THURSDAY, AUGUST 31, 1893.

BIRDS IN A VILLAGE.

Birds in a Village. By W. H. Hudson, C.M.Z.S., author of "Idle Days in Patagonia," "The Naturalist in La Plata," &c. (London: Chapman and Hall, Limited, 1893.)

MR. HUDSON would probably think it a doubtful compliment if we were to say that his last book is as good as either of the two which preceded it. But to say that "Birds in a Village" is not equal to "Idle Days in Patagonia," and not to be mentioned in the same breath as the charming "Naturalist in La Plata," by no means implies that it is other than a pleasantly readable book, with here and there—more particularly in the chapter which gives the title—graphic sketches of the habits of the birds he watched in his ideal country village, such as only a close and loving observer of Nature, and a practised writer, can give.

The unregenerate man may perhaps at first be a little inclined to rebel when he finds his insular ignorance of languages brought, he may think, rather too obtrusively home to him by untranslated Spanish poetry and a critical discussion on the superiority of Melendez to Tennyson in a chapter in which he had hoped to forget himself and his failings among blackbirds and thrushes. But any resentment he may have felt for the moment will be forgotten as he looks over the fence into the cottage garden and sees the hedge sparrow feeding the young cuckoo with caterpillars, "like dropping a bun into the monstrous red mouth of the hippopotamus at the Zoological Gardens," or lolls on the moss in the wood to watch through Mr. Hudson's binocular the jay, "high up amongst the topmost branches," as he "flirts wings and tail, and lifts and lowers his crest, glancing down with wild, bright eyes . . . inquisitive, perplexed, suspicious."

By the time he has wandered up the brook-side to the corner where "buttercups grew so thickly that the glazed petals of the flowers were touching, and the meadow was one broad expanse of yellow," and has caught sight of the kingfisher, "like a waif from some far tropical land," flying off "so low above the flowery level that the swiftly vibrating wings must have touched the yellow petals," he will have realised that he is in the company of one of the devoted worshippers of Nature, by whom "where'er they seek her she is found," and for whom every spot—country village, London park, or solitary South American plain—is "hallowed ground."

As might be expected of a man who has lived on such impartially friendly terms with living things of many kinds that, after lying helpless and alone miles away from any one, with a revolver bullet in his knee, he could find relief to his pain in the knowledge that the poisonous snake which had shared his rug with him through the night had got off in the morning without inhospitable treatment at the hands of his returning friend, Mr. Hudson rejects as "utterly erroneous" the "often quoted dictum of Darwin, that birds possess an instinctive fear of man," and quotes in support of his view—in which we entirely concur—the tameness of the moorhens in St. James's Park.

The wood-pigeons—in the country the wariest of birds, in London tamer if possible than the sparrows—are even stronger witnesses for him. It is said that the Paris wood-pigeons, which are as common and tame there as with us, and make frequent excursions to neighbouring country places, the moment they leave the precincts of the town assume their natural wildness, putting it off again the moment they return to the children and *bonnes* in the Tuileries Gardens.

By-the-bye, in connection with wood-pigeons we have a very small bone to pick with Mr. Hudson. Since Science has become a religion it was only to be expected that the religious parasite—*odium theologicum*—would develop new forms to suit. It has done so, and too many recent scientific works—notably one of the best modern bird books—are disfigured by sneers at other writers.

A charm of Mr. Hudson's writings hitherto has been, and we hope it always will be, that he has kept himself free from smallnesses of the kind. But there is "a little pitted speck" in this last fruit which we have never noticed in any of his earlier gatherings, and, microscopic though it is, we are sorry to see it. He is perfectly justified if he thinks it so in speaking of the wood-pigeon—the "deep, mellow crush" of whose note in Campbell's ears "made music that sweetened the calm" of the birchen glades he loved—as "*that dismal croaker.*" But having done so he ought not to fall foul of a brother ornithologist and his ancestry, and to throw Wordsworth at his head because he has ventured to write disrespectfully in *Blackwood* or *Macmillan* of the note of the greenfinch. We hope that Mr. Hudson will feel grateful to us for a friendly reminder that people who live in glass houses should not throw stones.

Mr. Hudson, as many another writer has done, protests in impassioned language against the practice of eating larks. The song of the "blythe spirit" of meadow and corn-land is as sweet to us as to him; and, being unfashionable enough not to appreciate, as every self-respecting diner should do, *mauviettes en surprise aux truffes*, or in any other dainty form, we may venture with a clear conscience to express a doubt whether the supply of larks to the markets affects appreciably, if at all, the numbers remaining to breed in England. Wherever they may come from, there can be no question the number of immigrants in winter is almost incredible. The most striking feature of a partridge drive at the headquarters of the sport, in the flat country round Thetford and Brandon, towards the end of the season, is the sight of the apparently interminable flocks which stream over the waiting guns. We have heard it said by a large landowner in the district, an ardent bird-lover, that it is no exaggeration to say that larks there are, when the early corn is first shooting, a nuisance to the farmers scarcely less serious than are the rats in more enclosed parts.

Space will not allow us to follow Mr. Hudson into the interesting questions touched upon in his later chapters. We fear that, whatever may lie before our children in good times to come, the dimming eyes of our own generation will not be refreshed by the sight of the glancing colours of exotic kingfishers reflected in English streams, nor can we ourselves look forward with any

great confidence to an early realisation of Mr. Hudson's dream of artificial birds'-eggs of such magic perfection that schoolboys seeing them will rob birds'-nests no longer, though we agree with him in thinking that the volatile colours of most eggs when blown, make collections of but little lasting value.

There is in "Birds in a Village," unless we are mistaken, something which may possibly prove of more practical interest to lovers of good works of natural history than any such agreeable speculations.

"Travel fever" is a malady easily caught. It is recurrent, and when once caught, seldom completely shaken off until life energy begins to fail and a man nears the starting time for his last journey. There are touches—sometimes rather pathetic—in the book before us which suggests that it was written under the influence of an unusually sharp attack. A few words from a little girl in St. James's Park, "Oh, how I love the birds!" were enough to start the writer wandering "somewhat aimlessly" about the country till he stumbled on his nightingale-haunted village and stopped there. "I could not," he writes, "longer keep from the birds, which I, too, loved, for now all at once it seemed to me that life was not life without them, that I was grown sick, and all my senses dim; that only the wished-for sight of birds could medicine my vision; that only by drenching it in their melody could my tired brain recover its lost vigour."

The chapter headed "Chanticleer" is as symptomatic as the passage quoted above. Mr. Hudson tries seriously to persuade himself and his readers that he likes being awakened at three o'clock in the morning by his neighbours' cocks! When he believed himself listening to their crowings he was in a trance, having his eyes open. His body may have lain "on high ground in one of the pleasantest suburbs of London," but he was himself thousands of miles away—lying on the cliff-edge, dropping stones to startle the great coots of Patagonia, riding at a swinging gallop through rustling seas of giant thistles into the "mysterious, extra natural, low level plain, green and fresh and snaky, where horsehoofs made no sound," or gazing up at the starry skies of the Pampas. The sounds of which he was really conscious were the concerts of crested screamers, or the dance music of La Plata rails.

Mr. Hudson will not think we wish unduly to disparage his "Birds in a Village" if we express a hope that circumstances may allow him soon to let Nature have her way, and that before long he may be able again to show us, on larger canvas, other collections of sketches of scenes less easily accessible.

In these days of high pressure one of the most serviceable qualities that a man can possess is the power of self-abstraction—to be able to throw work and worries on one side and bury himself in other interests. In "Endymion," when the hero's father found money difficulties gathering round him, and his political hopes failed at what had seemed the very moment of realisation, he committed suicide "because," says the author, "he had no imagination." The power which could convey Lord Beaconsfield himself at the time of a crushing defeat back to the formal terraces and gardens of the Bradenham of his boyhood, and enable him there to forget himself in the hopes and fears of beings of his own creation, is a gift of the gods to the few. A love of Nature—its best substitute—is a possession scarcely less precious, and one to which every parent may do much to help his children.

For such an education many more ambitious works could be better spared than the transcripts from the less known pages of "God's great second volume" which Mr. Hudson so well knows how to write. T. D. P.

A MATHEMATICAL MISCELLANY.

Mathématiques et Mathématiciens, Pensées et Curiosités. By A. Rebière. Second edition. First edition, 1889. (Paris: Nony et Cie, 1893.)

THIS work, originally issued in 1889, contains quotations from various writers on the study or philosophy of mathematics, together with some anecdotes and problems on the subject. The first edition consisted of but 280 pages, but advantage has been taken of a new issue to make additions which have more than doubled its size. Save for a brief section on the history of mathematics, the work is almost entirely a compilation, and no attempt is made to connect together the extracts or draw any inferences therefrom. The reader thus has the advantage of being able to begin anywhere, but the effect of many hundreds of short and disconnected paragraphs is somewhat jerky. To form such a miscellaneous collection, drawn from writers of all ages, must have involved extensive preparation and years of reading. M. Rebière may be congratulated on the result of his labours, for the volume is undoubtedly interesting, though of somewhat unequal merit.

It is divided into four parts. The first is mainly devoted to remarks on the philosophy of mathematics—by far the greater portion being drawn from French sources. In our opinion this is the best section of the book, since many of the extracts here given would otherwise be practically inaccessible; moreover it is always instructive to read the opinions of writers like Condillac, Mdme. de Stael, Rousseau, and Comte, and not the less so when their knowledge of the subject discussed is rather superficial. At the same time we think that a reader may reasonably expect detailed references to the sources of the quotations, and certainly the value of the collection would be increased thereby.

The section on the history of mathematics, which is placed at the close of this part, is a mere travesty of the subject. We cannot suppose that M. Rebière, when writing his work, seriously thought that Galileo, Kepler, Newton, and Leibnitz were the only mathematicians outside France who should be mentioned as having been eminent in the last five hundred years; that among over forty names given as representing contemporary mathematicians not a single foreigner should find a place; or that five French papers were the only current periodicals of any importance (had not M. Rebière ever heard of *Crelle's Journal*?). In the second edition the names of Huygens, Euler, Gauss, and Jacobi, together with those of a few European contemporaries are added, but though M. Rebière in his preface specifically calls attention to these additions, we consider he would have been better advised to have omitted this section rather than give a sketch which is so unsatisfactory.

The second division of the work is of a very miscellaneous character, ranging from quotations and anecdotes to a note on the superstition that thirteen is an unlucky number, and a remark that Newton's fluxions is not, as might be inferred from the title, a medical work. Any citation involving a geometrical term or a number seems to be regarded as worthy of a place here: thus the observation of a diplomatist that the straight course is not always the shortest way is regarded as a geometrical anecdote. Such examples abound, but it is an unusual stretch of language to call them mathematical.

The third division commences with some quotations which might have been equally well placed in the first part of the book. Most of it is, however, devoted to what are called paradoxes and singularities; such as a mnemonic verse for recollecting the approximate value of π, that the number six hundred and sixty-six is supposed to be connected with Antichrist, that a map of the heavens is now being prepared by photography, that two and two do not truly make four because the units used can never be exactly alike, that since it is very cold at the North Pole it might be thought that it was very hot at the South Pole, that Cardan's solution of a cubic equation is useless for determining real roots, and so on. Such a collection of assertions and extracts—mostly unaccompanied by comment or reference — will probably be less attractive to the mathematician than to the general reader.

The book concludes with some problems, classified according to subjects. In general, only the enunciations are given. Thus, in arithmetic, we have the question how many digits are used in paging a volume of one thousand six hundred and forty-five pages; in algebra, the question of finding the number of rabbits and pheasants when altogether among them there are thirty-five heads and ninety-four feet; in optics, the determination of a point equally illuminated by two given luminous points; in mechanics, the curve of pursuit, and in higher (!) mathematics, the question of finding the sum to which a centime would amount in eighteen hundred and eighty-nine years at compound interest at the rate of five per cent. a year. Some "recreations" and celebrated problems are also included: historical notes on these or references are either absent or so incomplete as to be practically useless, though they would add greatly to the interest of the questions. Moreover, it seems desirable to add a warning that questions of this kind—such as the inscription in a circle of a regular polygon of seventeen sides, the theory of the knight's tour on a chess-board, and the formation of perfect numbers—are of a totally different character to the common catch of the time occupied in reaching the top of a pole twenty metres high by a snail which each day crawls up three metres and each night slips down two metres. Here, however, conundrums and problems of all degrees of difficulty are indiscriminately mixed up together. In spite of this obvious criticism the collection is a good one, and well adapted to stimulate interest.

The printing and get-up of the book are admirable, while the foregoing sketch will, we think, enable the reader to form a general idea of its contents. We have already stated that, in our opinion, its chief value lies in the citations on the philosophy of the subject; the scientific worth of the rest is more questionable, but it forms an amusing collection of assertions and notes concerning mathematics which may be commended to those interested in such matters.

OUR BOOK SHELF.

Grasses of the Pacific Slope, including Alaska and the Adjacent Islands. Part II. By Dr. George Vasey, Botanist to the U.S. Department of Agriculture. Issued June 1, 1893. (Washington: Government Printing Office, 1893.)

THIS is the fourth part of a series of plates and descriptions of the rarer American grasses which has been issued by the United States Department of Agriculture. The first volume was devoted to the species of Texas and the south-west, and the present volume, which is now finished, contains plates and descriptions of the grasses of California, Oregon, Washington, and the north-western coast, including Alaska. Dr. Vasey, who for many years was head of the department at Washington, died before the present volume was issued. He was a native of Yorkshire, who emigrated to the Western States in early life. For many years Dr. Vasey lived in Illinois, and was one of the leading authorities on the plants of the Western States. He was already advanced in years when he became a government servant, and made a special study of the grasses.

The number of grasses of the Pacific Slope reaches nearly two hundred species. They are nearly all specifically distinct from the species east of the Mississippi River. A considerable number of the grasses of the mountain regions of California, Oregon, and Washington reappear in the mountains of Idaho, Montana, and the interior Rockies.

