater or less diameter. The height of the graduated contact rod is read by a micrometer microscope. The first reading is taken when the contact piece touches a plate of plane-polished glass laid over the ring. The plate is then replaced by the surface to be measured, and its radius of curvature calculated by the usual formula.

ON Thursday, the 8th inst., the Cunard Royal Mail twin screw steamer *Campania* was launched from the yard of the Fairfield Engineering and Shipbuilding Company. This is the largest ship afloat, the dimensions being: length, 620 feet; breadth, 65 feet 3 inches; and depth, 43 feet. It exceeds the *City of Paris* or *City of New York* by 60 feet in length and 2 feet 3 inches in breadth. The launch of the *Campania* was an ideal one. Although the launching weight of the ship was 9000 tons, there seemed to be not the slightest hitch. At 2.45 p.m. Lady Burns performed the launching ceremony. The huge ship immediately began to move and slowly travelled down the ways, entering the water amidst the loud cheers of some 80,000 people. The Fairfield Company have every reason to be proud of this feat. Not only was the weight to be launched unprecedented, but, the Clyde at this point being very narrow, the big ship had to be stopped immediately she was afloat owing to her great length. The *Campania* will be driven by two sets of triple expansion engines, each set having five cylinders arranged to drive a three-throw crank shaft, the cranks being set at the angle of 120 degrees from each other; there are two high-pressure cylinders, one intermediate, and two low pressure cylinders, the high-pressure being placed above the low-pressure cylinders. These engines together will indicate about 25,000 horse-power. Steam will be generated by twelve large double-ended boilers with ninety-six furnaces. An auxiliary single-ended boiler is used for supplying the steam for the electric lighting and secondary purposes throughout the ship. The main boilers are arranged in two groups, each group having a funnel 19 feet in diameter. It is expected that the speed attained will reach twenty-two knots on the trial, and it is hoped, when the engines have settled down to their work, that this speed may be attained on the Atlantic.

THE weather has remained very unsettled during the past week, owing to the complex distribution of barometric pressure, there being during the first part of the time low-pressure areas over the northern parts of the kingdom, while an anticyclone lay over France and the Bay of Biscay. These conditions caused a considerable amount of rain, especially in the north and west, although in the southern and eastern parts of the country, the weather was fair, with mist or fog in places. During this period the maximum temperatures rarely exceeded 65° in any part; on Sunday and Monday, however, the anticyclone moved eastwards, and gave place to large depressions from the westwards, rain being general, except in the south-east of England, where the maximum temperatures rose to 70° and upwards, and similarly high readings occurred in the midland and southern districts. On Tuesday a cyclonic disturbance was crossing Scotland, and heavy rain was reported there and in the north-west of Ireland. The Weather Report for the week ending the 10th instant shows that the mean temperature was below the average over the whole of the United Kingdom, and although fairly high day temperatures were registered, the night readings were below 40° generally, and in the east of Scotland they fell to within a degree of the freezing point. The rainfall for the same period was generally less than the normal, and in the south-west of England there was still a deficiency of 8 inches since the beginning of the year.

IN his report on the rain, river, and evaporation observations, made in New South Wales during 1890, Mr. Russell states that the widespread interest in rainfall records is rapidly adding to the number of observers, which now amounts to 1088. The year was conspicuous for abundant rainfall, causing heavy floods in the river Darling, far exceeding those of which there are complete accounts. The average rainfall for the whole colony was 32·73 inches, being 32·6 per cent. greater than the average for the previous sixteen years. The report contains the results of interesting experiments on the effect of forests and elevation on the amount of the fall. At Dinby, which is situated in a densely timbered country, the amount was 35·89 inches, while the mean of nine of the nearest stations gave 38·92 inches. As an instance of the effect of elevation, the average rainfall at Wallongong, half a mile from the sea, at an elevation of 67 feet, is 38·84 inches, while at Cordeaux River, six miles from the sea, it is 55·53 inches.

THE Annual Report of the Acting British Resident of Perak for the year 1891 contains monthly summaries of meteorological observations at nine stations, and a chart showing the comparative range of monthly rainfall during the years 1888-91 at Taiping. The highest recorded temperature in the shade was 97° at Kuala Kangsar and Parit Buntar in the months of March and April respectively; the lowest 62°, in February, at Taiping and Salama. The only solar thermometer, that in Taiping, registered 121° in March and May. The rainfall varied from 85·6 inches at Teluk Anson to 183 inches at Topah. It is well distributed throughout the year, the driest months being May to July.

A MOST unusual phenomenon was seen in the Maltese Islands on July 21, when a thunderstorm raged for twelve hours, and deposited three inches of rain. According to the *Mediterranean Naturalist*, it is fifty-five years since rain fell in Malta in the month of July.

IN the annual report of the British Museum (Natural History) reference is made to two "principal events" relating to the conservation and arrangement of the Zoological collections. The first is the enlargement of the building which contains the collections of specimens preserved in spirits. An enlargement ad been rendered necessary mainly by the reception of the *Challenger* collections, which proved to be more extensive than had been anticipated. The addition to the building is already roofed in, and may be ready for occupation within the next twelve months. The other matter of exceptional importance is the arrangement of the collection of birds' eggs. In the old Museum this collection consisted of a small number of specimens of more or less great historical value, and of an imperfect series of deteriorated specimens of the British species, which were exhibited in three table-cases. The first important addition was received in the "Gould" collections, purchased in 1881; other miscellaneous series followed; and, finally, the magnificent donations of Europo-Asiatic species by Messrs. Godman, Salvin, and Seebohm, and of Indian eggs by Mr. A. O. Hume, added so much to the number of specimens, and imparted such a great value to this collection, that its systematic arrangement could be no longer delayed. At the same time the formation of a perfect series of British birds' eggs for exhibition and consultation by the public had become more and more urgent. A requisite grant having been made by the Lords Commissioners of the Treasury, Mr. Seebohm undertook the work of arranging both the general and the British series; and in the course of this year he has made such progress that about 24,000 specimens, belonging to fifteen families, are catalogued and beautifully arranged in thirteen cabinets, and that the British series can probably be opened to the public in the present year.

THE authorities of the French laboratory of physiological psychology have sent a circular to painters, sculptors, and designers, asking them to answer various questions as to their visual memory of colours and forms. Some replies have already been received, and one of the things noted in several of them is that the writers are able, when they see a painting, to perceive at a glance whether the artist has a good visual memory or not.

MR. M. A. DUMONT contributes to the current number of the *Revue Scientifique* an interesting paper on the history of the population in a small rural commune, Saint-Germain-des-Vaux. He has closely examined the communal registers from the early part of the eighteenth century until the present day. It is curious to see how the tendencies not only of the commune, but of its individual families, with regard to the increase or decrease of population, correspond to those of the French nation as a whole.

THE *Kew Bulletin* for September opens with a section on Caraguatá fibres. Samples of the Caraguatá plant were obtained through the Foreign Office from Dr. Stewart, British Consul at Asuncion, and submitted to Mr. J. G. Baker, by whom the plant is here described. The number also contains Decas III. of "Decades Kewenses," "New Orchids: Decade 3," and sections on Lagos palm oil and some vanillas of commerce.

WE learn from the *Kew Bulletin* that a handbook of Australian fungi has been prepared by Dr. M. C. Cooke, Mycologist in the Herbarium of the Royal Gardens, Kew, and published under the authority of the several Governments of the Australian Colonies. It contains a full description of all the fungi so far known to occur in Australia and Tasmania, number 2084 species. All the genera are illustrated by 36 plates, 20 of which are coloured.

MR. VICE-CONSUL SCRATCHLEY, of Philippeville, Algeria, has presented to the Museum of the Royal Gardens, Kew, an axe, scraper, and knife, such as are used in the collection of cork in Algeria. The *Kew Bulletin* says that the Museum contains numerous illustrations of the applications of cork, the bark of the cork oak (*Quercus Suber*, L.). The tree grows in Spain, Italy, South of France, and Algeria, and the first crop of cork is taken from the trunk as it stands, at the age of about thirty years, and afterwards at intervals of from six to ten years. The later crops furnish the best bark, which is used for bottle corks and similar purposes.

IN his annual report to the Secretary of the Science and Art Department, Dr. V. Ball, Director of the Science and Art Museum, Dublin, says that throughout the past year Major McEniry was continuously engaged in the rearrangement of the Royal Irish Academy collections. Mr. W.F. Wakeman rendered valuable assistance in preparing descriptive lists of the "Crannog finds," and Mr. George Coffey made a catalogue of the Irish coins. Both have been printed, and will serve as valuable records, for future reference, of the present condition and contents of these two branches of the collection. They will, moreover, afford useful material in the preparation of a contemplated handbook to the collection, which now claims attention, but for which some special arrangement will have to be made. In the same report Dr. Ball notes that under the efficient management of Mr. Moore the Royal Botanic Gardens, Glasnevin, maintained during the year their now well-established position as one of the principal centres of scientific horticulture in the United Kingdom. The continued and widespread interest in the operations carried on there is amply shown by the generous support which plant growers still afford by their contributions of novelties.

MR. E. S. MORSE, Director of the Peabody Academy of Science, has been investigating the older forms of terra-cotta roofing tiles, and presents the results of his inquiry in the latest Bulletin of the Essex Institute, Salem. His paper is a valuable contribution to the study of a very interesting subject. The earliest known form of tile consists of two elements—a wide tile (tegula) either square or rectangular, more or less curved in section, and a narrow semi-cylindrical tile (imbrex), usually slightly tapering at one end to fit into the wider opening of the one adjoining. The tegula is placed on the roof, concave face upwards, and the imbrex, placed concave face downwards, covers the lateral joint between two adjacent tegulæ. Tiles of this kind covered the roof of the very ancient temple of Hera at Olympia, the form being identical with that of tiles still used in the remote East. Afterwards the form was modified in Greece and Italy. In one or other of its varieties, this tile—which has been called by Graeber the normal tile—is found all over Asia, in Asia Minor, and in the countries bordering the Mediterranean. The well-known pantile combines the two elements, imbrex and tegula, in one piece. It originated in Belgium or Holland, and is used mainly in those countries, in Scandinavia,, and to some extent in England. The flat tile is simply a shingle in terra-cotta, and has no genetic relation to the other forms of tiles. It is used in Germany, Austria, Poland, Switzerland, France, and England. Mr. Morse's paper is well illustrated, and contains a map showing the geographical distribution of these three types of tile.