The interior of California is a dry region, verging in the extreme south into desert country, and is very deficient in grasses. In the present part there are descriptions and plates of 1 Schimdtia, 1 Phippsia, 1 Arctagrostis, 2 species of Agrostis, 3 of Calamagrostis, 2 of Deschampsia, 1 Trisetum, 1 Danthonia, 6 of Melica, 2 of Pleuropogon, 1 Uniola, 15 of Poa, 1 Colpodium, 2 of Dupontia, 1 Glycera, 1 Atropis, 3 of Festuca, 2 of Bromus, 1 Agropyrum, 3 of Elymus, and 1 Gymnostichum. Only two of the species are British, *Calamagrostis neglecta* and *Elymus arenarius*. The descriptions are mainly drawn up by Mr. L. H. Dewey. We wish the department could see its way next to issue a complete synopsis of all the grasses of the United States. J. G. B.

Reveries of World History, from Earth's Nebulous Origin to its Final Ruin; or, the Romance of a Star. By T. Mullett Ellis. (London: Swan Sonnenschein and Co., 1893.)

IT is difficult to estimate the place of this book in scientific literature. The object of its publication is apparently to give the world the benefit of moralisings very similar in style to those indulged in by Mr. Richard Swiveller of *Old Curiosity Shop* fame. But there is no substance in the book whatever. From the first to the last page the author meanders on with wearisome platitudes expressed in high-flaunting style, obscuring a line of fact in a page of padding. This is the manner in which he is carried away on the subject of the origin of man.

"He came like an apparition. Whence? Who shall say? Who shall dare, out of his absolute knowledge, to declare his origin, his ancestry?

"What hopes had he in that dreary desolation? What thoughts? What ambitions?

"What a being! What a nature, his! How noble his form! Between the mammoth and himself, between

the animals that he chased and he, what a chasm in the scale of creation!"

So the rhapsody continues, without backbone or argument of any kind. Mr. Millett Ellis probably means well. Indeed, his literary effort may be highly appreciated by people who mistake verbiage for eloquence. To us, however, the contents appear to be in a nebulous condition like that which existed when, to use Mr. Ellis's words, "The chaos of earth circled in the vastness."

LETTERS TO THE EDITOR.

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The Publication of Physical Papers.

THE discussion started by Mr. J. Swinburne in NATURE of June 29, seems to have wandered from its original purpose, and from the points suggested in your article of July 13. It is the duty of an investigator in any branch of Natural Science to publish the results of his research if they appear to be both new and of sufficient interest. He has three courses open to him. He can write a book, relying on the advertisements of his publisher and on reviews to inform other workers that such a book exists. His space is unlimited, but he cannot make sure of a circulation unless by presentation copies. He may communicate his results to a scientific society. His space is somewhat limited, but he secures a definite circulation, and an opportunity for discussion. Or he can communicate them to some technical journal, securing generally the maximum circulation, but with considerable restriction as to space.

The publication of books needs no comment, and was alluded to by Mr. Swinburne. Mr. Buchanan thinks that the publication of papers in all branches of science is in as unsatisfactory a state as that of physics, and advocates the central organ suggested by Dr. Oliver Lodge, and referred to by Mr. Swinburne as a last resort. But the real question seems to be one of facilities for the publication of original communications, not of abstracts or reprints; and these not of general science, but of physics. Mr. Swinburne has given reasons which render a purely physical journal impossible, unless it be endowed or subsidised, as in the case of the excellent *Physical Review* of the Cornell University. Nothing could be more complete than the publication of chemical researches; and geology, astronomy, biology, and physiology, though untainted by the patentee, and treated often as a hobby rather than as a study, seem to be well provided for.

Exhaustive and important physical researches, such as those of Ewing on Magnetism, should undoubtedly be communicated to the Royal Society. The Transactions, it is true, are very expensive, and the circulation appears to depend largely on presentation copies, unless an abstract or reprint appears elsewhere. Work done at University laboratories is in many cases appropriately communicated to local societies, the circulation is almost negligible, and the majority of the papers are never heard of by outsiders. The Physical Society appears to offer the greatest facilities, and to publish its proceedings in the best possible manner—first through its own Proceedings, secondly by a recent arrangement with the *Philosophical Magazine*, thirdly by a number of reprints issued to the author, and last, but not least, by the admirable report which is sent to and printed by a number of technical journals, and which appear regularly in NATURE. Dr. Lodge thinks that "the method of publication invented, or at any rate adopted, by the Physical Society of London" is "well worthy of imitation." Not of imitation surely, for to multiply societies will hinder rather than facilitate reference to the published papers. The valuable work of the Physical Society needs extension. The double publication in the *Philosophical Magazine* and in the Proceedings seems to be somewhat wasteful. A selection of its heavy mathematical papers might be offered by the Society to the *Philosophical Magazine;* and thus leave room in its Proceedings for publication, in addition to its present contents, of papers accepted for printing, but not necessarily for reading and discussion; and for abstracts or for full publication of the more important physical papers of the societies of Cambridge, Oxford, Dublin, Edinburgh, and Glasgow. The Institution of Civil Engineers publishes a number of "selected papers"; these are either unsuitable for reading and discussion at a meeting, or are of minor importance. They receive perhaps less attention from London members who frequently attend the meetings, and who rarely read the Proceedings, but they secure as wide a circulation as those which are accepted for reading. A very successful departure was made by the Institution of Electrical Engineers in the publication, early in August, 1892, of a paper by Mr. J. Swinburne on "Problems of Commercial Electrolysis." At the meeting on November 10, this paper was taken as read, and a useful and vigorous discussion followed, occupying two evenings.

By the brief but careful and always accurate abstract of the papers, and by the no less excellent though much more care-demanding report of the discussion, an unusually wide circulation of the chief points of all communications to the Physical Society is secured. The lithographed reports are sent gratuitously to any technical journal that cares to publish them. Abstracts of "selected papers" could be sent out in the same way, and could be made with far less trouble, since, unlike the report which is issued a few days after each meeting, they could be dealt with at leisure; the abstract might indeed be furnished by the author, though I am not sure that this is advisable. The Physical Society seems in every way admirably fitted for the publication of physical papers, and no greater facilities for experimental demonstration could be desired than those which are so freely afforded to the authors of papers read before it.

Mr. Basset suggests that the London Mathematical Society would be a good medium for the publication of physical papers. May I protest against confusion between the two sciences, and I am sure that many pure mathematicians, though from a different point of view, will agree with me? There was once and I believe still exists, a "science" called Microscopy. It was divided into two factions, strongly opposed to each other. These were named, reciprocally I suppose, "The Glass and Brass School," and "The Slug and Bug School." The one regarded the *navicula* and the *grammatophora* as having been specially created to afford test objects for showing off the performance of favourite instruments; the other considered immersion objectives and correcting adjustments as mere tools, the use of which must be learned; and regarded polariscope attachments and mechanical stages as toys. The problem worker, it would be ambiguous to call him a mixed mathematician, finds in physics an unlimited material for problem-setting. In many cases he accidentally makes an original contribution to physical science, he frequently gives most valuable finishing touches to the experimental work of others, and occasionally actually retards progress, as in alternate current electrical engineering, by introducing complications on insufficient data, to the discouragement and confusion of the experimental worker. Good tools are in themselves a delight to a good workman; no true physicist can disregard mathematics, even in those branches which are to him useless. But the aims differ, and the sciences should be distinct.

There need be no rivalry whatever with the Royal Society. Elaborate memoirs do not admit of discussion, and it would be a pity to burden the Physical Society with the expense of printing them, when the Royal Society can so well afford to give them place in its Transactions. The strict rules of the Institution of Civil Engineers against the publication of its papers in technical journals before they have appeared in its own proceedings, and the similar rule of the Royal Society, so far as its Transactions are concerned, may perhaps be in keeping with the unapproached prestige of these institutions. But the Royal Society issues proofs of its Proceedings after the papers have been read, and the Institution of Mechanical Engineers and other societies send out proofs of their papers with the simple condition that they are not to be reprinted until the communications have been actually read. The Physical Society tacitly adopts the latter course, sending proofs before the meeting to those who are likely to take part in the discussion. The only objection to the free publication of a paper *before* it is read and discussed, is that a discussion may take place prematurely in the technical journals; but with the exception of NATURE, these are in touch with so few branches of physics, that but little harm would be done.

I venture to think that the publication of physical papers can be carried out most efficiently by means of the present procedure

of the Physical Society; that with a few modifications it could deal with all the more important physical papers annually published in this country; and that such centralisation is very desirable. Such modifications I beg to suggest are the following:—(1) Let mathematical papers, *i.e.*, those which consist of problems in mixed mathematics rather than pure physics, be offered to the *Phil. Mag.*, publishing the conclusions, with a reproduction of any resulting diagram, in brief abstract in the journal. (2) Let papers be invited not only for reading during the winter season, but for publication at intervals throughout the year, whenever enough matter has been collected to fill a number, as is done in many other publications. (3) Let selections be made from these for reading, on the grounds [*a*] of scientific importance, [*b*] suitability for discussion, [*c*] experimental demonstration. (4) Reprint in abstract, or occasionally in full, papers read before other societies (excepting, of course, the Royal Society).

I feel that some apology is due for making these suggestions elsewhere than at an annual general meeting of the Physical Society, but the attendance at the meetings is no measure of the important work which this society does in the publication of physical papers, and as these suggestions arise directly out of the discussion which has arisen in your columns, they may perhaps not be out of place there. ALEX. P. TROTTER.

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The Definition of "Heredity."

WHEN all the world is ringing with the words "heredity" and "inheritance," it is natural to feel some surprise and amazement on hearing from even so high an authority as Dr. Hurst that they are expressive of nothing but the incoherence of ideas emanating from confused brains. Perhaps as a student of Darwinism I may be allowed a little space in your columns to suggest that there is an alternative view to that held by Dr. Hurst.

His position I understand to be this: No force of any kind except natural selection is at work to preserve the form of organisms from alteration. Does he mean to confine the application of this statement to organisms existing under stable conditions, or would it have equal force in the probably numerous cases where temporary changes in circumstances occur? Now it cannot be denied that there is some factor of considerable power controlling the variations of species from the normal type; but that it is a natural selection, as ordinarily understood, seems to me to be at least open to discussion. If, without the action of natural selection all species are liable to react to any change in their environment, there is no reason against and very great probability in favour of many species having been destroyed by the advent of new conditions followed by the substitution of new forms quite ill-adapted to the old conditions. What would then be likely to happen should the original circumstances return? Two alternatives are possible under Dr. Hurst's view. Either the form resulting from the first change must be lost, or it must again become modified; but the chances are infinite against any approximation to the original organism being reached unless there be some tendency towards a return to former types.

If we adhere to the opinion that "heredity is something more than mere family likeness," and not quite comparable to the "tendency of all weathercocks to point to the south-west," we are at once freed from the difficulty, and can see how a species might outlive many temporary changes in the form of influences to which it might be subjected. In order that species may be modified to suit new permanent surroundings it is obviously unnecessary that the variations arising among the individuals shall be very frequent, and, when organisation and environment are in agreement, it is equally obvious that the fewer the departures from the normal type the better will it be for the species. If, then, the tendency is strong in all organisms to conform to an ancestral type, whenever there is a merely temporary change of environment the chances of some at least of the individuals leaving unmodified descendants, when the old conditions reassert themselves, is vastly increased; and if meanwhile some other individual families have become somewhat modified, then the number of species in existence may also have been increased. Of course I am supposing that the period during which abnormal conditions of life remain in force shall not extend sufficiently to allow all the unmodified individuals to be eliminated by the action of natural selection.

If I have been successful in my argument, I think it will be clear that the force which I should designate by the term "heredity" cannot be described as a tendency fostered by natural selection; for, while any influence it may exert antagonistic to the development and continuance of species will be counteracted by natural selection, the benefits it may confer are almost entirely prospective, and therefore do not fall within the range of the force which tends to preserve favourable variations.

I conceive that the definition of the word "heredity" should be—the tendency, more or less strong according to the age of the species, to follow certain types, exhibited by all organisms, and that it is no mere abstract idea devoid of objective existence, but a force the importance of which we are not yet able to fully grasp.

In conclusion I should like to mention a point with regard to the case of Saturnia which has, I think, been overlooked. What has really been proved is simply the fact that the insect is extremely susceptible to modification by change of food. If some entirely new food-plant, if possible chosen from an entirely different order, could be found as a substitute for either species of Juglans, and the result were carefully watched, the experiment could not fail to be instructive, I will not say conclusive.

Rochdale, August 19. T. SPENCER SMITHSON.

Sexual Colouration of Birds.

THE recent controversy in your columns with regard to the non-inheritance of acquired characters opens up the question whether the principle of natural selection operates universally in the animal kingdom, or whether we must involve other causes to supplement it. In Dr. Hurst's letter of August 17 (p. 368) is a sentence which seems to embody what has generally been understood as Darwinism: "If anything has ever been rendered certain in biology by prolonged experiment and observation, it is the fact that specific characters are maintained constant by selection, and that alone." But how does this agree with Dr. Wallace's theory of accessory plumes? This theory he himself thus expresses ("Darwinism," p. 293): "The fact that they have been developed to such an extent in a few species is an indication of such perfect adaptation to the conditions of existence, such complete success in the battle for life, that there is in the adult male, at all events, a surplus of strength, vitality, and growth-power which is able to expand itself in this way without injury." Here we have two entirely different views of what is meant by the struggle for existence. According to Dr. Hurst it is incessant; let its operation cease, and the characters of the species become speedily obliterated. According to Dr. Wallace a victorious species may leave the arena, and rest upon its laurels. But if natural selection ceases to work in this field, why not in others? The colours, it is true, may be due merely to waste products turned to account, but the annual growth of the peacock's plumes—often nearly five feet in length—must require a great expenditure of vital force.

In Brown's "Thier-reich" it is stated that even in ordinary cases moulting is not unaccompanied with danger to the bird. And this is not all: the secondary wing feathers of the argus pheasant are developed to such an extent that they are said "almost entirely to deprive the bird of flight" ("Descent of Man," vol. ii. p. 97). The theory by which Darwin himself accounted for these phenomena, viz. that the female selected the most brilliantly coloured male as her partner, explained the facts, but failed for want of sufficient evidence that any such selection took place. I cannot think that the two forms of sexual selection, by battle and by female preference, conflict, since the hen bird might well admire the combination of fine plumes and warlike prowess.

There is, besides, Mr. Stolzmann's theory that it is to the advantage of the species that the number of males should be kept down, since bachelor males persecute the hen bird upon the nest. This assumes what is not well proved, that males largely outnumber females. But a very large proportion of the species in which the cock-bird is highly decorated are polygamous, and in these cases the number of males is obviously excessive. Mr. Stolzmann's theory in no way conflicts with Darwin's, but rather supplements it. Moreover, it is hardly more than an extension of Dr. Wallace's view that the dullness of the female's plumage is due to her need of protection, which in the case of the male is less necessary. Both Darwin's theory and Mr. Stolzmann's require further evidence, but they each have the merit of suggesting a cause for the constancy of the same plumage through successive generations.

Scourie, Lavig, N.B., August 24. F. C. HEADLEY.

Bird's Steering Methods.

MR. HEADLEY'S suggestion (NATURE for July 27) that gulls sometimes steer by dropping one foot, is, it seems to me, hardly tenable, for so small a rudder acting on so thin a medium as air would be of little effect. And although I have seen many gulls under very varying circumstances, I have never seen them even appearing to direct their course in such a manner.

That birds, to a great extent, steer by changing the position of their centre of gravity is undoubtedly correct, and it is especially true of birds with long narrow wings, such as the petrels and sheerwaters. The albatross exhibits this method to perfection, and anyone who has watched this bird circling far and wide, will have noticed what an angle the outstretched, almost motionless, wings make with the level of the water, an angle frequently as great as 45°

The flexion of the body is, I take it, of comparative little help, difference in force or direction of wing stroke being the main method by which birds direct their course.

The wings may act synchronously, a change in the direction of one wing causing it to act with more or less force than the other, while such change might be so slight as to elude the eye, or even a camera. A humming-bird will hover about a cluster of blossoms, now hanging motionless, now circling right or left around the flowers, and as there is no turn of the head or swaying of the body, it is evident that the directed force lies in the wings, although their presence is indicated by a mere hazy blur. The body is usually held at an angle of from 30° to 45° with the vertical, and the tail is kept closed, being indeed rarely spread, except when the bird is darting about in the air.

The use of wings is well shown by the crows, which in fall and winter roost in great numbers on the other side of the Potomac, and may be seen towards sunset winging their way homeward from their feeding places. When the wind is light, the crows fly high and steadily, but in windy weather they may be seen beating back, just skirting the tree-tops, apparently to take advantage of any favouring eddy that may exist near the earth. As the birds dart up and down, and from side to side, one can clearly see the wings open and close, and unless my eyes are very deceptive, the two wings are by no means always opened to the same extent.

The principal use of a bird's tail seems to be to effect vertical changes in direction, and while birds with moderately long tails usually have a more graceful, gliding flight than their abbreviated relatives, they are no more expert on the wing. The flight of the forked-tailed swallow is more pleasing than that of the short-tailed chimney swift, but the swift is quite as much at home in the air as is the swallow.

Birds with unusually long tails, such as the hornbills, are apt to be but indifferent flyers.

Washington, D.C., U.S.A., August 14. F. A. LUCAS.

The Early Spring of 1893.

THE exceptional character of the spring of this year has already been described in these columns. It seems worth the while to inquire to what extent the warm weather commencing in March affected the times of flowering of our native flora. The Botanical Section of the Halifax Scientific Society has now for seven years, since 1887, kept a record of all plants observed by its members growing within the limits of the Halifax parish. This, it may be mentioned, is of considerable extent, perhaps measuring six miles by twelve or more. Thus, the record affords a means of comparing the dates of flowering this spring with those of previous years. Of course these will not coincide with records from other districts, as the South of England, but they will satisfy the necessary condition of such an inquiry, viz. that the district should be of limited extent so that the time of flowering of any species in one year is practically the same throughout it. In addition there is the advantage that the drought was not so great as to retard or kill the vegetation. On the other hand, such a record must necessarily be open to error; a plant may have been in bloom some time before it was met with; only a comparatively few species have been recorded *every* year without a break; some days often intervene between a flower being in bud and in bloom, and the record may possibly, without saying so, refer to the former. However, these errors are partly constant, and may be partly eliminated by neglecting the rarer species, which have only been noted two or three times.

In February almost the only plant to flower was the hazel, seen this year on the 15th, and last year fourteen days later.

In March twenty different species were observed in flower; of these only half had been previously recorded in March, the other half being equally divided between April and May. Coltsfoot (*Tussilago Farfara*) and *Salix Caprea* appeared at the usual time within the first week; the daisy was not noticed till the 31st, whereas it had previously been found on the 29th; but almost all the others were very much earlier than usual. The average was more than eighteen days before the earliest previous record. This is borne out by the fact that the same elm (*Ulmus montana*) was in flower this year (on March 9) twenty days earlier than last year. In some cases, *e.g. Stellaria Holostea*, *Ranunculus acris*, and *Alchemilla vulgaris*, the period was increased to as much as five weeks.

There were a few apparent exceptions, but they may certainly be put down to accident or rather neglect. The chickweeds, *Cerastium triviale* and *Stellaria media* escaped notice till April, groundsel had previously been noted earlier than April 9, and shepherd's purse was no doubt in flower early in April, but was ignored till May came in.

The effect of the weather became more pronounced throughout April. Excluding the common "weeds" just mentioned, every flower was at least a fortnight before its earliest previous record, and the list of twenty-five species is composed almost entirely of May flowers; in fact the only exceptions were the wood sorrel and the marsh marigold, in flower on the 5th and 8th, or antedated fourteen and twenty days respectively. On an average the flowers of April were 25·5 days earlier than in any of the previous years. The exact dates of a few of the commonest are appended.

Cardamine pratensis	April 8, 1893;	May 10–15, 1887–92
Scilla nutans	,, 13, ,,	,, 1, 1887
Lychnis diurna ...	,, 13, ,,	,, 10, ,,
Veronica Chamaedrys	,, 13, ,,	,, 15, 1888
Allium ursinum ..	,, 16, ,,	,, 5, ,,

Thirty-five fresh species were added in May, twelve of which are usually June flowers. By this time, however, it became difficult to keep a complete record, so that about half-a-dozen appear to flower later this year than in one or other of the previous years. Again excluding these, the remainder flowered seventeen days earlier than before. From a consideration of those given below it would appear that the season was about three weeks earlier at the beginning of the month, and a fortnight at the end.

Cytisus Scoparius ...	May 6, 1893;	May 13, 1890
Orchis mascula ...	,, 6, ,,	,, 14, 1892
Geranium Robertianum	,, 6, ,,	,, 17, 1887
Trifolium pratense ...	,, 6, ,,	,, 28, 1892
Quercus Robur ...	,, 6, ,,	,, 29, 1887
Crataegus Oxyacantha	,, 7, ,,	,, 29, 1888 (But usually June 3–9.)
Rhinanthus Crista-galli	,, 27, ,,	June 9, 1890
Chrysanthemum Leucanthemum ...	,, 27, ,,	,, 9, ,,

In June the advance still remained about a fortnight, taking twenty seven species into consideration, but an increasing number have to be left out owing to the impossibility of recording all as soon as they appeared. Ten out of the twenty-seven had previously belonged to the catalogue of flowers appearing in July.

Lychnis Flos cuculi ...	June 10, 1893;	June 17–26, 1887–92
Silene Cucubalus ...	,, 10, ,,	,, 26, 1888
Rosa canina	,, 10, ,,	,, 28, 1887
Centaurea nigra ...	,, 10, ,,	July 2, 1889
Lonicera Periclymenum	,, 15, ,,	,, 2, 1892
Spiræa Ulmaria ...	,, 15, ,,	,, 2, 1889
Digitalis purpurea ..	,, 15, ,,	June 24, 1890
Valeriana officinalis ...	,, 17, ,,	,, 24, ,,
Achillea millefolium ..	,, 26, ,,	,, 27, 1892

In July there seems to be no evidence for the maintenance of the advance; the flowers were then appearing at their normal season, *e.g.*—

Campanula rotundifolia	July	8,	1893;	July	2–15,	1887–92
Calluna Erica	,,	22,	,,	,,	19,	1887
Jasione montana ...	,,	1,	,,	,,	2,	1892
Cnicus arvensis ...	,,	1,	,,	,,	2,	1889
Scabiosa succisa ...	,,	22,	,,	,,	23,	,,
Galeopsis Tetrahit ...	,,	15,	,,	,,	16,	1892

The general result is, then, that the season was three weeks early in March, but that by the first of April the advance had increased to four weeks; this was maintained through most of the month, but May day was only some three weeks in advance; the fall continued slowly through May and June with an average advance of a fortnight. In July, however, the effects of the early spring had ceased to have any effect. These conclusions are more likely to err on the side of moderation, for it must be remembered that the flowering time this year has been contrasted not with the average, but with the earliest record of previous years. W. B. CRUMP.

Mr. Love's Treatise on Elasticity.

THE second volume of Mr. Love's treatise will doubtless be reviewed in NATURE in due course; but in the meantime I desire to make some observations upon certain criticisms, which this work contains, on my own papers on thin elastic shells, plates, and wires.

The theory of thin plates, and shells in the form given by Mr. Love, is based upon those of Kirchhoff, Saint-Venant and Clebsch. All these theories are incomplete and defective, and depend upon certain assumptions and approximations which have been called in question, and are by no means free from difficulty. An attempt has been made—see pp. 92 and 207—to remove these objections by classifying the different cases which arise, but whatever may be thought of the success of this explanation, it requires the reader to wade through a long and complicated analytical investigation before he is in a position to apply the theory.

On the other hand, the method of expansion originally employed by Poisson, and afterwards by myself, coupled with the hypothesis that the stresses R, S, T may be *treated* as zero, is one of great power, and, as I showed a few years ago, enables an approximate theory to be *completely* worked out as far as terms involving the cube of the thickness of the plate or shell, and Mr. Love is forced to admit on p. 236 that his own theory is incapable of doing this. It is true that Clebsch and Saint-Venant have raised objections against the method of expansion which I cannot regard otherwise than as frivolous ones; but although an account of the first class of theories is no doubt desirable, it is much to be regretted that Mr. Love has allowed his bias against the second class of theories to lead him to adopt a mode of treatment which greatly increases the difficulties of the subject, is less perfect, and which, I fear, will retard its further progress by throwing unnecessary obstacles in the way of students.

On pp. 238 and 262, Mr. Love imagines that he has detected an error in my own work as regards the values of T_1, T_2 (in his notation P_1, P_2), but this conclusion is not warranted. His investigation in § 353 expressly supposes the vibrations to be non-extensional, whereas in the investigation by which I have calculated, T_1, T_2 by means of the variational equation, extension is expressly supposed to take place. If it were desired to calculate the values of T_1, T_2 by the variational method in the case of inextensibility, it would be necessary to start with the corresponding form of the potential energy, and to take account of the fact that δu, δv, δw are not independent, either by means of indeterminate multipliers or by elimination. The two cases are therefore not parallel, and the so-called test is nugatory. If a direct test were desired, it could be supplied by means of the theory of the radial vibrations of a cylinder worked out to a second approximation.

The only other point to be noticed is that in the case of a bent wire the values of the three couples given by Mr. Love on p. 169 disagree with those obtained by myself. Mr. Love *assumes* these couples to be respectively proportional to the changes of curvature and twist, and he then proceeds to calculate the latter quantities in terms of the displacements by a method which leaves nothing to be desired as regards elegance and conciseness and comprehensiveness. But he can scarcely be said to have given anything which can be called a proof that these couples are *actually* proportional to the above-mentioned quantities; and a new and independent investigation is much to be desired. A. B. BASSET.

Hotel de Russie, Bad-Ems, Nassau, Germany, August 23.

An Appeal to Mathematicians.

SINCE I have commenced the study of the "Ramayana" (the great Sanskrit epic) in original Sanskrit, and its translations, epitomes, and commentaries by renowned European scholars, I have been struck with the inadequacy the western scholars of Indian chronology have shown in fixing the date of Rama.

I cannot but admire the method used by our modern Egyptologists in computing the dates of Egyptian chronology, and correcting the discoverics of some of the earlier researches in that interesting branch of knowledge. Having discovered it written in some old MSS. that in the reign of a certain king some remarkable comet or eclipse was observed, or a building was erected pointing to a certain star in the heavens, which has since changed position, &c., &c., our scholars have obtained sufficient data to compute with tolerable correctness a more or less trustworthy date for that king.

There is no doubt that such refined discoveries could never have been made if this branch of knowledge were left alone with simple historians or simple chronologists—I mean, no light would have been thrown over the pages of the dark history of Egypt had not astronomical methods been employed to solve the vital questions of Egyptian history.

I am very much grieved to see that the chronology of India has not at all been touched by any scientific investigator whose conclusions could be relied on, though Indian chronology is now proving to be far more interesting than the chronology of any other country or nation of the world. India has now the honour of being under the benign rule of the British nation, so forward in scientific matters; then does it not give grief to the lover of India to see this important branch of past history so much being neglected?

The second half of the eighteenth century and the first quarter of this nineteenth century had seen a few benefactors of India, like Profs. Colebrooke, Muir, Wilson, &c., whose discoveries brought to light much interesting information about ancient India. It was a misfortune for India of to-day that among those benefactors they were few who could bring in mathematical astronomy to solve some vital points of Indian chronology. Prof. Colebrooke wrote some valuable essays on the Hindu system of astronomy, but it was our misfortune that his attention was not drawn towards the Indian chronology; otherwise he was a man who could have done much to settle the dates of Hindu chronology.

Rama has been a personage of Indian history whose existence has not yet been denied by any scholar, yet see what conflicting dates have been given to this mighty king of ancient India: Sir William Jones places Rama in the year 2029 B.C., Tod in 1100 B.C., and Bentley in 950 B.C. Govvesio would place him about the thirteenth century before the Christian era!

Govvesio computes his date thus:—"From Rama to Sumitra, the contemporary, as it appears, of Vikramaditya (B.C. 57), fifty-six kings ruled in successsion. By allowing on a reasonable computation an average of a little more than twenty years to each reign, we arrive at the thirteenth century before the Christian era." ("Ramagana," vol. i. Introduction.) While it is questionable whether any king by name of Sumitra ever reigned in India, or was a contemporary with Vikramaditya, Govvesio confesses—"But to this opinion I do not intend to attribute more weight than that of a probable conjecture." And so it is; and a ridiculous one, too; for Sumitra[1] was not a king contemporary with Vikramaditya, but *she* was one of the queens of the king Dasaratha, the father of Rama.