MR. WALTER HOUGH contributes to the report of the U.S. National Museum for 1890, just issued, a very good paper on the methods of fire-making. Having in a previous paper discussed the apparatus of fire-making, he now deals with the handling of the apparatus. All mechanical methods of generating fire take advantage of the law that motion, apparently destroyed by friction, is converted into heat. These methods can be grouped under three classes:—(1) wood friction, (2) percussion of minerals, (3) compression of air. Three other methods exhaust the entire range of usages in fire-making, and, with one exception, they are perhaps recent. These may be arranged in the following classes:—(4) chemical, (5) optical, (6) electrical. These exhibit the action of friction in its highest manifestations. Each method Mr. Hough examines in turn. His exposition is concise and clear, and carefully illustrated.

SEVERAL sponge deposits have been discovered at a distance of about 150 metres from the western shore of the island of Pantelleria (depth about thirty metres). Five Greek vessels, with two divers, obtained in three days about twenty-five quintali of sponges of the finest quality.

TWO papers which will be included in the forthcoming Macleay Memorial Volume were read at the meeting of the Linnean Society of New South Wales on July 27. One of them, by Prof. F. W. Hutton, is on the Pliocene Mollusca of New Zealand. It gives a complete list of the Mollusca hitherto met with in the Pliocene fossiliferous beds of New Zealand. Such beds have been found only in the southern and eastern parts of the North Island. About 64 per cent. of the Pliocene Mollusca are also found in Miocene rocks, but the Pliocene fauna is well characterized firstly by the presence of the genera *Trophon*, *Columbella*, *Turricula*, and *Mytilicarda*, by the absence of certain genera present in Miocene strata, and thirdly by the small size of sundry species common to both formations. From the recent fauna, that of the Pliocene is distinguished by the presence of from 23–37 per cent. of extinct species, and of a number of genera no representatives of which up to the present time are known to inhabit New Zealand seas. The Pliocene fauna, therefore, seems to be the remains of an earlier fauna disappearing rapidly before the conquering host of the recent fauna, which had invaded New Zealand some time previously. The other paper is by Prof. W. Baldwin Spencer, and offers contributions to our knowledge of Ceratodus, with special reference to the blood-vessels.

AT the same meeting of the Linnean Society of New South Wales, Mr. Rainbow exhibited the two sexes of an undescribed Sydney spider (*Nephila* sp.), the webs of which were said to be strong enough to catch male birds.

MR. A. C. GATTO writes in the *Mediterranean Naturalist* that the pretty moth *Deiopeia pulchella*, Beis, has occurred this year in Malta in unusual abundance. On August 10, when his note was written, and for a fortnight before, it was the commonest moth to be seen on the wing in the island. He does not remember ever to have had occasion to record such extraordinary numbers of any butterfly or moth. This remarkable abundance he supposes to be due to the fact that the rains of the late spring caused an overgrowth of the *Heliotropium europæum*, on which the Deiopeia feeds. The moth is white, with small red and black spots on the forewings, and with white underwings bordered with black. It is subject to much variation, sometimes the black dottings predominating, sometimes the red ones; but it is a very characteristic form and easily distinguished.

A NEW edition of Mr. Alfred Gibson's well-known "Agricultural Chemistry" has been issued by Messrs. Routledge and Sons. The book was originally issued more than thirty years ago, and there has been a steady demand for it ever since. In preparing the present edition the author has had the help of his nephew, Mr. A. E. Gibson, in making such changes as the advance of agricultural chemistry has rendered necessary.

MESSRS. MACMILLAN AND CO. have issued a new edition of Mr. W. H. H. Hudson's "Arithmetic for Schools." The work has been enlarged and very carefully revised.

THE University College of North Wales, Bangor, has issued the prospectus of the work to be done by its agricultural department during the session 1892–93. The fund for the promotion of agricultural education amounted, in the session 1891–92, to £1900, and was derived partly from a grant by the Board of

Agriculture, partly from private subscriptions, and partly from grants by the County Councils of Anglesey, Carnarvonshire, and Montgomeryshire. A considerable sum was also contributed locally to meet the expenses of field experiments, dairy demonstrations, and Extension lectures. Two things are aimed at in connection with the College scheme of agricultural education :—(1) To provide at the College as complete a training in agriculture and the sciences related to agriculture as can be obtained at any of the recognized Agricultural Colleges, and especially to provide such a training as would be suitable for land agents, farmers, bailiffs, and young men who intend emigrating with a view to farming in one of the colonies. (2) To make the College a centre of agricultural education for North Wales, and to organize in the six northern counties of the Principality, in connection with the College, a system of instruction to meet the special wants of each agricultural district, and supply a graduated system whereby pupils may pass from the School to the College. Several local landowners and farmers have enabled the College to make arrangements by which farms in the neighbourhood of Bangor can be used by the lecturer in agriculture and the members of his classes for the purpose of practical instruction.

IN a paper on the Ainos of Yezo, contributed to the latest report of the U.S. National Museum, Mr. Romyn Hitchcock refers to the arrow poisons used by the Ainos. The method of preparing these poisons has been revealed to only one traveller, Dr. B. Scheube, who believes his information to be correct, as the accounts obtained from different localities entirely agree. His account is as follows :—The young side roots of *Aconitum Japonicum* are usually gathered in summer and dried in the shade until autumn. The roots which contain active poison become softer, while the others grow harder; apparently a process of fermentation takes place. The former, after the removal of the skin, are rubbed between two stones to a pasty mass. There is no further preparation. This material is either spread directly upon the arrowheads or preserved. The poison maintains its activity for five months. Dr. Scheube adds that in every village the poison is prepared only by a few old men, not because the process of preparation is unknown to the others, but because these men have had experience in its production. Prayers, magic formulas, and the like are not recited during the preparation. The activity of the poison is tested by a portion being placed on the tongue. To ensure its action each arrow receives portions from three different preparations. Dr. Stuart Eldridge has made some chemical and physiological investigations of this poison, which confirm the supposition that aconite is its active ingredient. But Dr. Eldridge declares that the pulp prepared as described is mixed with other ingredients, which he has been unable to identify, but which are probably inert, and the resulting mass is buried for a time in the earth. On removal from the earth the poison, he says, appears as a stiff, dark, reddish-brown paste, through which fragments of woody fibre are distributed; and the poison, when applied to the arrow, is mixed with a certain proportion of animal fat. Mr. Hitchcock secured two specimens of the poison, which are in the form of hard lumps. Specimens of the plant from which the poison is obtained were collected by Mr. T. Holm, and determined by him as *Aconitum Japonicum*. In some parts of the country it grows in great abundance, and the fine purple flowers are very pleasant to the eye.

IN their very interesting account of various plants growing in and through the shells of marine mollusca (noticed by us in NATURE) Bornet and Flahault called attention to some fungoid-like hyphæ, which were recorded under the names of Ostracoblabe and Lithopythium, but in the absence of any fructification or of very definite characters, their position was not more accurately determined. Dr. Bornet, on looking over the fourth part of the Berichte der deutschen botanischen Gesellschaft was struck by the resemblance of *Lithopythium gangliiforme*, B. and F., to the deeper hyphæ of *Verrucaria caliseda* as represented by M. Bachmann in figures 3 and 4 of plate ix. accompanying his memoir (Die Beziehung der Kalkflechten zu ihre Substrat) and it occurred to him that the hyphæ found perforating the marine shells might be those of lichens. To verify such an idea, Dr. Bornet spent some time at Croisic towards the close of the summer of 1891. Here, of the shells gathered at low-water mark or not uncovered at each tide, a large number had the calcareous portions traversed by filaments of *O. implexa*. Sometimes these filaments were solitary, at other times and more frequently they were accompanied by one or more of the perforating Algæ (Gomontia, Ostreobium, Mastigocoleus, Hyella), but nothing either in or externally seemed to indicate that they were the hyphæ of a Lichen. When the shells were gathered off the rocks at a height at which they were frequently out of the water, a large number were found to present discoloured patches covered with dark depressed spots formed by the spermogonia and apothecia of a Verrucaria. The shells of *Purpura lapillus* with the mollusc, or serving as a home for some hermit crab, were the more frequently attacked. Some shells of Patella and Balanus were also attacked. When thin sections were made, perpendicular to the surface of the shell, the outer border appeared granular and was nearly opaque, the hyphæ and the alga condensed in the gonidial layer, having caused the semicrystalline shell structure to disappear, leaving it in a powdery state. But deeper in that portion of the shell which in part preserved its transparency the filaments could be seen perforating it to a considerable extent, and these presented all the characters of those described by Bornet and Flahault as belonging to *O. implexa*, with the sole exception that the fusiform dilatations were not observed. On decalcification the gonidia were found to be mostly supplied by *Mastigocoleus testarum*, some few by *Hyella cæspitosa*. Towards the margin they were reduced to the condition of isolated cells, but deeper down, the long branches of the thallus were found little altered and most easily recognisable, presenting a most favourable example of the connection existing between the gonidial stages of the filamentous algæ. M. l'Abbé Hue recognized the lichen of *Purpura lapillus* as *Verrucaria consequens* (Nyl). It will be noted that the hyphæ of this Verrucaria are capable of living isolated, not except under certain conditions uniting with the algal forms, these latter requiring the presence of the open air from time to time, so that the lichen stage is not developed on the shells always submerged. *Lithopythium gangliiforme*, though carefully looked for, was not met with, but its history, when known, will no doubt be equally interesting.

DR. A. B. GRIFFITHS writes to us to explain, in answer to a criticism which appeared in the recent review of his book, "The Physiology of the Invertebrata," that it is extremely difficult to determine in what state of combination uric acid exists in the urine of invertebrates. He, however, considers it more than probable that both potassium and lithium occur in the urine of some of these animals.

THE additions to the Zoological Society's Gardens during the past week include two Philantomba Antelopes (*Cephalophus maxwelli*) from Sierra Leone, presented by Mr. P. Lemberg; two yellow-bellied Liothrix (*Liothrix luteus*) from China, presented by Mr. J. Holmes; four Poë Honey Eaters (*Prosthemadera novæ-zealandiæ*) from New Zealand, presented by Capt. Edgar J. Evans, R.M.S. *Tainui*; a Little Grebe (*Tachybaptes fluviatilis*), British, presented by Mr. Thomas Riley; a Hoopoe (*Upupa epops*), a Greater-spotted Woodpecker (*Dendrocopus major*), twelve Fire-bellied Toads (*Bombinator igneus*), European, purchased.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A NEW SATELLITE TO JUPITER.—A telegram from New York announces that Prof. Barnard, of the Lick Observatory, Mount Hamilton, California, has discovered a fifth satellite to Jupiter. It is of the thirteenth magnitude, with a period of revolution round the primary of 17h. 36m., its distance from the centre of the planet being 112,400 miles.