I now come to the point of my appeal. Here is the position of the seven primary planets at the birth of Rama plainly written in Canto xix. of the first book of the Ramagana: Moon in Cancer, Sun in Aries, Mercury in Taurus, Venus in Pisces, Mars in Capricornus, Jupiter in Cancer, and Saturn in Libra. The problem to be solved is this: Taking January 1, 1894, as starting-point, compute when the planets occupied the positions respectively referred to above, and when again they will occupy the same positions in the future? Though the problem appears to be a simple one of permutation and combination, but I must confess with regret that none

[1] "Sumitra" is a Sanskrit word of feminine gender. As Sanskrit was a living language at the time of Vikramaditya, though perhaps only within higher circles of society, yet it could not be believed that this word might have been so degenerated as to be used in opposite gender at that time.

of the professors of mathematics here with whom I have come in contact have taken the trouble of solving it, and therefore it is that I am appealing in this strain to the mathematicians who have any interest in the chronology of India.

Many interested scholars have expressed their desire for the solution of this problem. Thus says Prof. Schlegel: "I leave to astronomers to examine whether the parts of the description agree with one another, and if this be the case, thence to deduce the date. The Indians place the nativity of Rama in the confines of the second age (Treta) and the third (Dwapara); but it seems that this should be taken in an allegorical sense. . . . . We may consider that the poet had an eye to the time in which, immediately before his own age, the aspects of the heavenly bodies were such as he has described."

Besides the positions of the planets at the birth of Rama, I have a few more data concerning the Hindu system of the division of heavens, which I shall be glad to communicate to any gentleman who is acquainted with that system, and expresses a desire for the same.

KANHAIYALAL.

Lahore, August 8.

Arrangements for Work of Chemical Section of the British Association.

MANY of your readers will be interested to know that M. Moissan has kindly arranged for a demonstration of the properties of fluorine, and his method of isolating the element, at a meeting of the Chemical Section of the British Association at Nottingham, in September. M. Moissan will also exhibit some specimens of the diamonds he has artifically produced.

We also hope to have at least two discussions, one on Bacteriology and its related chemical problems, which Prof. Percy Frankland has been so good as to promise to open, and another on explosions in coal mines, with special reference to the "dust theory." This, Prof. Harold Dixon has kindly consented to introduce.

Permit me to remind authors that they will greatly facilitate the arrangements for the satisfactory grouping of papers at the sectional meeting, if they will communicate as early as possible with the Secretaries, Burlington House.

J. EMERSON REYNOLDS.

University of Dublin, Trinity College, August 21.

The Bacchus Marsh Boulder Beds.

YOUR issue of August 10 contains an interesting communication by Messrs. Officer and Balfour on the glacial boulder beds of Bacchus Marsh in Victoria, in which they are referred to as triassic. May I be permitted to point out that this is erroneous? It is true that the late Dr. O. Feistmantel in his earlier descriptions of, and references to, the flora of these beds, regarded them as triassic, but this was the natural consequence of their correlation with the Talchir group of India, which he then ascribed to the trias. In 1886 it was shown by Dr. Wagner and myself sumultaneously that the true correlation of the Talchir group was with the marine beds below the Newcastle coal measures of New South Wales; the Bacchus Marsh boulder beds are consequently upper carboniferous, and form part of the traces of the upper carboniferous glacial period which have been recognised in Australia, Africa and Asia. The matter will be found fully dealt with in pages 120–123 and 191–214 of the second edition of the "Manual of the Geology of India," just published by the Indian Geological Survey.

S.S. *Rena*, August 19. R. D. OLDHAM.

Old and New Astronomy.

WHILE thanking you and your reviewer for your very courteous and appreciative notice of the "Old and New Astronomy," I should like to be permitted to point out that the chapter on the sun's surroundings was printed and was in the hands of the public before my connection with the work commenced. Your reviewer suggests that I ought to have corrected certain statements in this earlier part of the volume, but I felt that it was sufficient to mention in the preface that I did not agree with *all* Mr. Proctor's conclusions, and it must be obvious that it would neither have been an easy nor a gracious task to have attempted in the latter part of a book to criticise the statements and theories of the deceased author of the earlier chapters.

Your reviewer suggests that the proof I give of the very small density of the Orion Nebula is "vitiated by the fact that it is impossible to estimate the gravitational effect of the dark matter in interstellar space." I conclude that he does not refer to dark matter within the area of the nebula, for this would only add to the mass of the nebula and to the observed velocities of the stars in its neighbourhood. That dark matter evenly distributed in space around would not interfere with the gravitational effect of the nebula will be evident to those who remember that the attraction of a hollow spherical shell on a body within it may be neglected, since the attractions in all directions balance whatever is the position of the body within the spherical shell. The stars around the nebula seem to be distributed in all directions, and it cannot be supposed that in each case there is a gravitating dark mass on the side away from the nebula which counterbalances the attraction of nebulous matter.

Your reviewer cannot, I think, have seen Dr. Huggins's photograph of the spectrum of the Orion Nebula and the stars involved in it, or he would not suggest that the bright lines in the spectra of the stars could be due to the overlapping by tremors and atmospheric disturbances of the spectrum of the nebular matter. The bright nebula lines distinctly widen and brighten in the neighbourhood of the stars. One is therefore forced to conclude that the bright lines when they cross the stellar spectra belong to the stars. A. C. RANYARD.

August 19.

THERE is nothing in my review that implies the desirability of Mr. Ranyard having modified any of Mr. Proctor's *conclusions* in the chapter on the sun's surroundings; I simply pointed out an *error of date* that should have been corrected.

I do not see any reason for supposing that the quantity of matter in the area we call the Orion Nebula is greater than that in any other arbitrarily selected equal area in space, and the evidence seems conclusive that the whole of interstellar space is a meteoric *plenum*. This being so, there is no reason why stars in the neighbourhood of the nebula should have their velocities in any way affected by it. Mr. Ranyard proves that there is no great difference in density, but does not touch the question of the absolute quantity of matter involved.

I have not seen Dr. Huggins's original photographs of the spectrum of the Orion Nebula, and the stars involved, nor have I seen direct copies of them, but I have examined other photographs in which the star and nebula spectra appear, and have also visually examined the spectra, and am by no means convinced that the nebula lines are brighter and wider in the stars.

THE REVIEWER.

An Old Device Resuscitated.

IN the Astronomical Column of the current number of NATURE a description is given from *L'Astronomie*, of M. Jarson's method of giving equatorial motion to a telescope mounted on an ordinary altazimuth stand. This method will be found figured and described by Lord Lindsay, now Earl Crawford, in the *Monthly Notices* of the Royal Astronomical Society, xxxvii. 1, Nov. 10, 1876. Moreover, in a note appended to the paper, Lord Lindsay says that since writing it his attention had been drawn to the fact that this principle of mounting had been described by Sir George Airy in *Monthly Notices*, xv.

F. W. LEVANDER.

30, North Villas, Camden Square, N.W., August 28.

Laws of Error in Drawing.

I SHOULD be obliged if you allow me to state in the next issue of NATURE, to prevent any misconception of the extent of those "compulsory errors" alluded to in my article printed in the current number, that I am able to specify such, with equal particularity, as they occur in the following additional figures, viz.:—The cylinder, the ringed cylinder, the oblong, the octagon, cone, hexagonal pyramid, octagonal pyramid, triangle (solid). Also in those figures framed of square-sectioned woodwork that have the following shapes, viz. square, cross, triangle, arch, hexagon, pentagon, circle. Again, that they are observable in all forms which are complexities of the primal forms above given; and, moreover, I have traced them clearly in the draughtsmanship of Orientals, and even in the drawing of the greatest painters. ARTHUR L. HADDON.

Glenavon, Cornwallis Avenue, Clifton Vale, Bristol, August 25.

THE INFLUENCE OF EGYPT UPON TEMPLE-ORIENTATION IN GREECE.

I HAVE shown in former articles that in our own days and in our own land the idea of orientation which I have endeavoured to work out to the best of my ability for Egypt still holds its own. It is more than probable, therefore, that we shall find the intermediate stages in those lands whither by universal consent Egyptian ideas percolated.

Among these lands Greece holds the first place. It is perhaps proper that I should state here that the view as to the possibility of temple orientation being dominated by astronomical ideas first struck me at Athens and Eleusis, and that I endeavoured to settle the question by studying the Egyptian monuments, because they were the only monuments I could study as a stay-at-home, thanks to the labours of the French Commission and of Lepsius.

When I found that the same idea had been held by Nissen, and that the validity of it seemed to be beyond all question, I consulted my friend, Mr. F. C. Penrose, particularly with regard to Greece, as I knew he had made a special study of some of the temples, and that, being an astronomer as well as an archæologist (for, alas, they are not as I think they should be, convertible terms) it was possible that his observations with regard to them included the requisite data.

I was fortunate enough to find that he had already determined the orientation of the Parthenon with sufficient accuracy to enable him to agree in my conclusion that that temple had been directed to the rising of the Pleiades. He has subsequently taken up the whole subject with regard to Greece in a most admirable and complete way,[1] and has communicated papers to the Society of Antiquaries, February 18, 1892, and more recently to the Royal Society, April 27, 1893, on his results.[2]

The problem in Greece was slightly different to that in Egypt; we had not such a great antiquity almost without records to deal with, and moreover the feast calendars of the various temples presented less difficulty.

There was no vague year to contend with, and in some cases the actual dates of building were known within a very few years. Mr. Penrose has been convinced that in Greece, as in Egypt, the stars were used for heralding sunrise. He writes:—

"The object the ancients had in using the stars was to employ their rising and setting as a clock to give warning of the sunrise, so that on the special feast days the priests should have timely notice for preparing the sacrifice or ceremonial, whatever it may have been:

"Spectans orientia solis
Lumina *rite* cavis undam de flumine palmis
Sustulit," &c.

In Greece, not dominated by the rise of the Nile, we should not expect the year to begin at a solstice but rather at the vernal equinox. I have shown that even in pyramid times in Egypt the risings of the Pleiades and Antares were watched to herald the equinoctial sun; it is not surprising, therefore, to find the earliest temples in Greece to be so oriented. Mr. Penrose has found the following:—

				B.C.
η Tauri (The Pleiades)	Archaic temple of Minerva	Athens[3]	R	1530
	Asclepieion	Epidaurus	R	1275
	The Hecatompedon site of Parthenon	Athens	R	1150
	Temple of Bacchus	Athens	R	1030
	Temple of Minerva	Sunium	S	845
Antares	Heræum	Argos	R	1760
	Earlier Erechtheum	Athens	S	1070
	Temple at	Corinth	S	770
	Temple on the mountain .. .. Jupiter Panhellenius	Ægina	S	630

Here we find the oldest temple in a spot which by common consent is the very cradle of Greek civilisation.

It has also been shown that in Khu-en-Aten's time the new sun-temple at Tell el-Amarna was oriented to Spica, Spica too, we find, so used in Greece in the following temples.

				B.C.	
Spica	The Heræum at Olympia		R	1445	
	Nike Apteros	Athens	S	1130	
	Themis ...	Rhamnus	R	1092	
	Nemesis ...	Rhamnus	R	747	
	Apollo	Bassæ	R	728	Eastern doorway
	Diana	Ephesus	R	715	

When owing to precession the sun's spring equinox place had receded from Taurus and entered Aries, in Egypt the equinoxes were no longer in question, since the solstitial year was thoroughly established, and consequently we find no temples to the new warning star α Arietis.

In Greece, however, where the vernal equinox had now been established as the beginning of the year, we find a different state of things, no less than 7 temples oriented to α Arietis are already known.

α Arietis	Minerva	Tegea ...	R	1580	
	Jupiter Olympius	Athens ...	R	1202	
	Jupiter	Olympia ...	R	790	
	Temple (perhaps Juno)	Platea ...	S	650	
	Jupiter	Megalopolis	S	605	
	Temple at the harbour ...	Ægina ...	S	580	
	Temple on Acropolis of Mycenæ	...	R	540	Eastern doorway
	The Metroum ...	Olympia ...	S	360	

The above are all intra-solstitial temples, that is, the sunlight as well as the light of the star can enter them, and this enables us to note a certain change of thought brought about in all probability by the artistic spirit of the Greeks. The Egyptian temples were all dark, often with the statue of a god or a reptile obscure in the naos, and many were oriented so that sunlight never entered them. Mr. Penrose points out that almost all the Greek temples are oriented so that sunlight can enter them, of such temples we have the following 27.

7 examples from		Athens.	
3	,,	Olympia.	
2	,,	Epidaurus.	
2	,,	Rhamnus.	
2	,,	Ægina.	
2	,,	Tegea.	
1	,,	Nemea.	
1	,,	Corcyra.	
1 example from		Sunium.	
1	,,	Corinth.	
1	,,	Bassæ.	
1	,,	Ephesus.	
1	,,	Platæa.	
1	,,	Lycosura.	
1	,,	Megalopolis	
2	,,	Argos.	

Now in all these Greek temples, instead of the dark naos of the Egyptian building, we find the cella fully illumined and facing the entrance. Frequently, too, there was a chryselephantine statue to be rendered glorious by the coloured morning sunlight falling upon it, or if any temple had the westerly aspect by the sunset glow.

It was perhaps this, combined with the later invention of water clocks for telling the hours of the night, which led to the non-building of temples resembling those at Thebes and Denderah facing nearly north. Still there are scattered examples; one of very remarkable importance, as it is a temple oriented to γ Draconis 1130 B.C., built therefore not very long after the temple M at Karnak, and this temple is at Bœotian Thebes! A better proof of the influence exerted by the Egyptians over the temple

[1] In the lists of temples which follow all the orientations were obtained from azimuths taken with a theodolite, either from the Sun or from the planet Venus. In almost every case two or more sights were observed, and occasionally also the performance of the instrument was tested by stars at night. The heights subtended by the visible horizon opposite to the axes of the temples were also observed.

[2] See NATURE, February 25, 1892, and May 4, 1893.

[3] R indicates a rising, and S a setting observation.

building in Greece could scarcely be imagined. As Mr. Penrose remarks :—

"Thebes was called the City of the Dragon, and tradition records that Cadmus introduced both Phœnician and Egyptian worship."