VARIATION OF LATITUDE.—Dr. Chandler, in the *Astronomical Journal* No. 273, concludes his series of very important articles on the discussion of observations with regard to the cause of the variation of latitude. The material he has used comprises more than thirty-three thousand observations, made in seventeen observatories with twenty-one different instruments, as many as nine distinct methods of observation having been employed. Out of the forty-five series in which these observations are arranged, only three show results which do not harmonize with the general law as stated in the fifth article (see "Astronomical Notes," NATURE, vol. xlvi. p. 211). The values of the three come out negative, and as they are numerically small, they can be with justice discarded, for, as Dr. Chandler says, "a mere rejection of a single discordant equation (out of a total number of 427), in two cases, and of two in the third, would convert them into positive values." Instead, then, of the ratio of the difference of the two moments of inertia to the principal one being 1°·18, and perfectly uniform as given by theory, observation suggests the value 0°·85 (for 1875), the motion not being uniform but subject to a slow retardation which "in its turn is not uniform." The first difference was soon found by Prof. Newcomb to be due to a defect in the theory, an allowance of the earth's elasticity not having been taken sufficiently into account, but with regard to the second he urges an objection "on the ground of dynamic impossibility." In such a discussion as this of course an outside opinion cannot be counted of much value, but we quite agree with Dr. Chandler that if an observed fact disagrees with the result of theory, and a flaw is found in the theory, there can be no reason why another observed fact of equal weight, but also in discord with theory, should be regarded as "impossible."

BRIGHT STREAKS ON THE FULL MOON.—In *Astronomische Nachrichten*, No. 3111, Prof. Pickering gives a brief condensed account of the investigation that has been carried out at Arequipa with regard to the systems of bright streaks, especially round prominent craters, that are visible on our satellite at the period of the second and third quarters. The instrument employed was the 13-inch, and the magnification ranged from 450 to 1120 diameters. The chief results noted were:—(1) That the streaks of the systems round many of the large craters are not oriented to the centre of the prime crater, but towards other craters whose dimensions are considerably smaller. (2) These minute craters are extremely brilliant, and rarely exceed one mile in diameter. (3) Some streaks are found to lie across or upon ridges; these are very seldom connected with small craters. (4) In the case of Copernicus, streaks are found to start from craterlets inside the rim and low up the inner side of the walls, and down the other side. The rim of Tycho also contains similar craterlets, but the streaks do not extend very far. (5) A difference in colour was noticed between the streaks systems of Copernicus, Kepler, and Aristarchus, and those of Tycho, the last-mentioned being considered whiter than the others. (6) There are no very long streaks; their general length may be reckoned from ten to fifty miles. What have been previously taken for long streaks are found, by minute observation, to be simply a series of these smaller ones connecting up, apparently, many small craters. That extending from the regions of Tycho across the Mare Serenitatis is so constructed. In seeking an explanation to account for the origin of these bright streaks, Prof. Pickering suggests that if, for example, the craterlets on the rim of Tycho were constantly emitting large quantities of gas or steam, which in other regions was being absorbed, "we should have a wind uniformly blowing away from that summit in all directions." Should other craterlets in the vicinity "give out gases mixed with any fine white powder, such as pumice, this powder would be carried away from Tycho, forming streaks." This hypothesis, besides explaining the presence of the streaks themselves, satisfies very well the fact that they can only be seen after and before the first and last quarter of the moon phase, for it is only at this time that the contrast would be best seen.

NOVA AURIGÆ.—On the receipt of Mr. H. Corder's information relative to the brightening of Nova Aurigæ, Mr. Espin made an examination of its light on August 21, and found that the star was of the 9·2 magnitude. Since then Prof. Küstner, has also observed it (August 31, 11m.·4 Bonn mean time), and reckoned it to be as bright as on March 21 last. The Astronomer Royal's photographic determination, made on August 30, accounts it to be about the 12th magnitude.

NEW OBSERVATORIES.—Mount Monnier, in the Maritime Alps, has been visited by M. Bischoffsheim and M. Perrotin, with the object of setting up a new observatory. It is proposed to raise on the summit (2800 metres altitude) an observatory, the work of which will be commenced next April. *L'Astronomie* for September also informs us that the Astronomical Observatory of Abbas-Touman (lat. N. 41° 46′, long. E. Paris, 40° 32′) will be ready for work in a few weeks. The observatory is already installed with a refractor of 29 inches, and as it is situated at a considerable height, it will be used for those special stellar studies which are difficult at Pulkowa, Moscow, and Kazan.

SOLAR OBSERVATIONS AT ROME.—Prof. Tacchini, in the July number of *Memorie della Società degli Spettroscopisti Italiani*, gives in tabulated form the results of the observations made at the Royal College with reference to the prominences seen at the sun's limb during the months of April, May, and June. In the table showing the frequency of these phenomena for every 10° of latitude north and south, we find that the numbers for the three months respectively were 83, 97, and 147 for the north, and 75, 110, and 183 for the south latitudes. This shows an excess of 41 for the south, the zone in which they mostly occurred being $(-50^\circ-60^\circ)$: the zone of greatest frequency for the north was $(+60^\circ+70^\circ)$. The frequency at the equator was comparatively small, 26 and 23 being the numbers recorded for the zone of 10° each side.

GEOGRAPHICAL NOTES.

A REUTER telegram from St. John's, dated September 11, says that the steamer *Kite*, which left that port three months ago to relieve the Peary Expedition, has just arrived there, after having successfully accomplished its object. Lieutenant Peary, who is an engineer in the United States Navy, left America early last year in command of a small expedition consisting of only five men, the object of which was to spend one or more winters in Greenland for the purpose of scientific observation, and to make an attempt to reach the North Pole across the interior of Greenland. The commander of the expedition was accompanied in this arduous enterprise by his young wife. The winter quarters of the party were fixed at McCormick Bay, whence Lieutenant Peary travelled 1300 miles northwards over the inland ice, which he found to be in a favourable condition for his journey. After making some important discoveries, the explorer returned to the quarters at McCormick's Bay, where, according to previous arrangements, he awaited the arrival of the relief expedition. Lieutenant Peary, his wife, and his five men are all well. Lieutenant Peary's great sledge journey commenced on May 15 last on the true ice cap of Greenland at the head of McCormick's Bay, and at an elevation of four thousand feet. The explorer, who took with him only one man and fourteen dogs to draw the sledge, passed along the edge of the Humboldt Glacier and then across the feeder basins of the St. George's and Osborne Glacier system. On June 26 he reached the 82nd parallel. Here the coast trended to the north-east, and then east, and finally compelled the explorer to pursue a south-easterly course. After four days' march, during which the coast still stretched south-east and east, Lieutenant Peary reached the head of a great bay in latitude 81° 37′, and longitude 34°. This was on July 4, and in honour of the day he named this opening Independence Bay. The glacier terminating on its shores he called the Academy Glacier. . The land here was of a red-brown colour and free from snow, and flowers, insects, and musk oxen were abundant; while hares, foxes, and ptarmigan were also seen. On July 9 Lieutenant Peary and his companion started on their return journey, taking a more inland course, and in seven days' time they were travelling over soft snow on the interior plateau, at an elevation of 8000 feet.

The explorer then again descended to the coast, covering thirty miles a day. He met the *Kite*, with the relief party, on August 4, near the head of McCormick's Bay, having completed his original programme to the very letter. The geographical discoveries made by the expedition include the tracing of the Greenland coasts above the 79th parallel, the termination of the continental ice-cap below Victoria Inlet, and the existence of glaciers on all the northern fiords. Many valuable tidal and meteorological observations were also obtained, as well as a quantity of material for the ethnological study of the northern Eskimo, including specimens of their costumes, tents, and sledges. The expedition brings home, besides a number of photographs of natives and of Arctic scenery, a large collection of the flora and fauna of the high latitudes visited.

THE four Dundee whaling vessels, whose intended voyage to the Antarctic seas has been already referred to in these notes, sailed from Dundee last week. Three of the vessels carry surgeons who have been specially instructed in making meteorological and biological observations. They are fully equipped with appliances for collecting specimens of every kind. The more strictly geographical conditions will be observed by the captains, who have been supplied with additional instruments to enable them to lay down their track with a greater degree of accuracy than would be necessary in ordinary circumstances. Their long Arctic experience fits them for navigating the ice-hampered waters of the South and for comparing the conditions found there with those of the better-known North Polar zone.

THE railway from Jaffa to Jerusalem is now practically completed, and will be opened for traffic before the end of this month. Recent events in Russia have caused a great increase in the Jewish population of Jerusalem, leading to the extension of the city beyond the walls. The railway will do much to promote the prosperity of Palestine and will probably be largely utilized.

THE Gilbert Islands, in the Central Pacific, have been definitely brought under British protection. The group is bisected by the equator, and forms the central link in the long chain of coral and volcanic islands which stretches from the northern to the southern tropic between the meridians of 160° and 180° E. The Marshall Islands, which are the most northerly of this chain, are under German control.

THE Proceedings of the Royal Geographical Society for September publishes an interesting account of a journey in Sikkim undertaken by Mr. C. White and Mr. Hoffman in July 1891, with the purpose of exploring and photographing the surroundings of Kanchinjinga. The travellers crossed by the Zeumtso La pass into the Tremu Valley, the magnificent glacier in which was visited for the first time by Europeans. The main glacier—fifteen miles long—is joined by the union of six smaller glaciers, and several others were observed which could not be approached. The Tremu Valley was proved to be only a fortnight's journey from Darjiling, a fact which makes the almost entire ignorance of the existence of glaciers in it very remarkable.

IN the course of his travels into the interior of Iceland (*Petermann's Mitteilungen*, vol. 38), Th. Thoroddsen discovered an unknown lake in the unexplored region of Vatna-Jökull. "The greatest part of the western edge of the Vatna-Jökull is formed by a mighty glacier, whose margin stretches with faint curvature towards the southern horizon. The mountain chains which reach the glacier are powerless to influence its shape. We were surprised by the discovery of a very long lake, stretching from the margin of the glacier close to us towards the south-west as far as the eye could see, and filling up the valley between us and a parallel mountain chain. The narrow lake is of a milk-white colour, formed as it is by glacier ice. I named it Langisjor. The glacier reaches with its steep flank to the north end of the lake, and as it is riddled with clefts it is impossible to ride round on this side. The landscape round the lake is of magnificent beauty, only vegetation is quite absent. The greenish-white lake is surrounded by red and yellow tuff hills, with innumerable fantastic points and summits. On the other side of the chain which terminates the lake in the south stretches an extensive flat plateau, in which glitters a large watercourse, probably the Skapta, and far to the south are seen some great lava streams, dating probably from the 1783 eruption."

INTERNATIONAL CONGRESS OF PHYSIOLOGISTS.

THE second International Congress of Physiologists, which took place at Liège on August 29, 30, and 31, was attended by more than 100 physiologists, including among others:—Prof. F. Holmgren (Upsala), President of the Congress, Profs. Hensen, Hürthle, Kühne, Rosenthal, Cybulski, Kronecker, Miescher, Fredericq, Héger, Heymans, Arloing, Chauveau, Dastre, Gréhant, Hédon, Langlois, Laulanié, Morat, Wertheimer, Hamburger, Grigorescu, Wedensky, and the following English members: Profs. Foster, Burdon Sanderson, Schäfer, Allen, Gotch, Halliburton, Horsley, Purser, Waymouth Reid, Stirling, Waller, Drs. Adami, Beevor, Paton, Martin, Mott, Pye-Smith, Sherrington, Starling, Shore, Sims Woodhead; Messrs. Bayliss, Burch, and Parsons.

The work of the Congress was carried on in the Institutes of Zoology and Physiology, these institutions being placed at the disposal of the members by the kind courtesy of the two directing professors, whilst in addition the whole arrangements were excellently organized through the energy of the Professor of Physiology, Prof. Léon Fredericq.

The work of each day was so arranged that the mornings only need be devoted to the formal hearing of communications in the large lecture hall of the Zoological Institute, and the afternoons were thus left entirely free for informal meetings in the Physiological Institute, when demonstrations of special interest were shown in the rooms of the laboratory, thus adding very materially to the interest and utility of the proceedings. The following list of the various communications and demonstrations will at least serve to show the large extent of ground covered by the subject-matter brought forward, and the activity with which physiological research is now being pursued.

MONDAY, AUGUST 29.—PRESIDENTS: PROF. CHAUVEAU (Paris), PROF. BURDON SANDERSON (Oxford).

A. *Communications.*

1. Hermann.—Phonophotography.
2. Rosenthal.—Results of observations with improved calorimetric methods.
3. Halliburton.—Nucleo-albumins.
4. Starling.—The fate of peptones in the blood and the lymph.
5. Max Cremer.—Experiments on the effects of feeding animals with certain sugars.
6. Langlois.—The functions of the suprarenal bodies.
7. Morat.—The innervation of the tensor tympani.
8. Hamburger.—The effect of different salts upon the properties of red blood corpuscles.
9. Céline Muro.—Physiological evolution.

B. *Demonstrations.*

1. Hürthle.—A new method of registering the sounds of the heart in man by means of a microphone.
2. Wertheimer.—(*a*) The excretion by the liver of bile introduced into the blood.
(*b*) Vaso-dilatation effects of strychnia.
3. Laulanié.—The cardiograph (needle method).
4. Wedensky.—Demonstration by the telephone of the electrical changes which accompany the passage of nerve impulses, and the influence upon these of electrotonic alterations in nerve excitability.
5. Sherrington.—The cortical representation of the movements of the hallux and especially of the anus in the Macaque monkey.
6. Langlois.—The variations in the discharge of heat during "la maladie pyocyanique."

TUESDAY, AUGUST 30.—PRESIDENTS: PROF. KÜHNE (Heidelberg), PROF. HÉGER (Brussels).

A. *Communications.*

1. Bowditch.—Composite photography.
2. Olivier.—Protoplasmic continuity.
3. Schäfer.—The structure of the insect's wing muscles.
4. Schäfer.—The negative effects of severance of the frontal lobes of the cerebrum.
5. Vitzou.—(*a*) The visual centres of the dog and monkey.
(*b*) The effects of total ablation of a cerebral hemisphere.

6. Wertheimer.—The elimination of pigments by the liver.
7. Loew.—The distinction between the "active" and the "passive" albuminous material of plants.
8. Sherrington.—The varieties of leucocytes.

B. *Demonstrations.*

1. Chauveau.—The changes in mammalian endocardiac pressure as recorded by the tambour and air transmission method. (This classical experiment formed the main part of the afternoon's work.)
2. Gréhant.—(*a*) Absorption of carbonic oxide by living organisms.
3. Gréhant and Martin.—On the physiological effects of opium.
4. Wedensky.—Demonstrations with the telephone upon nerve excitation and upon voluntary muscular contraction in man.
5. Zwaardemaker.—The mechanism of smell.

WEDNESDAY, AUGUST 31.—PRESIDENTS: PROF. WEDENSKY (St. Petersburg), PROF. GRIGORESCU (Bucharest).

A. *Communications.*

1. Cybulski.—The use of the condensor for the excitation of muscles and of nerves.
2. Hédon.—The effect of removal and of transplantation of the pancreas upon the production of diabetes mellitus.
3. Gotch.—The increased excitability of nerve and of muscle occasioned by low temperature.
4. Burch.—(*a*) The apparatus for photographing the movements of the capillary electrometer.
(*b*) The method of analyzing the electrometer curves obtained by the photographic method.
5. Burdon Sanderson.—The electrical changes in muscle as shown by the capillary electrometer.
6. Fredericq.—Autotomy in crabs.
7. Jacobi.—The muscular sense.
8. Bayliss.—The functions of the depressor nerve.
9. Doyon.—Tetanus.
10. Wedensky.—The impossibility of causing fatigue in motor nerves.
11. Verworn.—The effect of galvanic currents on simple living organisms.
12. Moussu.—The functions of the thyroid body.
13. Slosse.—(*a*) The functions of the thyroid body;
(*b*) Autopsy of a case of thyrodectomy in the dog.
14. Kaufman.—The intra-muscular circulation.
15. De Boeck.—The effects of partial ablation of the cerebrum immediately after birth.

B. *Demonstrations.*

1. Waller.—The discharge of heat from the muscles of man.
2. Gotch.—The increased excitability of the sciatic nerve of the cat produced by low temperature.
3. Grigorescu.—Action of certain poisons upon the central nervous system.
4. Cybulski.—Method of stimulating muscle and nerve by means of condensor discharges.
5. Mares.—Nerve excitation by means of varying induced currents due to variations in the rapidity of magneto-induction.
6. Wedensky.—The most favourable and the least favourable frequency for effective intermittent excitation of nerve by electrical currents.
7. Paton.—A crystalline globulin obtained from urine.

In addition the following members showed instruments and models:—

1. Lahousse.—Model of the nerve centres.
2. Rosenthal.—Calorimeter with recent improvements.
3. Laulanié.—(*a*) A universal inscribing manometer.
(*b*) Apparatus for studying respiratory changes.
4. Morat.—Recording apparatus.
5. Cybulski.—The Photohæmotachometer.
6. Miescher and Jacquet.—A recording chronometer.

On Wednesday evening, at the conclusion of the proceedings, the members dined together in the large foyer of the theatre, the President of the Congress, Prof. Holmgren, being in the chair.

As the Congress is held every three years, the next meeting will take place in 1895, and it was decided that in response to the kind and cordial invitation of Prof. Kronecker, the meeting should be held in Berne (Switzerland).

ELECTRO-METALLURGY.[1]

THIS is not the first time a lecture has been delivered here on electro-metallurgy. I find that so long ago as January, 1841, there was a lecture on the subject by Mr. Brand.

At that time electro-metallurgy was very new and very small. It consisted solely of electro-plating and electrotype. Electro-plating had already begun to be practised as a regular industry, but it was still a question whether the new kind of plating was good, and there were not a few silversmiths who would not offer electro-plate for sale because of its supposed inferiority to plate of the old style. That question has long been definitely settled by the fact that every week more than a ton of silver is deposited in the form of electro-plate.

Electrotype in 1841 was not so far advanced—it had not then been taken hold of by the artisan and manufacturer—it was still in the hands of the amateur.

While the voltaic battery was the cheapest source of electric current, electro-metallurgy was necessarily restricted to artistic metal work, or to those applications where the fine quality of the electrotype cast outweighed the consideration of its cost, or where only a thin film of metal was required for the protection of a baser metal from the action of the air.

Within this limited field, the electro deposition of copper, of gold, of silver, of iron, and of nickel, has been carried on commercially with very great success and advantage for almost the whole period of the existence of the art. But beyond these bounds, set by the limitation of cost, it could not pass.

Now, all this is changed—since engineer and electrician have united their efforts to push to the utmost the practical effect of Faraday's great discovery, of the principle of generating electric currents by motive power. The outcome is the modern dynamo, with its result—cheap electricity. The same cause that has led to electric lighting, and to the electric transmission of power, has also led to a very great development of electro-metallurgic industry, and not only in the old directions but in new. It is no longer a matter of depositing ounces or pounds of metal, but of tons and thousands of tons. And it is no longer with metal deposition merely that electro-metallurgy now deals, but also with the extraction of metals from their ores, and the fusion and welding of metals. Electro-metallurgy has in fact grown so large and many-branching, that it is impossible to treat it in a complete manner in a single hour.

One of the latest developments is electric welding. This, in one of its forms, that invented by Elihu Thompson, has recently been so thoroughly explained and demonstrated by Sir Frederick Bramwell, that it is not necessary for me to do more than mention it as belonging to the subject.

There is also another species of electric welding—that of Dr. Benardos—in which the electric arc is used after the manner of a blow-pipe flame, to obtain the welding of such forms and thicknesses of iron, steel, and other metals, as would be difficult or impossible to weld in any other way; and not only is the electric blow-pipe used for welding, but also for the repair of defects in steel and iron castings, by the fusion of pieces of metal, of the same kind as the casting, into the faulty place, so as to make it completely sound. This new kind of electric welding, as improved by Mr. Howard, is now of sufficient importance to entitle it to the full occupation of an evening. I therefore propose to leave it for detailed description to some other lecturer, and content myself with calling your attention to the interesting collection of specimens on the table, and in the Library (lent by Messrs. Lloyd and Lloyd), showing the results of this process.

Even with this curtailment, the extent of the field is still too great, and I must reduce it further by omitting a considerable section of that portion which relates to the extraction of metals from their ores, and, in this connection, only speak of the extraction of aluminium.