It would be very surprising if we assume, as we are bound to do, that these temples to stars were built under Egyptian influence, that Sirius should not be represented among them, that being the paramount star in Egypt at a time when we should expect to find her influence most important in Greece. Still, I have shown already that as the Greek year ignored the solstice, the use of Sirius as a warning star for all purposes of utility would not come in. Mr. Penrose finds, however, that in spite of this Sirius was used for temple worship.

"Leaving the solar temples, we find that the star which was observed at the great Temple of Ceres must have been Sirius, not used, however, heliacally—although this temple is not extra solstitial—but for its own refulgence at midnight. The date so determined is quite consistent with the probable time of the foundation of the Eleusinian Mysteries and the time of year when at its rising it would have crossed the axis at midnight agrees exactly with that of the celebration of the Great Mysteries.

"It is reasonable to suppose that when, as in the case of Sirius at Eleusis, brilliant stars were observed at night, the effect was enhanced by the priests by means of polished surfaces."

Another question. Does the star follow the cult in Greece as it does in Egypt?

In Greece we find the following :—

"The star *a* Arietis is the brightest star of the *first sign of the Zodiac*, and would therefore be peculiarly appropriate to a temple of Jupiter. The heliacal rising of this star agrees both with the Olympieium at Athens and that at Olympia. There is a considerable difference in the deviation of the axes of these two temples from the true east; but this is exactly accounted for by the greater apparent altitude of Hymettus over the more distant mountain at Olympia.[1]

"The Pleiades are common to the following temples of Minerva, viz. the Archaic temple on the Acropolis, the Hecatompedon, and Sunium. In the two former it is the rising, the latter the setting star.

"There must have been something in common between the temples at Corinth, Ægina, and Nemea. The two last, at any rate, are reputed temples of Jupiter."

The Greek side of the inquiry becomes more interesting when the connection between the orientation of the intra-solstitial temples and the local festivals are inquired into; in Egypt this is all but impossible at present.

A temple oriented to either solstice can only be associated with the longest or with the shortest day; if the temple points to the sunrise or sunset at any other period of the year the sunlight will enter the temple twice whether it points to the sunrise or sunset place.

Now Mr. Penrose finds that in Greece as in Egypt the initial orientation of each intra-solstitial temple was to a star, and this would, of course, secure observations of the star and the holding of an associated festival at the same time of the year for a long time. But when the precessional movement carried the star away they would only have the sun to depend on, and this they might use twice a year. It is possible, as Mr. Penrose remarks, there would have been no reason for preferring one of these solar coincidences to the other, and the feast could have been shifted to a different date if it had been thought more convenient." He goes on to add, "It would appear that something of this sort may have taken place at Athens, for we find on the Acropolis the Archaic temple, which seems to have been intended originally for a vernal festival, offering its axis to the autumnal sunrise on the very day of the great Panathenaia in August.

"The Chryselephantine statue of the Parthenon, which temple followed on the same lines as the earlier Hecatompedon (originally founded to follow the rising of the Pleiades after that constellation had deserted the Archaic temple alongside), was lighted up by the sunrise on the feast to the same goddess in August, the Synæcia, instead of some spring festival, for which both these temples seem at first to have been founded.

"The temple at Sunium, already quoted for its October star-heralded festival to Minerva, was oriented also axially to the sun on February 21, the feast of the lesser mysteries."

I have had to insist again and again that in the case of the Egyptian temples the stated date of foundation of a temple is almost always long after that in which its lines were laid down in accordance with the ritual. No wonder then that the same thing is noticed in Greece.

"In about two-thirds of the cases which I have investigated the dates deduced from the orientations are clearly earlier than the architectural remains now visible above the ground. This is explained by the temples having been rebuilt upon old foundations, as may be seen in several cases which have been excavated, of which the archaic Temple of Minerva on the Acropolis of Athens and the Temple of Jupiter Olympius on a lower site are instances. There are temples also of the middle epoch, such as the examples at Corinth, Ægina, and the later temples at Argos and at Olympia (the Metroum at the last named), of which the orientation dates are not inconsistent with what may be gathered from other sources."

The problem is, moreover, helped in Greece by architectural considerations, which are frequently lacking in Egypt, of two temples it can be shown, on this evidence alone, that one is older than the other. Such an appeal strengthens my suggestion that two of the temples of the Acropolis Hill were oriented to the Pleiades, by showing the older temple to point to an earlier position of the star group. To these Mr. Penrose adds another pair at Rhamnus, where he has found that there are two temples almost touching one another, both following (and with accordant dates) the shifting places of Spica, and still another at Tegea.

J. NORMAN LOCKYER.

[In a letter received from Mr. Penrose, giving me permission to use the above quotations from his preliminary account, he makes the following interesting statements :—

"In my paper sent to the Royal Society there was a passage which seems to make it practically *certain* that heliacal stars were connected with the intrasolstitial temples as derived from Greek examples alone, independent of the powerful aid of the Egyptian cases.

"That the first beam of sunrise should fall upon the statue centrally placed in the adytum of a temple or on the incense altar in front of it on a particular day, it would be requisite that the orientation of the temple should coincide with the amplitude of the sun as it rose above the visible horizon, be it mountain or plain.

"That a star should act as time-warner it was necessary that it should have so nearly the same amplitude as the sun that it could be seen from the adytum through the eastern door, if it was to give warning at its rising, or to have a similar but reversed amplitude towards the west, if its heliacal setting was to be observed; and it follows that in the choice of the festival day and the corresponding orientation, on these principles, both the amplitude of the sun at its rising and that of the star

[1] With regard to a temple of Minerva using *a* Arietis at Tegea, Mr. Penrose writes :—"Minerva is allowed by the poets to have been able to use Jupiter's thunder, so this is no misappropriation of the star. Juno also seems to have claimed the use of *a* Arietis as at Samos, and at Girgenti it suits the orientation of the temple of Juno better than Spica. But Spica seems to have been connected with the worship of Juno and Diana in their more strictly female capacity."

eastwards or westwards as the case might be would have to be considered in connection with one another.

"From what has been said it is obvious that in the intrasolstitial temples the list of available bright stars and constellations is in the first instance limited to those which lie within a few degrees of the ecliptic, and it will be found that in the list above given and those which follow, if we omit Eleusis, where the conditions were exceptional, all but one of the stars are found in the zodiacal constellations. A very great limit is imposed in the second place by one of the conditions being the heliacal rising or setting of those stars from which the selection has to be made. So that when both these combined limitations are taken into account it becomes improbable to the greatest degree that in every instance of intrasolstitial temples of early foundation of which I have accurate particulars, being twenty-eight in number and varying in their orientation from 21° N. to 18° 25′ S. of the true east. There should be found a bright heliacal star or constellation in the right position at dates not in themselves improbable unless the temples had been so oriented as to secure this combination.

"I have just been looking into the number of possible stars which could have been used, *i.e.* within the limits of the greatest distance from the ecliptic that could have been utilised.

"The stars which could have been utilised in addition to the seven which serve for nearly thirty temples are ten only, viz. :—

Aldebaran.	β Libræ.
Pollux.	α Libræ.
β Arietis.	α Leonis.
β Tauri.	γ Leonis.
α and β Capricorni as a group.	β Leonis.

"If the orientations had been placed at random would not our thirty temples have made many misses in aiming at these seventeen stars, it being necessary also to hit exactly the heliacal margin? And would they have secured anything like a due archæological sequence?

"Another point is this:—

"Whenever a star less than first magnitude is used (Pleiades only excepted) it has been necessary to secure coincidence to give it several more degrees of sun depression than in the cases of Spica and Antares."]

BRITISH ASSOCIATION MEETING.

FURTHER information is now to hand as to the scientific work which has been arranged for the approaching meeting of the Association at Nottingham.

In Section A two papers have been received on "Physics Teaching in Schools." G. H. Bryan contributes an interesting paper on "The Moon's Atmosphere and the Kinetic Theory of Gases," showing that every planet must be throwing off some of its atmosphere on the kinetic theory, though at an exceedingly slow rate in the case of the larger bodies. Prof. J. J. Thomson will exhibit and explain a new form of air-pump, which will be of interest to sections A and B. Prof. Viriamu Jones is sending a paper on "Standards of Low Electrical Resistance."

As reported by Prof. Emerson Reynolds on p. 416, Section B has been most fortunate in securing a promise from M. Moissan to describe and demonstrate the preparation and properties of fluorine. This will probably have the effect of inducing chemists from all parts of this country to visit Nottingham, as the demonstration has never yet been made in this country, and is of almost unique importance and interest. It is anticipated that M. Moissan's communication will be put down for Monday, September 18, and will probably include the exhibition of his artificial diamonds. Prof. Percy Frankland will introduce the discussion on "Bacteriology in its Chemical Aspects" on Friday, 15, and amongst other papers will be one by J. T. Wood, on "A New Bran Bacterium." Tuesday, 19, will probably be mainly devoted to the discussion of "Colliery Explosions," introduced by Prof. H. B. Dixon, one of H.M. Commissioners. On this day further communications on flame researches are also expected. The President's address is put down for twelve o'clock on Thursday, September 14; it will deal essentially with "The Comparative Chemistry of the Elements," specially treating of carbon and silicon, and of silico-organic researches; showing further that it is possible in the light of recent knowledge to fill in some details of the chemical history of the earth. Dr. Phookan has promised a description of his recent researches on the "Rate of Evaporation of Bodies in Different Atmospheres."

In Section C Prof. Hull will read a paper "On the Water-supply of Nottingham"; Mr. Walcot Gibson, one on "The Geology of British East Africa"; Prof. Brögger will describe "The Eruptive Rocks of the Christiania District"; E. T. Newton, "The Trias Reptiles"; Prof. Sollas, "The Carlingford Rocks" and "Glendalough Amphibolite"; R. M. Deeley, "The Drifts of the Trent Valley"; and Prof. Iddings, of Chicago, "The Petrology of a Dissected Volcano." Amongst other papers already promised are the following:—"The Gypsum Deposits of Nottinghamshire," by A. T. Metcalfe"; "Derbyshire Toadstone," by H. A. Bemrose; "Mollusca from the English Trias," by R. B. Newton; "Transported Mass of Chalk in Boulder-clay of Culworth, in Huntingdonshire," by A. and C. Cameron; "Some Volcanic Rocks of South Pembrokeshire," by F. T. Howard and E. W. Small; "Midland Trias," by Dr. A. Irving; "Limestone Inclusions in the White Sill," by E. T. Garwood.

Two further papers are sent in for Section D—one by Prof. Gilson, of Louvain, on "Cytological Difference in Homologous Organs," and one by G. B. Rothera, on "Some Vegetal Galls and their Inhabitants."

In connection with Section E the exhibition of the 120 pictures painted on an Antarctic sealing expedition by Mr. Burn-Murdoch has been referred to. The discussion on the "Limits between Geography and Geology" will be introduced by Mr. Clements R. Markham, Pres.R.G.S. Mr. Delmar Morgan will summarise our knowledge of Thibet, and Miss Taylor will describe her recent journey in that country. Mrs. Grove will read a paper on the "Islands of Chiloë." Mr. E. G. Ravenstein will give an account of recent African travel; and a large number of other papers are promised, many of which are of more than ordinary interest. The illustration of many of these papers by lantern photographs will be a special feature.

With respect to Sections F and G there is at present nothing further to add to the original statement made a few weeks since.

In Section H Mrs. Grove promises a paper, "The Ethnographic Aspects of Dancing." Prof. Boyd Dawkins, who is now on a visit to Glastonbury, intimates his intention to discuss the scientific bearings of the discoveries made at the lake village in that neighbourhood; and, in order that the members may be better able to understand the structural details of the woodwork exposed in the course of the excavations, Dr. Munro proposes to give an illustrative sketch of the different methods adopted in the construction of lake-dwellings. Hitherto lake-dwelling researches have furnished little evidence of the kind of houses erected on the artificial islands, but during last autumn a crannog was investigated in Argyllshire which has disclosed some remarkable information on this point. The discussion on lake-dwellings is fixed for Sept. 19, and as this important subject has formerly only incidentally come before the Association, the occasion promises to be most instructive to all interested in the early history of Britain. Among the other papers sent to

the section is one by Mr. Romilly Allen on the "Origin and Development of Early Christian Art in Great Britain and Ireland." This paper is to be well illustrated. Indeed, this is the case with most of the archæological papers. Dr. Hildebrand is arranging illustrations of the Swedish antiquities he wishes to compare with our Anglo-Saxon ones, in groups, which are to be printed on sheets and distributed among the audience when he reads his communication.

The information contained in the above paragraphs has been furnished by request by presidents and recorders of sections; possibly further details may be forwarded in time for publication before the meeting.

The promises of exhibits of scientific apparatus, models, diagrams, and photographs in the laboratories of the University College, Nottingham, are now coming in. Scientific novelties are promised for the conversazione at the Castle.

Visitors can obtain on application the usual lists of hotels and lodgings. FRANK CLOWES.

GEORGE BROOK.