But, in the first place, I am going to speak of the deposition of copper, and you will pardon me if I treat it as if you were unacquainted with the subject.

[1] Friday evening discourse delivered by Mr. J. Wilson Swan, at the Royal Institution, on May 20.

One of the wonderful things about the electro-deposition of copper, and in fact any other metal deposited from a solution of its salt in water, is, that bright, hard, solid metal, such as we are accustomed to see produced by means of fusion, can, by the action of the electric current, be made to separate from a liquid which has no appearance of metal about it.

The beginning of every electro-deposition process is the making a solution of the metal to be deposited. I am going to dissolve a piece of copper, the most elementary of all chemical operations, but I want to make it quite clear where the metal to be deposited comes from—to show that it is actually in the solution, and actually comes out of it again; for that is an effect so surprising, that it requires both imagination and demonstration to make it evident. There is projected on the screen a glass cell containing nitric acid. Mr. Lennox will put into it a piece of copper. He has done so; it quickly disappears, and a blue solution of copper nitrate is formed. Now, if I pass an electric current through this solution, or through some solution of the same kind, which, to save time, has been prepared beforehand, and immerse in it, a little apart from each other—the positive and negative wires coming from some generator of electric current—this will happen: metallic copper will come out of the solution, and attach itself as a coating to the negative wire, and consequently that wire will grow in thickness. At the other wire—the positive—exactly the reverse action will take place. There, if the positive wire be copper, it will gradually dissolve, and become thinner. The quantity of metal deposited on the negative wire will almost exactly equal the quantity dissolved from the positive, and therefore the solution will contain the same quantity of metal at the end of the experiment as at first, but it will not be the same metal; it will be fresh metal dissolved from the positive wire, and the metal originally contained in the solution will have been deposited as metallic copper.

I will show on the screen this process in operation. Here are the two wires I spoke of. The electric circuit, which includes these two wires, is so arranged that on its completion the thick wire will be the positive, and the thin wire the negative. Now please complete the circuit. One wire (the positive) is carrying an electric current into the copper solution, and the other (the negative) is carrying the current away. The solution is conveying the current between the wires, and one of the incidents of the transport of current from wire to wire by the solution, is electro-chemical decomposition, or electrolysis; and the result of that is, the deposition, out of the solution, of copper, upon one wire, and the dissolving away, or entering into solution, of copper, from the other. Now it can be clearly seen that the wire that was thick is now thin, and the wire that was thin is now thick.

Imagine the growing wire to be an electrotype mould, and that the deposit of copper which formed on the wire has spread over the surface and formed a nearly uniform film, and that by continuing the process it has become thick, that deposit, stripped from the mould, would be an electrotype.

Or imagine the negative wire to be a thin sheet of pure copper, and the positive wire to be a thick sheet of impure copper, and suppose the action carried on so far that the thin sheet has become thick by the deposition of copper upon it from the solution, and the thick one thin by its copper entering into solution, that case would represent the condition of things in electrolytic copper refining.

Allow your imagination to take one more short flight, and suppose that this is not a solution of copper, but one of silver, and that the growing wire is a teapot to be silvered; and, further, suppose that the dissolving electrode is silver, and you will then understand the principle of electro-plating.

It requires very little explanation to make the ordinary arrangement of electrotyping intelligible. Here is a trough containing sulphate of copper solution. Here is a mould that, through the kindness of Messrs. Elkington, has been prepared for me; this is connected with the negative pole of a battery—and here is a plate of copper connected with the positive pole. When I immerse the mould in the solution—at about two inches from the copper plate—the electrical circuit is completed, and the same electrolytic action that the experiment illustrated will take place. Copper will be deposited on the mould, and will be dissolved in equal quantity from the copper plate, and the supply of copper in the solution will thus be kept up. As it will take a little time to obtain the result I wish to show, I will put this aside for ten minutes or so, and proceed to speak of different applications of this principle of copper deposition.

For the reproduction of fine works of art in metal, electrotype is unapproachable. The extreme minuteness with which every touch of graver or modelling-tool is copied by the deposited metal film, separates electrotype by a wide space from all other modes of casting. Even the Daguerreotype image is not too exquisitely fine for electrotype to copy it so perfectly that the picture is almost as vivid in the cast as in the original.

It is this quality that has given to electrotype a *rôle* which no other process can fill, and, so far, its practical utility is not greatly dependent on the cost of the current. This applies to all those most beautiful things here and in the Library, lent by Messrs. Elkington. These could all have been produced commercially, even if there had been nothing better for the generation of the current than Smee's battery—a very good battery, by the way, for small operations in copper deposition. It gives a very low electro-motive force and that is a defect, but in copper deposition, the half-volt or so is generally sufficient to produce, automatically, the required current destiny.

One of the uses of electrotype, not greatly affected by the cost of deposition, is that of the multiplication of printing surfaces. In these days of illustrated periodicals, electrotype has come more and more into use for making duplicate blocks from wood engravings, which would soon be worn out and useless if printed from direct. It is also employed to make casts from set-up type, to be used instead of ordinary stereotype casts, when long numbers of a book have to be printed; also as a means of copying engraved copper-plates. Here are examples of all these uses of the electrotype process. The electro-blocks are lent by Messrs. Richardson and Co., and the copper-plates by the Director-General of the Ordnance Survey Office, Southampton.

The plates illustrate the method employed at Southampton in the map-printing department. The original plates are not printed from except to take proofs. The published maps are all printed from electrotypes. Here is an original plate—here the matrix, or first electro, with, of course, all the lines raised which are sunk in the original. The second electro is, like the original, an intaglio. Here is a print from it, and here one from the original plate. Practically they are indistinguishable from each other, and bear eloquent testimony to the wonderful power of electrotype to transmit an exceedingly faithful copy of such a surface.

Nickel has, of late years, come into extensive use for what is termed nickel-plating, as applied to coating polished steel and brass with nickel. Nickel not only has the advantage over silver of cheapness, but also, in some circumstances, of greater resistance to the action of the air.

Another metal, usually deposited in the form of a coating, is iron. The electrolytic deposit of iron is peculiarly hard—so much so, that it is commonly but erroneously spoken of as *steel*-facing. The deposition of a film of iron upon engraved copper-plates, as a means of preventing the wear incidental to their use in being printed from, has become almost universal. Valuable etchings, mezzo-tints, and photogravure plates are thus made to bear a thousand or more impressions without injury. By dissolving off the iron veil with weak acid, when the first signs of wear appear on the surface of the plate, and re-coating it with iron, an engraved copper-plate is, for all practical purposes, everlasting.

In this case, of course, the film of iron is extremely thin—one or two hundred-thousandths of an inch. But it is possible to produce most of the metals commonly used as coatings in a more massive form. Here, for example, is an iron rod half-an-inch in diameter, entirely formed by electrolytic deposition. I am indebted to Mr. Roberts-Austen for being able to show this, and also for this other example of a solid deposit of iron, and for this beautiful specimen of electrolytic coating with iron. Here also are solid deposits of silver. This drinking cup is a solid silver electro-deposit.

These are all departments of electro-metallurgy which would have maintained a perfectly healthy industrial existence and growth without the dynamo; but now I come to speak of a branch of the subject—electrolytic copper refining—which, without that source of cheap electricity, could not have existed. This is the most extensive of all the applications of electro-chemistry, and is rendering valuable assistance to electrical engineering by the improvement it has led to in the conductivity of copper wire.

One of the results of this is seen in the raising of the commercial standard of electrical conductivity.

Ten years ago, contracts for copper wire for telegraphy stipulated for a minimum conductivity of 95 per cent. of Matthiessen's standard of pure copper. Now, chiefly owing to electrolytic refining, a conductivity of 100 per cent. is demanded by the buyer and conceded by the manufacturer.

To show the difference between the past and present state of things in relation to the commercial conductivity of copper, I am going to exhibit on the screen measurements of the resistance of six pieces of wire of equal length and equal cross section—they have been drawn through the same drawplate. Three of the pieces are new, and three are old. The three new pieces are made from electrolytic copper, and are representative of the present state of things. The three old pieces are taken from three well-known old submarine telegraph cables, and they show how very bad the copper was when it was first employed for telegraphic purposes, and how great has been the improvement. I will take No. 1 wire as the standard of comparison. It is a piece of the wire about to be supplied to the Post Office Telegraph Department for trunk telephone lines. It will show the very high standard of conductivity that has been reached in the copper of commerce. I am indebted for it, and for two out of three of the old cable wires, to Mr. Preece. No 2 wire is made from electrolytic copper, deposited in my own laboratory. No. 3 is also electrolytic copper, but such as is commercially produced in electrolytic copper refining; it has been supplied to me by Mr. Bolton, to whom I am also indebted for wire No. 6—a particularly interesting specimen: it is from the first Trans-Atlantic cable—the cable of '58. No. 4 wire is from the Ostend cable of 1860, and No. 5 wire is from the old Dutch cable. These wires are so arranged that I can send a small and constant current partly through any one of them, and partly through a galvonometer. When this is done the result will be a deflection of the spot of light on the scale from the zero point to an extent corresponding to the resistance of the particular wire in the circuit. The worse the wire is, the greater will be the deflection. We will begin with the Post Office sample first. I connect the galvanometer terminals to wire No. 1; you see there is a deflection of ten degrees. I will now shift the contacts to wire No. 2—exactly the same length of wire is included—but now you see there is a deflection of slightly less than ten degrees, showing that this wire has a little lower resistance than No. 1. The difference is very small—it may be 2 per cent.—and 2 per cent. less of it would be required to conduct as well as the No. 1 wire. The next is No. 3. This is Mr. Bolton's wire, and shows a resistance almost equal to the last.

No. 1, 2, and 3 are, therefore, nearly alike, and have a degree of conductivity almost as high as it can possibly be.

Now we come to the three old wires.

We will take No. 4 (the Ostend cable). There, you see, is a great difference. Instead of the spot of light being on the tenth degree, it is upon the eleventh.

We will now try No. 5 (the Dutch cable). That drives the index to 17.

Now I change to No. 6 (the old Atlantic cable), and we have a deflection of no less than 25 degrees. I suppose we may assume that this wire fairly represents the commercial conductivity of copper in 1858, for it is highly probable that for a work so important as the first Atlantic cable every care would be taken in the selection of the copper.

The result of this experiment shows that the copper of that cable was extremely bad as a conductor—that, in fact, it is 150 per cent. worse than the best commercial copper of to-day. In other words, it shows that, in point of electrical conductivity, one ton of the copper of to-day will go as far as two-and-a-half tons of such copper as was used for the cable of '58.