GEORGE BROOK, whose untimely decease on August 12 we have already chronicled, was born on March 17, 1857. He died, therefore, in his thirty-sixth year, apparently from the effects of heat-apoplexy, while on a visit to his wife's family near Newcastle-on-Tyne. On the fatal day he joined a shooting party on the adjacent moor; after a successful expedition and a repast in the shooting-box, he was complaining laughingly of the necessity for early rising on such occasions, when his head fell back and he expired without uttering a sound. He was buried at Benwell Church, Newcastle, where, six years previously, he was married to Fanny, second daughter of Mr. Walter Scott, of Riding Mill. He was educated at the Friends' School, Alderley Edge, and, although he afterwards studied for a couple of years under Prof. Williamson and others at the Owens College, Manchester, he may be said to have been, as a naturalist, mostly self-taught. His earlier years of active life were spent in his father's business at Huddersfield, and he turned the experience thus gained to good account in his after career. His first definite association with scientific work dates from his connection with the recently deceased Mr. J. W. Davis, of Halifax, and others, in the prosecution of biological investigation in the West Riding of Yorkshire. He was in 1884 appointed scientific assistant to the Scottish Fishery Board and lecturer on comparative embryology to the University of Edinburgh. He retired from the first-named office in 1887, leaving as a legacy a series of valuable notes and reports upon the food fishes, but the last-named one he held till death. As an embryologist, he is himself best known for his work upon the origin of the endoderm from the periblast in teleostean fishes, and although not the first to have suggested this, it must be said, in justice to his memory, that certain recent investigators have reverted to his views without according him befitting recognition. His love of experimental marine zoology, and his personal munificence in the interests of pure science, reasserted themselves in 1889, in his attempt to found a lobster hatchery and marine observatory at Loch Buie, Isle of Mull, duly noted in our pages (NATURE, vol. xlii. p. 399), and which we know to have involved him in a not inconsiderable loss. He was secretary to the Huddersfield Naturalists' Society, and to the Scottish Microscopical Society, of which he was a founder; he was for three years a vice-president of the Royal Physical Society of Edinburgh, and a member of council of the same, the Linnean Society of London, and the Royal Society of Edinburgh. He had recently joined the Zoological Society, and was but a few months ago appointed an examiner in Biology to the Royal College of Physicians, Edinburgh. In the year 1889 he rose suddenly into fame as the author of the *Challenger* Report on the Antipatharia. His preliminary paper, dealing (*Proc. R. Soc. Edin.*, vol. xvi. p. 35) with the homologies of the mesenteries in the Antipatharia and the Anthozoa, had apprised the world of the breadth of his inquiry into, and the extent of his knowledge of, this difficult and little understood group; but the preparation, within approximately a year, of that which came to be termed "one of the most praiseworthy" of all the *Challenger* reports, set a seal to his reputation, and exalted him to a foremost position among living Actinologists. In this work he elaborated his important discovery of dimorphism (in Schizopathinæ) by division of a single primitive zooid into three, instead of by specialisation of individual polypes; and at the time of his death he had well-nigh completed an important paper dealing with this and kindred subjects, for which his talented assistant, Mr. Binnie, had prepared a large series of beautiful sections and some elaborate drawings. The thorough and conscientious manner in which he had worked out the Antipatharians of the *Challenger* collection led, in 1890, to his engagement by the Trustees of the British Museum for the arrangement and cataloguing of their very large collection of stony corals; and the present month marks the publication of that which will perhaps rank as his *magnum opus*, viz., the "Catalogue of the Genus Madrepora," a quarto volume of 212 pages, with 35 beautiful plates, mostly from photographs taken by himself. This welcome treatise, which was the first of a projected series dealing with the stony corals, like most of the set to which it belongs that have appeared under Dr. Günther's direction, is, in reality, no catalogue at all, but rather a revisionary monograph, founded upon the study of rich material from world-wide localities, which must furnish a basis for succeeding inquiry into the group with which it deals. None but those who enjoyed the deceased author's personal friendship can form an adequate idea of the labour and expenditure, both of time and capital, which he bestowed upon this volume. It is the practical outcome of the last three years of his life's work. The success with which he dealt with the bewildering difficulties before him may be perhaps sufficiently gauged from its "Introduction," and to what important lines of structural investigation and conclusions the task was leading him, it is obvious from this and his last published paper "On the Affinities of the Genus Madrepora" (*Jour. Linn. Soc. Zool.* xxiv. p. 353).

The most striking features in George Brook's personality were his right living and his manly independence, his moral attributes being in every way worthy his mental ones. There can be no question that his capacity to form an independent judgment, and his great powers of organisation, under the influence of his indomitable will, formed the keystone of his successes, and placed him in a position to rise supreme above petty jealousy and the evils begotten of narrow cliquism and over-ambition. His natural inclinations were towards solid work, as will be obvious from his having originally settled down to the study of the Crustacea, but to relinquish it for that of the Corals—a choice which makes his loss a well-nigh irreparable one to British zoologists of the present generation. In addition to the many unfinished works to which we have alluded, he has left behind him at least the material for a reconsideration of the morphology of certain great veins in the Amniota, and for a detailed report upon some of the corals collected by Prof. Haddon in the Torres Strait, which had been placed in his hands. Indeed, almost his last words to the writer of this notice were expressive of a desire to "get on" with the latter. His final act, as a zoologist, was the determination of a Collemboloid (upon which group he was an authority) for his friend Prof. W. A. Herdman,

with whose pioneer's work in British marine zoology he was in active sympathy. A devoted husband, an exemplary parent, a true friend, whose advice was always sound, and whose criticism was as well founded as it was frank, he passes from us in the heyday of life. His life furnishes a noble example of independent manliness, and of enthusiasm for the spread of truth and the cause of scientific advancement.

NOTES.

WE learn from the *Revue Générale des Sciences* that M. d' Abbadie, late President of the Paris Academy of Sciences, has asked the Academy to accept a considerable gift in the name of his wife and himself. The donation consists of the Abbadia estate (Basses-Pyrénées), having an annual revenue o twenty thousand francs, and one hundred shares in the Bank of F rance, representing a capital of four hundred thousand francs and an annual income of fifteen thousand. By the deed of gift, these properties will not fall to the Academy until after the decease of the donors. Two of the principal clauses and charges of the legacy are as follows :—(1) The Academy may establish on the Abbadia estate any researches or laboratories, except those devoted to vivisection. (2) An observatory must be established at Abbadia, in which a catalogue of five hundred thousand stars can be made, the work to be completed in 1950. In order to reduce the expenses which this stipulation carries with it, the work may be confided to some religious order. The Academy has nominated a commission to examine the conditions of this munificent donation, and has expressed its deep gratitude to M. and Mme. d'Abbadie. It is not too much to say that this feeling is shared by all men of science.

THE following men of science have been elected Fellows of the Reale Accademia dei Lincei :—In mathematics, Prof. L. Bianchi and Dr. G. D'Ovidio; chemistry, Dr. G. Ciamician and Prof. D. Mendelejeff; botany, Profs. E. Strassburger and N. Pringsheim; agriculture, Dr. F. Cohn. Dr. E. Bertini has been elected a correspondent in mathematics; E. Millosevich in astronomy; A. Abetti in mathematical and physical geography; and O. Mattirolo in botany.

THE *Times* announces the death of Prof. M'Fadden A. Newell, Superintendent of Public Instruction of the State of Maryland, U.S.A. He was educated at Trinity College, Dublin, and the Royal College of Belfast, and went to the United States in 1848. He was Professor of Natural Science in the Baltimore City College from 1850 to 1854, and occupied the same chair in Lafayette College, Pennsylvania, from 1854 to 1864. In 1865 he was appointed President of the Normal School of the State of Maryland, succeeding, three years later, to the position of State Superintendent of Public Instruction, a post he held for a quarter of a century. In connection with Prof. Crury he published a series of text-books entitled the "Maryland Series," and his Annual Reports, in twenty-five volumes, are held in high esteem.

WE regret to record the death of Father R. P. Vines, Director of Belen Observatory, Havannah.

A DISASTROUS cyclone swept northwards along the Atlantic seaboard of the United States on August 29. At Savannah, Georgia, property to the value of millions of dollars has been destroyed, and news of great loss of life and property is reported from Brunswick, Georgia, and further south, while the town of Tybee has been completely wrecked. It is reported that the storm traced out a path marked by devastation across Georgia and South Carolina to Charlotte, in North Carolina, and thence to the east coast again to Petersburg, Virginia. The city of Savannah presents a scene of wreck and ruin surpassing even the effects of the great storm of August, 1881. For eight hours the wind rushed through the city with terrific force and swept down houses as if they were packs of cards. Nearly every house in the city has suffered some damage, and the streets have been rendered quite impassable by the wreckage.

A REUTER'S telegram from New York states that a cyclone passed over that part of the Atlantic coast on August 23, in the direction of the New England States, and left its marks over a region around New York extending over an area of fully a thousand miles. A rainfall of 3·82 inches in twelve hours was measured, and is said to be the highest ever recorded by the local signal service.

THE next meeting of the French Association for the Advancemence of Science will be held at Caen, with M. Mascart as president. M. E. Trélat will preside over the meeting to be held at Bordeaux in 1895.

IT has been finally arranged that the Congress of the Photographic Society and Affiliated Societies shall be held on October 10, 11, and 12. All the arrangements will be completed in a few days, and a full programme will be circulated as soon as possible.

AN International Exhibition of Photographic Art has been organised by the Paris Photo Club, and will be held from December 10 to the end of this year. The address of the Secretary is 40 Rue des Mathurins, Paris. An international exhibition of amateur photography will be held in the Museum of Fine Arts, Kunsthalle, Hamburg, on October 1–31.

THE annual general meeting of the members of the Federated Institution of Mining Engineers will be opened on Wednesday, September 6th, in the rooms of the Philosophical Society of Glasgow. A number of papers on mining subjects will then be read, and on the two following days excursions will be made to collieries, iron and steel works, and other places of interest.

THE Indiana Academy of Science has decided to make a biological survey of the State of Indiana, and Profs. L. M. Underwood, C. H. Eigenmann, and V. F. Marsters have been appointed as organisers and directors of it. The first work will be the preparation of a complete bibliography of materials bearing on the botany, zoology, and palæontology of Indiana, to be published by the Academy. When this has been done, it will be possible to discuss the fauna and flora, its extent, distribution, biological relations, and economic importance, and thus accomplish the main purpose of the survey.

MR. J. F. JAMES gives in *Science* a description of the "Scientific Alliance of New York," instituted at the end of last year, and having for its chief object the establishment of a centre where knowledge of what is being done in one society is conveyed to all the rest. Much is to be gained by this kind of cooperation, both by science and individual workers. Already the Alliance has been joined by the New York Academy of Science, Torrey Botanical Club, New York Microscopical Society, Linnean Society of New York, New York Mineralogical Club, New York Mathematical Society, and the New York Section of the American Chemical Society, each of these societies being represented by its president and two members upon the council of the Alliance. At the opening meeting the president deprecated the views of so-called practical men in whose eyes science "is worth only what it will bring when offered in the form of dynamos, telephones, electric-lights, dyestuffs, mining machinery, and other merchantable wares." The need of endowment for research in the region of pure science was pointed out, reference being made to the German Univer-

sities, where the professors are expected to do original work, leaving the teaching to instructors. The second meeting was held in March, 1893, when the report of a committee, recommending the establishment of an endowment fund of 25,000 dollars for the purpose of encouraging original research, was adopted. The fund is to be known as the "John Strong Newberry Fund," and will be used for furthering researches in geology, palæontology, botany, and zoology. All information relating to it or to the Alliance can be obtained from Dr. N. L. Britton, Columbia College, New York.

THE question as to whether amber was exported from the far east to Europe is discussed by Herr A. B. Meyer in a paper read before the Isis Society of Dresden. There seems to be little doubt that some specimens now sold at Rangoon are of Baltic origin, as proved by the amount of succinic acid contained in them. But there are, on the other hand, many authorities for the early derivation of amber from India and especially Burma. There are four passages in Pliny giving India as the native country of amber, and ancient Greek authors, especially Sophocles, testify to its origin in eastern India. It would be very strange if the Phœnicians, while shipping ivory, peacock feathers, tin, jewels, and spices from "Ophir," had left behind a highly valued, abundant, striking, and easily transportable article like amber. A specimen of Burmite, as the Indian amber is now usually called, from the Indian Museum, Calcutta, gave 2 per cent. of succinic acid; another specimen, analysed by Dr. Helm, gave off none. The specimens examined by the latter "had frequently embedded in them small particles of decayed wood and bark," which recalls a passage in Archelaos, who says that the Indian amber often has pieces of pine bark adhering to it. The Indian origin of much of the amber acquired by the Mediterranean nations in ancient times appears, therefore, to be placed beyond doubt. It is, indeed, probable that Baltic amber did not become a regular article of commerce before the first century of the Christian era.

WHILST our knowledge concerning the behaviour of bacteria in animal tissues is daily receiving fresh additions, but little is known on the relatively unimportant although interesting question of their deportment in vegetable tissues. Much uncertainty exists as to whether bacteria are or are not normally present in healthy vegetable tissues, but the most recent investigations appear to show that they are absent, although they may obtain easy access through minute abrasures, and retain their vitality for a considerable time, and in some cases even multiply. This view is supported by Russell, who has recently presented an interesting dissertation to the John Hopkins University on "Bacteria in their Relation to Vegetable Tissue." A large number of examinations were made of healthy plant tissues, but in no case were bacteria isolated from them, although in wounded tissues they were frequently found. Ordinary saprophytic bacterial forms were inoculated into the healthy tissues of various plants, and were identified after several days, thus the *B. luteus* was found in large numbers in the stem of a geranium after forty days from the date of its introduction. Moreover, nearly as many bacilli were obtained 10 millimetres above the point as at the seat of inoculation, 1850 being found at the latter place, and 1764 above. In all the experiments, although the distance at which bacteria were found varied from 30-50 mm. above, in no case were they identified at more than 2-3mm. below the point of inoculation. Russell suggests that this upward distribution of the germs may be due to food materials being more abundant in the rapidly growing apex, whilst smaller resistance is offered to their passage in the less developed cellulose walls than in the more matured cell-membrane of the older tissue. Moreover, as the bacteria were definitely located in the interior of the cells, and no opening of any kind could be determined, he suggests that they have the power, by means of a ferment excreted, to work their way from cell to cell without causing a permanent rupture.

THE August number of the Journal of the Royal Horticultural Society contains several interesting papers, among which is Prof. F. W. Oliver's second report on the effects of urban fog upon cultivated plants. The report deals especially with the physiological aspect of the question, the action of fog upon plants, both by reduction of light and atmospheric impurities, being described in detail. The Rev. G. Henslow gives the results of experiments made with a view of determining the effects of growing plants under glasses of various colours. His observations show that during germination it is generally immaterial whether the seeds are subjected to light or not. In the case of a variety of larkspur, however, light was found to be positively injurious. No coloured light, or combination of lights, which was not of the quality of pure colourless daylight, gave such good results as ordinary daylight. A comparison made between plants growing under ordinary window-glass and in the open showed that the glass exercises a deletereous effect, due possibly to an excess of heat by which respiration is stimulated and assimilation reduced. It is suggested that in order to reduce "scorching" some means must be used which reduces the heat rays without lessening the whole amount of white light.