This change is largely due to electrolytic copper refining.

The process of electrolytic copper refining is the same in principle as that which produced the thickening of one of the wires and the thinning of the other in my first experiment. To prepare the crude copper for the refining process it is cast into slabs; these form the anodes, and correspond to the wire which in my first experiment became thin. The cathodes, corresponding to the wire which became thick, are formed of thin plates of pure copper. Here are plates such as are used in electrolytic copper refining works. They are portions of actual cathodes and anodes, and represent the state of things at the commencement, and at the end, of the depositing operation—an operation that takes several weeks to complete, and effect the great change these plates show. In copper refining works an immense number of these plates, each having 6 to 10 square feet of superficial area, are operated upon together in a great number of large wooden vats containing sulphate of copper solution and a small proportion of sulphuric acid. Electric current from a dynamo, driven by a steam-engine or water-power, is conveyed by massive copper conductors to the vats, arranged in long lines of 50 or 100 or more in series. Thick copper bars connect adjoining vats, and provide a positive and negative support for the plates, which hang in the solution opposite each other, two or three inches apart. During the process the impure slabs dissolve, and at the same time pure copper is deposited from the solution upon the thin plates. The deposition and dissolving go on slowly, in some cases very slowly, for a slow action takes less power, and gives purer copper than a more rapid one. The usual rate is one to ten ampères per square foot of cathode surface. You will better realise what these rates of deposit mean, when I say that one ampère per square foot rate of deposition gives for each foot of cathode surface, nearly one ounce of copper in twenty-four hours, and a thickness of one-eighth hundred of an inch; and therefore the production of one ton of copper at that rate in twenty-four hours would require a cathode surface in the vats, in round numbers, of 36,000 square feet. At the higher rate of ten ampères per square foot, which is used where coal is cheap, one-tenth of this area would be required.

The importance of the electrolytic copper refining industry, and the extent of the plant connected with it, may be inferred from the fact that, reckoning the united production of all the electrolytic copper works in the world, nearly one ton of copper is deposited every quarter of an hour.

Very little power is required for copper deposition if the extent of the dissolving and depositing surfaces is large, relatively to the quantity of copper deposited in a given time.

Some of the impurities ordinarily found in crude copper are valuable. Silver and gold are common impurities, and these and some other impurities do not enter into solution, but fall down as black mud, are recovered, and go to diminish the cost of the process or increase the profit; and even those impurities which enter into solution are, under ordinary conditions, almost completely separated.

Electrolytic copper refining is both an economical and an effective process. The deposited copper is exceptionally pure. At one time it was supposed that it must necessarily be quite pure, but this is not the case; other metals can be deposited with the copper, but it is not difficult to realise in practice a close approximation to absolute purity in the deposited copper. Here is an example of the deposition of a mixed metal—brass, that is, copper and zinc deposited together, and there are in the Library a number of interesting specimens of mixed metal deposition. These deposits of brass and other alloys show that more than one metal can be deposited at the same time. The great enemy to conductivity in copper is arsenic, and the deposition of arsenic as well as copper is one of the things to be guarded against in electrolytic copper refining. Not only are the chemical characteristics of electrolytically refined copper generally good, but its mechanical properties are largely controllable. Usually electrolytic copper is melted down and cast into billets of the form required for rolling and wire-drawing. This treatment not only involves cost, but the copper is apt to imbibe impurity during fusion; though, if the process is carefully conducted, the deterioration is slight.

But it is evident that the re-melting of the deposited copper is a thing to be avoided if possible, and the question naturally arises, why, now that deposition costs so little, may not the beautiful principle which comes into play in electrotype, and which enables the most complicated forms to be faithfully copied be taken advantage of to give to plainer and heavier objects their ultimate form?

There are several reasons why this idea is not more frequently acted upon. One is that the process of electrolytic deposition is slow; another, that knowledge of the conditions necessary for obtaining a deposit having the required strength and other qualities, is not very widespread. Moreover, in the electrolytic deposition of copper, and indeed of all metals, there is a strong tendency to roughness on the outside of the deposit, and to excrescent growths, the removal of which involve waste of labour and material. These tendencies can to a very great extent be counteracted by careful manipulation and the use of suitable solutions, and they can also be counteracted by mechanical means. This has been done by Mr. Elmore. He remedies the faults I have mentioned by causing a burnisher of agate (arranged after the manner of a tool in a screw-cutting lathe) to press upon and traverse a revolving cylindrical surface on which the deposit is taking place, and while it is immersed in the copper solution. The result is that it is kept smooth and bright to the end of the process.

But the use of a burnisher is not the only means available for the production of a smooth deposit. It was observed in the early days of electro-plating how great a change was effected in the character of the metal deposited by the presence of a very small quantity of certain impurities. It was found, for example, that an exceedingly minute dose of bisulphide of carbon, if put into a bath from which the silver was being deposited, caused the deposit to change from dull to bright.

I have lately had experience of a similar kind with nickel and with copper. I was working with a hot solution of nickel, and up to a certain point the deposit had the usual dead-grey appearance. Suddenly, and without doing anything more than putting in a new cathode, I found the character of the deposit completely changed. Instead of the grey, tough, adherent deposit, there was produced a brittle, specular deposit, which scaled off in brilliantly shining flakes of metal. I sought for the cause of this extraordinary change, and traced it to the accidental introduction into the solution of a minute quantity of glue.

By adding gelatine to a fresh nickel solution I obtained the same peculiar bright and brittle deposit that had resulted from the accident. I then made a similar addition to a solution of copper, and when I hit the right quantity—an exceedingly minute one—bright copper, instead of dull or crystalline, was deposited. Here are some specimens. These were deposited on a bright surface, and they are bright on both sides.

Not only is the copper made bright, under the conditions I have described, but, if the proportion of the gelatine be carried to the utmost that is consistent with the production of a bright deposit, it becomes exceedingly hard and brittle. Beyond this point the deposit is partly bright and partly dead, the arrangement of the patches of dead and bright being in some cases very peculiar, and suggestive of a strong conflict of opposing forces.

Before I leave the subject of copper deposition, I may mention that I have found the range of current density within which it is possible to obtain a deposit of reguline metal, far wider than is commonly supposed.

The rate of deposition in copper-refining is usually very slow, and it is one of the drawbacks of the process, since slow deposition necessitates large plant. But rapid deposition necessitates a larger consumption of power, and larger cost on that account, and therefore, there is a point beyond which it is not good economy to go, in the direction of more rapid deposition. Still there are cases, where, if we had the power to deposit more rapidly, it might be found useful to exercise it. The subject of more rapid deposition is also interesting from a scientific point of view, I therefore mention an unusual result I have arrived at in this direction.

Taking as one extreme, the slow rate of deposit, of one ampère per square foot of cathode—a rate not infrequent in copper-refining, I have found that the limit in the other direction is not reached by a rate of deposit one thousand times faster. I have produced, and I hope to be able to produce before you, a perfectly good deposit of copper, with a current density of 1000 ampères per square foot of cathode.

This cell contains a solution of copper nitrate with a small proportion of ammonium chloride. The plate on which I am going to produce a deposit of copper has an exposed surface of 21 square inches. Opposite, at a distance of one inch, is a plate of copper. When I close the circuit, a current of 140 ampères is passing through the solution. I continue this for just one minute. Now I wash it and remove the outer edge so as to detach the deposit, and as you see, I have a sheet of good copper—an electrotype.

To have produced a deposit of this thickness at the ordinary rate used in electrotyping operations would have occupied more than an hour.

In this experiment an extreme degree of rapidity of deposition has been shown. I do not intend to suggest such a rate of practical value. But it is at least interesting, as showing that the characteristic properties of copper are not less perfectly developed when the atoms of metal have been piled up one on the other at this extremely rapid rate than when there is slower aggregation.

I think it probable that a rate of deposit intermediate between this rate and the usual one of about 10 ampères per square foot may frequently be useful, for no doubt the slowness of the rate of deposit has often prevented electrotype from being made use of where, if the rate could have been increased ten times, it might have been used with advantage.

Here are some thick plates, deposited at the rate of 100 ampères per square foot. They are as solid and as free from flaw as plates deposited ten times more slowly.

I said that electrolytic copper-refining owed its existence to the discovery and improvement of the dynamo, and that other electro-metallurgic industries had originated from the same cause. One of these industries is the electrolytic production of aluminium.

When Deville produced aluminium by the action of sodium on aluminium chloride, exaggerated expectations were entertained of the great part it was about to play in metallurgy. It was very soon found that aluminium had not all the virtues that its too sanguine friends had claimed for it, but that it had a great many most valuable properties, and, given a certain degree of cheapness, a number of useful applications could be found for it. Some of these are suggested and shown by the various articles made of aluminium, kindly lent by the Metal Reduction Syndicate, and metallurgical research is rapidly extending our knowledge of its importance in connection with the improvement of steel castings, and the production of bronzes and other alloys of extraordinary strength. The cost of aluminium produced by Deville's process was too great to permit of its use on any large scale for these purposes.

After Davy demonstrated, by the electrolytic extraction of potassium and sodium, the power of the electric current to break down the strong combination existing between the alkaline metals and oxygen, it seemed natural to expect that aluminium would also be reduced by the same means. But Davy did not succeed in producing any appreciable quantity of aluminium by the electrolytic method. Deville and Bunsen were more successful, but they did not possess the modern dynamo: that has made all the difference between the small experimental results they achieved and the industrial production of to-day, a production now so large that I suppose every day it amounts to at least one ton, and has resulted in a very great reduction of the price of the metal.

There are two electrolytic processes at work. One is the Hall process—employed at Pittsburg, and at Patricroft, Manchester—and now in experimental operation here. The other, the Herault process, worked at Neuhausen, is not greatly different from the Hall process—the shape of the furnace or crucible is different, and the composition of the bath yielding the aluminium may be different, but in all essentials these two processes are one and the same. They depend on the electrolysis of a fused bath, composed of cryolite, aluminium fluoride, fluorspar, and alumina. In the Hall process this mixture is contained in a carbon-lined iron crucible—the cathode in an electric circuit; and between which and the anode—a stick of carbon immersed in the fused bath—a difference of potential of 10 volts is maintained. In carrying out the process on a manufacturing scale, there are many of these sticks of carbon to each bath. Here, in our experimental furnace, there is only one.

The heat developed by the passing of so large a current as we are using (180 amperes) through an electrolyte of but a few inches area in cross section, is sufficient to melt and keep red-hot the fluorides in which the alumina is dissolved.

The electrolytic action results in the separation of aluminium from oxygen. The metal settles to the bottom of the pot, and is tapped or ladled out from time to time as it accumulates. The oxygen goes to the carbon cylinder, and burns it away at about the same rate as that at which aluminium is produced. It is only necessary to keep up the supply of alumina to enable the operation to be continued for a long time. I mean, of course, in addition to the keeping up of the current and the supply of carbon at the anode.

By far the greater part of the cost of aluminium obtained by electrolysis is the cost of motive power: 20 horse-power hours are expended to produce 1 pound of aluminium. Therefore it is essential for the cheap production of aluminium to have cheap motive power.

There is one feature about the Neuhausen production of aluminium which is very striking, and that is the generation of the electric current by means of water power derived from a portion of the falls of the Rhine at Schaffhausen.

The motive for making use of water power is economy. But, apart from that, it is interesting to see water replacing coal, not only in the production of power, but also in the production of the heat required in a smelting furnace.

Here is the Hall apparatus on a small scale. It is simply a carbon-lined iron crucible, and a thick stick of carbon. As already mentioned, the crucible is the cathode, the stick of carbon the anode.

As the process takes time to get into full operation, it was commenced some hours ago, and at the rate at which it has been working we should by now have produced several ounces of aluminium. In beginning the process the charge has first to be melted. This is done by bringing the carbon stick into contact with the bottom of the crucible, so as to allow the current to pass from carbon to carbon to develop heat between the electrodes.

The alumina compound, which, when melted, forms the bath, is added, in powder, little by little, and, when sufficient is melted, the carbon stick is raised out of contact with the bottom, and the electrolytic action then commences.

I will now ask Mr. Sample to empty the crucible and let us see the result of the operation, and while he is doing so I take the opportunity of expressing my very sincere thanks for his having so kindly and so successfully carried out this most interesting demonstration of the latest and one of the most important of all the applications of electricity to metallurgical operations.

Here is the result of our experiment. It is not very large certainly, but it is quite enough for our purpose, which is to illustrate the principle of a newly developed electro-metallurgical industry directly derived from discoveries made at the Royal Institution.

MOUNT MILANJI IN NYASSALAND.

HIDDEN in the recesses of one of the recently issued Parliamentary Papers (Africa, No. 5, 1892) will be found a very interesting report on the mountain and district of Milanji, in British Central Africa, by Mr. Alexander Whyte, F.Z.S., one of Mr. Commissioner Johnston's principal assistants in the task of ruling and developing the new British Protectorate of Nyassaland. Mr. Whyte was sent to Milanji by Mr. Johnston in October last, and dates his report from the "Residency, Zomba, British Central Africa," in the month following. Milanji is a large mountain mass in the extreme south-east corner of Nyassaland, drained on the west by the head waters of the Ruo, one of the affluents of the Shiré, and on the east by the Lukuga and other smaller streams, which run into the Indian Ocean north of the Zambesi. It is described by Mr. Whyte as an isolated range of, for the most part, precipitous mountains, the main mass forming a huge natural fortress of weather-worn precipices or very steep rocky ascents, sparsely clothed with vegetation. Many of its gullies and ravines are well wooded, and in some of them fine samples of grand African virgin forest are met with. Mr. Whyte's ascent, on the 20th of October, was made up the south-east face of Milanji, over steep grassy hills and across rocky streams, full of large water-worn granite boulders. Further on precipices were encountered, and it was necessary to clamber up, holding on by tufts of grass, roots, and scrub, after which a wooded gorge was entered, and welcome shade was obtained from the forest trees.

Here an interesting change in the vegetation was at once perceptible, the plants of the lower slope being mostly replaced by other species. These in many cases approached the flowers of temperate climes, such as brambles and well-known forms of *Papilionaceæ* and *Compositæ*. Ferns, too, became more numerous, and now and again were encountered perfect fairy dells of mosses, Selaginellas, and balsams, with miniature water-falls showering their life-giving spray on the little verdant glades, while overhead hoary lichens and bright festoons of elegant long-tasselled Lycopods hung from the moss-covered trees. After they had passed through some dense thickets of bamboo, and climbed up an ugly barrier of precipitous cliffs, another hour's ascent, the latter part of which was through a steep grassy glen, brought Mr. Whyte and his companions to the highest ridge of Milanji.

Hence was a splendid view over rolling hills of grassy sward divided by belts of dark-green forest, and the climate was found to be delightfully cool and bracing, with a clear dry atmosphere of about 60° Fahr. Altogether two weeks were spent at three different sites on this high plateau, and good collections of its natural history were made, although rain and mist occasionally interfered with the operations of the naturalists.

The flora of the mountain proved to be of great interest, being quite distinct from that of the surrounding plains, and even from that of the lower slopes. Tree-ferns were found to attain a great size in the damp, shady forest, and one was measured 30 feet in height and 2 feet in diameter at its base. The display of wild flowers is described as "gorgeous." Creamy-white and yellow helichrysums mingled with purple and blue orchids and irises, and graceful snow-white anemones were all blooming in wild profusion, and rearing their heads from a bed of bright green grassy sward. But the most striking botanical feature of the Plateau of Milanji was the cypresses formerly apparently quite abundant, but now confined to a few of the upper ravines and valleys, where the annual bush-fires, which take place in the dry months of August and September, cannot reach them. In some places hundreds of these giant trees thus destroyed lay prostrate, piled one above another, in every stage of destruction. One of these dead conifers was found to measure 140 feet in length and 5½ feet in diameter at 5 feet from its base. The foliage of this cypress is juniper-like. The timber, of a dull reddish-white colour, is of excellent quality and easily worked. Ripe cones of this fine tree were procured, and, as stated in a subsequent letter, have already germinated in the experimental garden at Zomba.[1]

The fauna of the mountain was found to be of nearly equal interest to the flora, but in the short space of time available it was not possible to make so nearly a complete collection. Raptorial birds were very scarce, but Passeres were plentiful. The grassy lands of the summits were tenanted by a small dark brown quail, a pipit, two grass-warblers, and the ubiquitous great-billed raven (*Corvultur albicollis*), which, however, was not so numerous as on the plains below. In the adjoining forest bird-life was abundant. Bul-buls, fly-catchers, warblers, finches, and honey-birds joined in chorus in celebrating the springtime and nesting season, which was then in full progress. Altogether about 200 specimens of birds were obtained. Of mammals few were met with. The beasts of prey consisted of the leopard, the spotted hyæna, the serval, and an ichneumon. Examples of three species of *Muridæ* were also obtained, and a little antelope, probably of the genus *Neotragus*, was observed, but not procured. A few snakes were likewise met with.

As regards the question of establishing a sanatorium on the Milanji Plateau, to which special attention had been directed, Mr. Whyte has no hesitation in saying that the climate of this district contrasts very favourably with that of some of the hill-stations in India and Ceylon. The year is pretty equally divided between wet and dry months, the former lasting from November till May, while the other six months are stated to be fine, clear, and bracing, the thermometer at night in the months of May, June, and July occasionally falling below the freezing point. In the month of October the air was found to be delightfully pure and balmy. We believe that steps have already been taken to build a small station on Milanji, but to render this of much use it will be necessary to form a road to it from the falls of the Ruo up the Lutshenya valley. This could be made with fairly good gradients, and would be of great advantage as an outlet for the cypress-timber, which now lies useless and decaying in the forest.

We are pleased to be able to add that Mr. Whyte's collections above spoken of, along with others from Mount Zomba, have already reached London, and are in the hands of Mr. Sclater, to whom Mr. Johnston has entrusted the task of getting them worked out and described. Mr. Oldfield Thomas has already commenced to determine the mammals, Captain Shelley will name the birds, and Mr. Boulenger, it is believed, will undertake the examination of the reptiles and batrachians. The plants will be examined in the Botanical Department of the British Museum, in which institution Mr. H. H. Johnston has directed the first set of specimens in every department to be deposited. The zoological results will be published in the "Proceedings" of the Zoological Society of London.

OBSERVATIONS OF THE PLANET MARS.[2]

I OUGHT to have written to you before on the subject of the planet Mars, which I have been studying for over four months with our great equatorial. My great desire to verify the

[1] Some cones of this supposed "Cypress" have also reached the Botanical Department of the British Museum, and have proved to belong to a Conifer of the genus *Widdringtonia*, probably of a new species. But this point cannot be definitely settled until more perfect specimens of the tree have been received.

[2] Letter from M. Perrotin to M. Faye, *Comptes rendus*, September 5.

extraordinary phenomena to which I alluded in my last letter may account for this.

Besides, I have gained nothing by waiting, and at the present time, after successive delays which I much regret, I am hardly further than I was a month ago. Owing, perhaps, to the images being less satisfactory, or to the phenomena in question not having recurred, nothing has been added to my first observations.

The phenomena alluded to are brilliant projections, comparable in colour and brightness to the southern pole cap, observed on three different occasions—viz., June 10 and July 2 and 3, on the western limb of the planet.

The last time, July 3, I was able to observe the several phases of this singular appearance. On that day the luminous point began to emerge on the edge of the disc at 14h. 11m. (local astronomical time), very faint at first; then I saw it gradually increase, pass through a maximum, and then diminish, to disappear finally about 15h. 6m. The facts would not have been different had it been a case of an elevation of the surface of Mars traversing the illuminated edge of the disc by the simple effect of the rotation of the planet. The phase which affected the western limb of the planet at that time, could only modify it in amount and in duration. The previous night, July 2, I had seen the crescent in a phase approaching the maximum, at 14h. 10m., and I was able to follow the bright point up to its complete disappearance at 14h. 40m.

On July 2 and 3 the things happened in the same part of the disc, about the 50th parallel of latitude, and with a retardation of half an hour against the previous day, as usual for a thing taking place in the same region of the planet.

The first observation of this kind goes back as far as June 10, when it lasted from 15h. 12m. to about 16h. 17m. This time the bright point occurred in the vicinity of the 30th southern parallel, probably in the southern portion of the isthmus Hesperia of Schiaparelli's chart.

I may add that during these observations the portion of the disc adjoining the small protuberance has always appeared to me slightly deformed and as if raised.

Such are the facts. I shall not attempt to interpret them. They presented themselves with such clearness that it is hardly possible to consider them as the result of any illusion.