WE have received from Dr. P. Bergholz the results of the meteorological observations at Bremen for the year 1892. This station is one of considerable importance, both on account of its outfit with self-recording instruments, and even with duplicate recording instruments for some of the elements, so as to avoid any possible gap in the continuity of the records, and also on account of the long continuance of observations. The first volume of this series, for the year 1890, contained the results of observations taken since the year 1803, and we see from Dr. Hellmann's *Repertorium* that observations were taken at Bremen as early as 1795. The work contains hourly readings, and, in addition, observations arranged for three hours daily, in accordance with the international scheme, together with curves showing the diurnal range for each month and for the year; it also comprises rainfall values for four other stations, and phenological observations for eleven years; the whole forming a very complete and creditable compilation.

IN *Wiedemann's Annalen*, No. 8, Herr W. Voigt gives a further account of the progress of his attempt to determine the greatest possible number of physical constants of the same pieces of metal subjected to the least mechanical manipulation. The pieces were carefully cast and sawed into shape where necessary. It is not surprising that the constants thus obtained differ in many cases from those found in the case of drawn and rolled metals, but it seems that the object of discovering the laws of the numerical relations between the various constants render it highly desirable that the substances should be investigated in what may be called their most natural state. The constants recently dealt with are thermal dilatation, thermal pressure, and specific heats at constant pressure and volume respectively. The determination of the specific heat by the method of mixtures has led to some ingenious contrivances for minimising the errors which are apt to influence this somewhat delicate operation. The outer vessel of the Neumann "cock" for heating the body under examination was made movable instead of the inner, thus enabling it to be refilled without removing it from the stand. The loss of liquid due to the splashing produced by the metal falling into the calorimeter was avoided by throwing it into a metal cage just in contact with the

liquid, which was then lowered about halfway towards the bottom. The liquid was stirred by a small turbine, and the thermometer was so arranged that it only came into contact with liquid which had ascended from the metal, and then had been drawn down through the turbine tube, thus giving a very rapid rise and gradual fall of temperature, as indicated by the thermometer. The scale was read by a small microscope provided with two wires touching the scale, the meniscus being brought midway between the two. This simple arrangemen has the effect of eliminating all parallactic errors.

THE Comité International des Poids et Mesures has issued a volume containing the proceedings of meetings held during 1892. M. L. Chappuis contributes to the volume a report of an investigation of the thermal expansion of water by the weight-thermometer method. He has made two complete determinations, one between 0° and 42°·4 C., and the other between 0° and 36°·6 C. The results show that the expansion of water from 0° to 40° is very closely given by the following expression $-0{\cdot}84 - 66{\cdot}573253t - 8{\cdot}798939t^2 - 7{\cdot}892005 \times 10^{-2}t^3 + 5{\cdot}155549 \times 10^{-4}t^4$. M. C. E. Guillaume has prepared a report on the metals employed in the construction of standard scales, in which he recommends nickel as the best substance.

COLONEL WATERHOUSE has been making experiments upon the electrical action of light upon silver and its haloid compounds, and communicated his results to the Asiatic Society of Bengal in May last. His arrangement was such that one plate could be exposed to light while another with which it was in electrical connection was screened from actinic rays. From the experiments it appears that, as a general rule, sunlight has an oxidising or dissolving effect on silver, whether in acid or alkaline solutions, the exposed plates being nearly always positive, and consequently forming the anode of the voltaic couple. With solutions decomposed by silver, and forming sensitive compounds with it, the action is variable.

MR. P. JANET, in the current number of the *Journal de Physique*, describes the methods he has adopted for experiments on electric oscillations of comparatively long period, $\frac{1}{10000}$ second and thereabouts. His object more particularly is to obtain the actual form of the curves of intensity and electro-motive force, rather than to find the period and logarithmic decrement. With a modified form of interruptor of M. Mouton's he is able to read accurately to $\frac{1}{30000}$ second, or even less. A mica-condenser forms part of his arrangement, and he was incidentally led to make experiments on the "hysteresis and dielectric viscosity" of the mica, from the study of certain variations which he found in the capacity of the condenser. He sums up his results on this point thus:—"In a condenser with solid dielectrics, under the influence of rapid [electric] oscillations, there is a lagging of the charges behind the differences of potential; or, in other words, for equal differences of potential, the charges are smaller with increasing than with decreasing potentials." A new and apparently accurate method for the determination of the coefficient of self-induction is also given as a secondary result of the experiments.

IN the same journal M. R. Malagoli gives a summary of his theoretical investigations on electrolysis by alternating currents, the results of which agree with the experimental determinations of M. Mengarini. He concludes that the necessary and sufficient condition under which electrolysis by alternating currents is possible, is that the quantity of electricity passing through the voltameter during a single alternation of the current must be at least twice that which is necessary for the production of the maximum polarisation of the voltameter. Electrolytic production ceases when these two quantities become equal, and the amount of the electrolyte decomposed is proportional to their difference.

AT the meeting of the Paris Academy of Sciences on August 14, MM. Delahaye and Boutille showed an ingenious fire-alarm. A hollow ball of aluminium, 15 to 20 mm. in diameter, is supported at one end of an arm, with a counterpoise at the other end, the whole being in equilibrium at the ordinary temperature and pressure of the air. The apparatus is purposely made not sensitive enough to show the ordinary natural changes of pressure, but if the specific gravity of the air becomes diminished considerably, either from a rise of temperature or an admixture of coal gas in sufficient quantity to become explosive, the balance is destroyed, and the ball in falling completes an electric circuit by which an alarm bell is set ringing until the normal state of affairs is again established.

SIR CHARLES TODD has issued a report on the rainfall in South Australia and the northern territory during 1892, with the weather characteristics of each month.

GUSTAV FISCHER, of Jena, has recently published second and revised editions of two well-known books—Prof. E. Strasburger's "Kleine Botanische Practicum," and Prof. Richard Hertwig's "Lehrbuch der Zoologie."

MESSRS. CROSBY LOCKWOOD AND SON will publish in September a comprehensive handbook on "Practical Building Construction," by Mr. J. P. Allen, lecturer at the Durham College of Science, Newcastle-on-Tyne. The work will be illustrated by about 1,000 diagrams.

WITH reference to the article on the "Position of Scientific Experts" in our issue of the 17th inst. a correspondent informs us that for some years it has been legal for a judge to select an expert to report to the Court upon a particular matter in dispute, and this practice is occasionally followed. The mode of selection and of appointment, and the status of the official English expert, are therefore almost identical with those of his German equivalent.

THE Isle of Man Natural History and Antiquarian Society visited the Marine Biological Station at Port Erin on August 14, and Prof. Herdman, F.R.S., the director of the station, gave the members an address upon the objects and methods of marine biology. We understand that it is intended to construct fish hatcheries at Port Erin, and to wall in several of the creeks round the coast for the preservation of young fish until they reach maturity.

AN "Electrical Engineer's Price-Book," edited by Mr. H. J. Dowsing, has been published by Messrs. Charles Griffin and Co. It contains a large amount of information on the commercial aspect of electrical work, and should be of great assistance, not only to electrical engineers, but also to borough engineers, architects, railway contractors, and local authorities who desire to be informed upon matters connected with electrical installations.

BRAZIL produces, on the average, about 360,000 tons of coffee per annum, that is, about four-fifths of the whole amount consumed in the world. Since the State of Sao Paulo alone produces one-half of this quantity, an illustrated pamphlet by Señor Adolpho A. Pinto, one of the Commissioners of the State at the World's Columbian Exposition, would be expected to contain an accurate account of coffee cultivation. The little pamphlet justifies the expectation. Every one interested in coffee-growing in general, and in Sao Paulo in particular, will find it well worth reading.

IT was generally admitted by those competent to judge that the display of scientific instruments at the Paris Exposition of 1889 was inferior to that of 1878. There were, however, a few striking exhibits scattered in different classes in an unaccountable manner. Mr. A. Lawrence Rotch was appointed to report

upon the meteorological instruments at the exhibition, and though there was a difficulty in comparing objects in the same class, owing to their being distributed over an immense area, it was satisfactorily overcome. Meteorologists will be glad to know that Mr. Rotch's report has been extracted from the second volume of the Reports of the U.S. Commissioners to the Universal Exposition at Paris, and is now issued separately.

THE report on the operations of the Department of Land Records and Agriculture, Madras Presidency, for the official year 1891-92 has been received. From it we learn that experiments made by the Madras railway companies in the use of eucalyptus leaves to prevent incrustation in locomotive boilers have turned out very satisfactory, and are therefore being continued. The chief feature of the year was the comparative immunity from serious disease which the cattle enjoyed. The total reported losses (87,000) were only fifty-eight per cent. of the average losses, and fifteen per cent. less than in 1890-91. The losses from snake-bite decreased from 2,698 to 1,751, and the decrease was spread over the whole Presidency, except Ganjam and Vizagapatam. Losses by wild animals also decreased by 345 head. No reason is given to account for this singular reduction.

THE Royal Society of Tasmania issued in June last the reports of its proceedings in 1892, and the volume has just reached us. Among other papers printed in full occurs one by Mr. G. M. Thomson on Tasmanian crustacea, with descriptions of new species, and another on new species of Tasmanian araneæ, by Mr. A. T. Urquhart. The Rev. F. R. M. Wilson contributes a paper on the climate of Eastern Tasmania, indicated by its lichen flora, in which he gives facts which "suggest to the medical faculty what probably their experience has already proved, that the climate of East Gippsland and the eastern coast of Tasmania must be pre-eminently beneficial to invalids. Lichenological observations indicate that both of these places are favoured by a much milder winter, as well as a cooler summer, than the other parts of their respective colonies." Mr. Wilson also gives a description of Tasmanian lichens, and Mr. John Shirley a list of those now known.

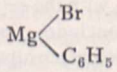
DR. D. S. JORDAN showed in 1889 that, in every case where the waters of Yellowstone Park were destitute of fish, the cause was topographical, that is to say, there was some physical barrier to the entrance of fishes from below. This being so, it seemed possible to stock these waters permanently with game-fish, so the U.S. Commissioner of Fish and Fisheries sent Prof. S. A. Forbes to Yellowstone Park in 1890 to investigate the variety and abundance of the lower animal life of the fishless waters, since upon this the fishes introduced would chiefly have to depend for food. Prof. Forbes has prepared his "Preliminary Report on the Aquatic Invertebrata Fauna of the Yellowstone National Park, Wyoming, and of the Flathead Region of Montana." In it he presents a summary review of the invertebrate life of the waters of Wyoming and Montana in the mid-summer season, with descriptions and determinations of such new or particularly abundant kinds as have thus far been made out. A detailed discussion of the results will be published as soon as the mass of material collected during the expeditions has been examined.

THE organo-metallic compounds of magnesium form the subject of a communication to the current number of *Liebig's Annalen* by Dr. Fleck of Tübingen. The di-methyl, di-ethyl and di-propyl compounds of magnesium were obtained by Dr. Löhr in the same laboratory in 1890. Dr. Fleck has continued the work, and now describes the di-phenyl compound and gives further details concerning the mode of preparation and properties of the fatty alkyls above mentioned. The magnesium alkyls are of a somewhat similar nature to the well-known zinc methide and ethide. They differ, however, in the nature o certain of their reactions, and their chemical activity is considerably superior to that of the zinc alkyls, which have hitherto been regarded as exceptionally active substances. Not only are the magnesium compounds spontaneously inflammable in the air, but the methyl compound was described by Dr. Löhr as igniting spontaneously and burning in a very beautiful manner in carbon dioxide gas, being capable of extracting the oxygen from its combination with carbon. The three fatty alkyls are best prepared by the action of the alkyl iodides upon magnesium amalgam. When an attempt, however, is made to prepare the diphenyl compound by heating in a closed and previously exhausted tube a quantity of magnesium amalgam and brom-benzene, instead of obtaining magnesium diphenyl decomposition occurs, and the resulting product is merely a mixture of bromides of magnesium and mercury with diphenyl itself $(C_6H_5)_2$. Dr. Fleck has at last succeeded in preparing magnesium diphenyl by heating a mixture of magnesium filings and mercury diphenyl, $Hg(C_6H_5)_2$, within a narrow range of temperature. About ten grams of mercury diphenyl and a little more than the calculated quantity of magnesium in fine powder are placed in a tube of soft glass, which is then exhausted by means of the air pump and sealed. Upon heating the tube and contents to 200 a violent reaction suddenly occurs, with production of a voluminous white mass occupying at least three times the space of the original mixture. Above 210° this white substance commences to carbonise, so that the tube is maintained for four or five hours at a temperature of 200—210°, not exceeding the latter limit. The product is spontaneously inflammable in air, so that it is necessary to open the tube under benzene. Any excess of mercury diphenyl is dissolved out by warming with benzene over a water bath, the residue is then treated with a mixture of ether and benzene, in which alone of all the organic solvents tested magnesium diphenyl is soluble; upon decantation from the residual amalgam and evaporation of the clear liquid in a stream of nitrogen, pure magnesium diphenyl is obtained as a grayish-white solid. Analyses of the product agree with the formula $Mg(C_6H_5)_2$.

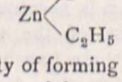
MAGNESIUM diphenyl, like the dimethyl, diethyl and dipropyl compounds, reacts in a most violent manner with water. Even when the substance is first covered with ether, and then small pieces of ice are slowly added, the reaction still occurs almost explosively. Magnesium hydrate and benzene are the products of the reaction as indicated by the equation

$$Mg(C_6H_5)_2 + 2H_2O = Mg(OH)_2 + 2C_6H_6.$$

Magnesium diphenyl is consequently extremely hygroscopic, attracting moisture from the air with great rapidity when covered with a layer of benzene. When freely exposed to the air it at once burns to magnesium oxide and a carbonaceous mass. If, however, the compound is covered with benzene and exposed to perfectly dry air for some days, an oxy-compound, $Mg(OC_6H_5)_2$ is formed as a brown solid. Bromine reacts with great energy to form bromides of magnesium and phenyl, even when largely diluted with ether, and so does not form an intermediate compound,



corresponding to the well-known zinc iodo-ethide,



Indeed, this incapability of forming mixed halogen alkyls, owing to greater activity, is one of the most characteristic distinctions between the magnesium and the zinc alkyls generally. Benzal

chloride, $C_6H_5.CHCl_2$, reacts with magnesium diphenyl in an interesting manner, forming without extraneous application of heat triphenylmethane, $(C_6H_5)_3CH$, and magnesium chloride.