On the other hand, since it is a question of projection beyond the disc of at least one or two tenths of a second of arc, that is to say, of phenomena at a height of more than 30 or 60 km., one feels overwhelmed by such numbers, to which we are not accustomed on our globe, and it is undoubtedly luminous phenomena only which could explain heights like that.

The southern snow cap has been the object of several measurements, which will be published with the drawings of this opposition. This cap has notably diminished in the last two months; it is, in fact, shifting; it is traversed by at least two black lines, a kind of crevices analogous to those which I announced in 1888 in the case of the northern cap. The first of these lines was seen at the end of June, the second on August 8.

The outline is now more irregular than in the past; in particular there is seen, between the meridians of 300° and 0° (Schiaparelli's map), a deep black hollow which grows steadily.

Although the actual conditions are not very favourable for the canals (at least for a portion of them), several are well visible; some are apparent enough to convince the most prejudiced observers.

Two of our drawings of the Great Syrtis, made at widely different dates, indicate some slight changes in the most northerly portion of this sea. They are no doubt due to mists and clouds, which have sometimes appeared to me to invade the northern regions on the east of this Great Syrtis, hiding the canals which traverse them, and only allowing us to see their most southern portion.

Our drawings of the Lake of the Sun, when compared with those of M. Schiaparelli, also indicate some changes of detail in the aspect of the lake itself and of the seas and canals surrounding it.

The most interesting observation of this month is the one I have made, on August 6, of a very bright point placed precisely a little to the north of this Lake of the Sun. This point, which struck me by its extraordinary radiance, could not be seen the next day; if it still existed—the images were not so good as the previous night—it was certainly much less luminous.

This phenomenon, and the analogous phenomena sometimes noticed on the surface of the planet, are perhaps not without some relation with the appearances of the limb which I have announced. Future observations will no doubt inform us on this subject.

I should perhaps have still deferred sending this letter if I had not, within the last few days, received from Mr. Newcomb the extract of a journal, in which it is reported that the Lick astronomers have also observed the luminous projections on the edge of the disc.

I may add that in the beginning of July I had imparted my observations to M. André, director of the Lyons Observatory, who happened to be on a visit to Mont Gros, and whom I had invited to come on the 5th and verify the strange appearances which I had told him of. Unfortunately, the sky remained obscured all night, and my project could not be carried out.

SCIENTIFIC SERIALS.

THE *American Meteorological Journal* for August contains:—Synoptical sketch of the progress of Meteorology in the United States, by W. A. Glassford, and reprinted from the annual report of the chief signal officer for 1891. From this summary it appears that Isaac Greenwood, a professor of mathematics in Harvard College, prepared a form for observations at sea in 1728, thus anticipating the efforts of Lieut. Maury by more than a century. Observations of temperature and rainfall were begun in Charleston in 1738, and were soon followed by several other series. In 1817, J. Meigs, Commissioner of the General Land Office, proposed to Congress the establishment of meteorological stations at each of the land offices, and as this proposal was not adopted, he started a voluntary system among his subordinates, and supplied registers for the purpose. This system lasted until his death in 1822. The next service was established by the Surgeon-General of the Army, in 1819, and was maintained, with modifications, until 1854, when the records were handed over to the Smithsonian Institution, and in due time were transferred to the Signal Service. The Patent Office, of which agriculture formed a division, and the Coast Survey also manifested great interest in the science. The article contains a good review of the labours of the principal American meteorologists.—Note on winter thunderstorms; by Prof. W. M. Davis. He asks whether the convectional origin of thunderstorms in summer implies a like origin for thunderstorms in winter, even though they occur then at night, and he explains the reasons which seem to favour this supposition.—Objections to Faye's theory of cyclones; by W. C. Moore. The writer attempts to show why the generally accepted theories seem to him preferable to those brought forward by M. Faye. The discussion is to be continued in a future number.—Artificial rain; by E. Powers. The writer is the author of a work entitled "War and the Weather," and he supports the view that rain can be artificially produced, and endeavours to refute the objections urged by Prof. W. M. Davis and others.

Wiedemann's Annalen der Physik und Chemie, No. 8.—On the refraction of rays of great wave-length in rock-salt, sylvine, and fluorspar, by H. Rubens and B. W. Snow. A series of bolometric researches concerning the infra-red rays, to determine the refractive indices of the three substances for light of various wave-lengths up to $\lambda = 80,000$. Fluorspar, though showing a lesser dispersion than the other two in the visible portion, excelled them enormously in the infra-red, hence it is specially suited for the production of prismatic heat spectra.—Reflection and transmission of light in certain æolotropic structures, by H. E. J. G. du Bois. An æolotropic structure is a portion of matter, generally plane, in which it is possible to fix upon an optically favoured direction. This can be due to its coarse macroscopic or its molecular and microscopic structure. In both cases vertically incident or reflected light will be acted upon differently according as its plane of polarization is parallel or normal to the favoured direction. This action is in general unequal as regards both the amplitude and the phase of the two components. The objects experimented upon were, in the first class, bright silver wire gratings, platinum film gratings, scratched metal reflectors, and scratched glass gratings; in the second class, crystals of cobaltine and pyrites, and a loaded steel mirror. In the case of the silver wire gratings it was found that light polarized in a plane normal to the direction of the wires was let through in greater intensity than that polarised parallel to them. The contrary was observed in scratched glass gratings, while a scratched metal mirror reflected 4 per cent. more perpendicular than parallel light.—The limiting index of refraction for infinitely long waves; transformation of the equations of dispersion, by E. Ketteler. The determination of the limiting coefficient of refraction is shown to be impossible, both in practice and by the current theory. Another form of the equation of motion of light is worked out, which promises a solution of the problem. —On the electricity of waterfalls, by Ph. Lenard. Numerous observations and experiments concerning the electricity developed by water falling in drops, jets, or waterfalls have led to the following general conclusions: Drops of water falling on to water or a wetted body generate electricity. Water is electrified positively, air escapes negatively electrified from the foot of the fall. Jets breaking up into spray make the electrification more apparent. Slight impurities in the water diminish the effect considerably. Other liquids and gases also produce electrification, but differing in intensity and sign. The essential conditions of electrification are the concussions among the waters themselves and against the wet rock. The friction against the rock and the fall of the earth-potential are of secondary importance, while no effect is due to the water's fall through air and its dispersion in it. The author explains these phenomena by the sudden diminution of the water surface, and the convection of negatively charged air away from the foot of the fall. A jet of water falling from an insulated tank into an insulated pail electrified the latter positively, while the negative electrification of the surrounding air grew to several hundred volts. A steady increase of potential was also produced by drops of water falling at the rate of two per second. Sparks were sometimes obtained from waterfalls, and in all cases the air was found to be negatively charged, though this charge was diminished if air bubbles were driven under water.—Note on a phosphoroscope with spark illumination, by Ph. Lenard. This ingenious apparatus consists of a Ruhmkorff coil with condenser and mercury interrupter, fitted with terminals of strip zinc or zinc wire, in order to produce as much ultra-violet and phosphorescent light as possible. The arm of the mercury interrupter is prolonged, and carries at its end a rectangular shade of black paper, large enough, in its mean position of rest, to hide the spark and the terminals. Hence when the coil is working the sparks are not seen. But if a phosphorescent substance be placed behind the terminals, it continues to glow when the screen is at its highest or lowest position, thus producing the impression as if the screen, which appears perfectly stationary, were only transparent for phosphorescent light. For lecture purposes the apparatus is placed behind a screen with an opening as large as the black paper shade. The results are in general the same as those of Becquerel's phosphoroscope. A brilliant green light is obtained from pentadecylparatolylketone. The interval between illumination and observation is $\frac{1}{400}$ second.—On the production and observation of very rapid electric oscillations (continued), by A. Toepler.—On the use and mode of action of the telephone for electric null methods, by A. Winkelmann.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, Sept. 5.—M. de Lacaze-Duthiers in the chair.—Note on the treatment of cancer and cholera by the testiculary liquid, by M. Brown-Séquard. Some recent results seem to indicate that the testiculary liquid, already proved to be efficacious in cases of pulmonary tuberculosis, leprosy, and other diseases, also exerts a beneficial influence on cancer patients. This is not due to any action upon the microbes producing the disease, but to an augmentation of the powers of the nervous system, which is enabled to resume its normal functions by subcutaneous injections of the extract. M. Ouspensky, a military physician sent by the Russian Government to study and cope with the cholera in the Caucasus, is reported to have "cured every patient" by this method. Whether or not this be true, there is no doubt that the injections strengthen the nervous system, which is much exhausted even in convalescents.—Observations of the comet Denning (1892, II.) made at the great equatorial of the Bordeaux Observatory, by MM. G. Rayet, L. Picart, and F. Courty, reported by M. G. Rayet.—Observations of the planet Mars, by M. Perrotin [see p. 482].—Reappearance of the leafy celandine of Pumeterre, by M. D. Clos.—Observations of the new comet Brooks (C. 1892), and of the new planet Wolf, made at the Observatory of Paris (west equatorial), by M. G. Bigourdan.—Observation of the comet Brooks (August 28, 1892), made with the Brunner equatorial (0·16) of the Lyons Observatory, by M. G. Le Cadet.—On the calculation of inequalities of a high order, by M. O. Callandreau.—On a new form of induction apparatus, by M. J. Morin. The induction coils usually employed in electrotherapy are constructed with two cylindrical and concentric bobbins, sliding one over the other, and giving the maximum effect when the coils coincide along their whole length. There is a difficulty in reaching the zero by a regular diminution of the current. This is obviated in the apparatus as constructed by M. Morin. The conducting wires are wound on two flat concentric rings provided with channels of appropriate form. When an intermittent current is sent through the outer ring induced currents will be obtained from the inner ring. The effect will be greatest when the two rings are in the same plane. If one of these rings be turned round a diameter common to both the induced current will gradually diminish, and will vanish when the one ring is at right angles to the other. This arrangement could be employed for obtaining alternate currents by sending a continuous current through one of the rings and rotating the other. A sinusoidal current would be thus generated, the effects of which have been lately much appreciated in electrotherapy. For electric lighting the number of alternations might be increased by transforming the currents into induced currents of a higher order, by Prof. Henry's method, utilized recently by M. Tesla.—Removal of the thyroid in the white rat, by M. H. Cristiani (Geneva). The apparent immunity of the rat from the fatal effects of the removal of the thyroid is shown to be due to the rapid regeneration of this organ. If the extirpation is total, death, otherwise inevitable, can be averted by grafting the organ in the peritoneum.

CONTENTS.