NOTES from the Marine Biological Station, Plymouth.—The *Actinotrocha* larva of *Phoronis* has now made its appearance in the floating fauna. The Radiolaria mentioned last week, though still present, have become much less numerous; the tow-nets have this week been crowded with *Rhizoselenia*. The Siphonophore *Muggiæa atlantica* is abundant, and the medusæ *Saphenia mirabilis* and *Amphinema Titania*, with swarms of small *Obeliæ*, have also been observed. The Nauplii of *Sacculina* are plentiful, and among Mollusca the larvæ of *Ægirus punctilucens* and the larva *Cirropteron semilunare* of M. Sars (possessing a four-lobed velum) have been observed. The Polyclad *Leptoplana tremellaris* is now breeding; and young metamorphosed specimens of the Opisthobranch *Oscanius membranaceus* have been taken with the dredge on the bottom.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mrs. H. Leavitt: a Blau-bok (*Cephalophus pygmæus*) from South Africa, presented by Mr. J. E. Matcham; a Yellow Baboon (*Cynocephalus babouin*) from West Africa, a Banded Gymnogene (*Polyboroides typicus*) from East Africa, a White-necked Stork (*Dissura episcopus*) from East Africa, presented by Mr. Thomas E. Remington; a European Tree Frog (*Hyla arborea*) from Europe, two Fire-bellied Toads (*Bombinator igneus*) from Europe, and a Spotted Salamander (*Salamandra maculosa*) from Europe, presented by Mr. Hood; eleven Garden Dormice (*Myoscus quercinus*) from Spain, forty-eight Glossy Ibises (*Plegadis falcinellus*) from Spain, and four Marbled Ducks (*Anas angustirostris*) from Spain, presented by Lord Lilford, F.Z.S.; a Rose-crested Cockatoo (*Cacatua moluccensis*) from Moluccas, presented by Lady Sudeley; two Ypecaha Rails (*Aramides ypecatra*) from South America, presented by Mr. F. H. Chalk, a Boa (*Boa constrictor*) from South America, and two Great Bustards (*Otis tarda*) from Spain, deposited; and a Wapiti Deer (*Cervus canadensis*) born in the Menagerie.

OUR ASTRONOMICAL COLUMN.

HONORARY DISTINCTIONS.—From the current number of *L'Astronomie* we gather that M. Janssen, director of the Observatory of Meudon, has been made a Commander of the Legion of Honour. Messrs. Callandreau and Bigourdan, assistant-astronomers at the Paris Observatory, have received the distinctions of Officers of Public Instruction, and MM. Camille Flammarion and Jordan and Hermite, of the Institute, have received from the King of Greece the Cross of the Commander of the Order of the Saviour.

A METEOR.—An observer, writing to us from Westgate-on-Sea, gives the following account of a meteor seen there on the evening of August 27:—"At about 8.40 p.m. I saw a very brilliant meteor here. The trail, as far as I could judge, must have commenced somewhere about the star β Sagittæ, but the most brilliant part of it was accurately noted as lying between two points, one being half-way between α and γ Aquilæ and the other being about a third of the distance (from η) between η and δ of the same constellation. The meteor may be described as "rapid," and its direction of motion was south. The most striking feature of this observation was the length of time (about six minutes) the trail remained visible in the heavens, and its subsequent change of shape. At first it appeared of a bluish-white colour and was very bright, its path describing practically a straight line; but about four minutes later it had dimmed very considerably (the same colour being maintained), but the trail was no longer straight but distinctly *wavy*, giving one the idea that the meteoritic dust particles must have encountered some air currents travelling at right angles to its length."

A BEQUEST TO ASTRONOMY.—By the will of Mr. Arthur Leake, late of Ashby, Ross, Tasmania, a sum of £10,000 was put by for the purpose of founding a school for the practical teaching of astronomy in one of the Australian universities, colleges, or leading schools. It was stipulated that a part of such teaching should consist of lectures illustrated with diagrams and instruments, and the sum of £3000 could be spent in purchasing the necessary equipment. From the proceedings of the Royal Society of Tasmania (issued June, 1893) it appears that there is a little difficulty in determining the best means of using the bequest. Mr. H. C. Russell, F.R.S., C.M.G., has drawn up a scheme for the proposed school which has much to commend it. He points out that Hobart offers special advantages of climate and position for the Leake Observatory, and suggests that £1800 should be spent in purchasing a photographic astronomical telescope, to be used for work in connection with the photographic chart. It is proposed that the University of Tasmania shall establish a school of astronomy and the observatory, and that the lecturer in mathematics and physics shall also teach astronomy, and have general control and direction of the observatory, for which he should be paid from the Leake fund £100 per annum in addition to his salary from the university. An observatory assistant is provided in the scheme with a salary of £200 per annum. The sum of £50 a year is set down for photographic plates, chemicals, &c., bringing the total annual expenditure up to £350, which is the interest on £7000 from the Leake estate. When Mr. Russell's paper was read, in August, 1892, an opinion was expressed that it was unnecessary to "import an astronomical expert in order to give the instruction in astronomy, and to superintend the observatory," and that the duties of the observer might be combined with those of the Government meteorologist. With this feeling the following resolution was passed:—"The Royal Society of Tasmania having placed itself in communication with the Council of the University with the view of formulating a scheme for securing the benefit of the Leake bequest to the colony of Tasmania, the Premier be requested to refrain from making any permanent appointment to the office of meteorologist pending the result of such conference."

GEOGRAPHICAL NOTES.

DR. NANSEN has telegraphed from Yugor Strait, at the entrance to the Kara Sea, on August 3, the message reaching the Vardö telegraph office on August 23. A good voyage had been made to Nova Zembla, the only unpleasant episodes being the occurrence of fogs and contrary winds. On the 27th ice was encountered in lat. 69° 50′ N., long. 50° E., about ten miles north-east of the Island of Kolgueff. Dr. Nansen forced his way through the ice, the *Fram* proving a splendid ship for the purpose, and reached Yugor Strait on the 29th, making a run of 250 miles in two days. The coal-ship, which was to have been waiting at Yugor Strait, had not arrived, but having sufficient coal on board Dr. Nansen intended to sail into the Kara Sea on August 3, rather than risk delay by waiting. He took on board "thirty-four splendid sledge-dogs." Little ice was reported in the southern part of the Kara Sea, a southerly wind having driven the pack northward. If the ice does not turn out worse than reported, Nansen hoped to reach the New Siberian Islands before the end of August, and if he does so he considers success almost certain. The *Fram* will touch at the Olonetz River, near the Lena delta, if there is time, and send farther news.

THE geography of South America has recently been receiving great attention from German travellers and officials in the various South American republics. In a recent number of *Petermann's Mittheilungen*, Richard Payer describes a journey from Lima across the Andes and down the valley of the Ucayali to the Amazon. In the course of it he visited an interesting Tyrolese colony at Pozuzo, which he found in the course of extinction, after thirty years' hard struggle on the part of the colonists to maintain a footing in their remote and isolated settlement. Dr. Brakebusch has from time to time published portions of the material he has been collecting for an exhaustive account of the physical geography of the Argentine. He divides the country from the crest of the Andes to the valley of the Parana into successive zones—snowy summits and cliffs, high-level sand-dunes formed from glacial débris, screes, alpine pastures, low-level sand-dunes, salt flats, forests, and pampas.

Dr. Hettner has been at work on the Andes of Colombia, and Dr. Theodore Wolf has published a magnificent monograph (in Spanish) on the geography and geology of Ecuador, accompanied by the best map yet produced of the country. Dr. Tippenhauer has written a fine work on the physical geography of Haiti, and many other papers by German geographers have appeared within the last few months.

SIR WILLIAM MACGREGOR, for the British Government, and the officers of the Dutch war-vessel *Java*, have rectified the frontier between British and Dutch New Guinea. The former boundary was the 141st meridian, and the new boundary, where it cuts the coast, is a stream, chosen to furnish a recognisable border-line, in 141° 1′ 40″ E. and 9° 7′ 40″ S.

ON August 6 the new ship-canal across the Isthmus of Corinth was formally opened, thus completing a plan which was projected by Periandros about 600 B.C., and actually commenced by Nero, who was, however, compelled to abandon the work, in 68 A.D. The canal is not quite four miles long, and will effect a saving of 120 miles in the passage from the Adriatic to the Ægean. Two new towns have been planned at the entrances to the canal, which will be named Poseidonia and Isthmia.

MR. F. C. SELOUS, the recognised authority on the exploration of Mashonaland, has been induced to return there at very short notice, on account of the threatening attitude of the powerful Matabele chief, Lo Bengula, and the consequent risk of interruption in the development of the country. An important work on Mashonaland, by Mr. Selous, will be published immediately.

MR. R. M. W. SWAN, who, with Mr. Theodore Bent, surveyed the ruins of Zimbabwe, is at present engaged in a systematic survey of other groups of ruins in South Africa, and he reports the discovery of a temple on the Limpopo, "oriented" to the setting sun at the solstice.

MR. W. H. COZENS HARDY, the Oxford geographical scholar, is now engaged in carrying out his explorations in Eastern Montenegro, one of the least known parts of Europe. The work of his predecessor, Mr. Grundy, on the Battlefield of Platæa, is on the point of publication as a supplementary paper of the Royal Geographical Society.

THE BEAVER CREEK METEORITE.

SOME of the readers of NATURE will no doubt be interested in a short account of a meteoric fall which occurred recently in British Columbia, and was noted in these columns on August 10. For the circumstances in connection with the fall, and the finding of fragments of the meteorite, I am indebted to Mr. James Hislop—a former student of this University, and a most trustworthy observer—and also to a letter by Mr. E. L. McNair in the *Spokane Review* of June 2.

Both gentlemen were members of a party of engineers engaged upon a survey for the Nelson and Fort Sheppard Railway Company on Beaver Creek, about eleven miles north and five miles east of where the Columbia crosses the international boundary line. About four o'clock on the afternoon of May 26 a series of sharp reports was heard, following one another in quick succession, and apparently occupying in all about half a minute. The first report was quite loud and sharp, and each succeeding one less so, as if coming from a greater distance. Following the reports was a whizzing sound, such as might be supposed to be produced by a body moving rapidly through the air.

At the time of the "explosion" a man named Gerling was walking along the Beaver Creek trail. At first he thought that the noise was thunder, but the whizzing sound puzzled him, and on looking upward to see if he could tell whence it came, it grew louder and louder until a stone struck the ground not far from where he stood. He searched for it, but without success, as the place was thickly overgrown with bushes.

Some distance from this a fragment fell within fifty feet of a man named Edward McLeod. It buried itself in the earth, but was dug out, and found to weigh four or five pounds. On the following day (May 27), in the course of his topographical work, Mr. Hislop came upon a freshly-made hole in the ground into which the loose earth had fallen, and on following it down to a depth of three feet from the surface a portion of the meteorite weighing about twenty-five pounds was discovered. The hole made an angle of 58° with the horizontal, and its course showed that the mass had come in a direction S. 60° E. (true meridian), The writer is indebted to Mr. Hislop for a portion of this mass, and a preliminary examination fully establishes its meteoric character.

The fresh fracture is light grey in colour and harsh to the touch, the crust being brown and dull. The chondritic character is distinctly seen without a lens, though the "chondra" are mostly under a millimetre in diameter. Examination of a thin section with the microscope showed the presence of olivine, enstatite, iron, troilite, and chromite (?). The iron is present in the form of little shining grains and strings. On treatment with hydrochloric acid the powder gelatinises readily (olivine) and evolves hydrogen sulphide. By means of an ordinary horse-shoe magnet some of the powder was separated into a magnetic and a non-magnetic portion. The former amounted to about 23·5 per cent. of the whole, and consisted mainly of nickel-iron, which, however, carried with it a portion of the other constituents.

A partial analysis of the magnetic material gave:—

Iron	78·72
Nickel (including cobalt)	6·87
Insoluble in hydrochloric acid	10·04
Soluble silica	1·46
Magnesia, &c., by difference	2·91
	100·00

If all the iron and nickel present be regarded as nickel-iron, the percentage of nickel (with cobalt) is 8·73. No doubt, however, a little of the iron was derived from olivine and possibly from troilite.

The writer hopes to publish before long the results of a less hurried and more detailed examination of the specimen in his possession. B. J. HARRINGTON.

SPANGOLITE, A REMARKABLE CORNISH MINERAL.

AMONG the valuable Cornish minerals from the Williams collection which have recently been acquired by the trustees of the British Museum[1] is one specimen which deserves immediate notice, since it proves to be a recently discovered mineral of which only one other example is known to exist, and that from a foreign country.

The mineral belongs to the fine series of copper ores from the St. Day mines, which are chiefly arsenates and phosphates, and among these, while it exceeds the remainder in scientific interest, it is inferior to none in beauty.

The specimen, about the size of a hen's egg, consists of a granular gossany quartz carrying on both sides a little massive cuprite, which is covered and replaced by greenish alteration products—chrysocolla, malachite, liroconite, and clinoclase—together with a little chessylite; especially conspicuous being the bright green crystals of liroconite and indigo-blue groups of clinoclase.

But among these, dispersed upon both sides of the specimen, are numerous brilliant and translucent crystals of a deep emerald-green colour, which at once strike the eye as something unusual. Their form is a hexagonal prism terminated by an acute hexagonal pyramid having the apex truncated by a single bright plane; and one cannot call to mind any other mineral having precisely this habit.

A minute group of crystals was detached and examined by Mr. Prior and myself with the following result:—The mineral belongs to the rhombohedral system, the pyramid angle being 53° 7′; it has a perfect basal cleavage; it is uniaxial, the birefringence being strong and negative; the specific gravity, determined by suspending a fragment in solution of cadmium borotungstate (Rohrbach's solution), is 3·07; it is insoluble in water, but readily soluble in acids; and is found to be a hydrated sulphate and chloride of copper and aluminium. This indicates a very remarkable and unusual composition, but the presence of both aluminium and chlorine is quite unmistakable.

In all the above characters the substance is identical with spangolite, a new copper mineral which was described by Mr. S. L. Penfield in 1890 (*American Journal of Science*, 39, p. 370).

The resemblance between the two specimens extends even to the circumstances of their discovery; the original spangolite

[1] NATURE, vol. xlviii. p. 357.

was found in a collection of minerals where it had attracted no attention until Mr. Spang obtained the specimen and brought it to the notice of Mr. Penfield; the present specimen has probably remained unnoticed in the Cornish collection at Caerhays for a large number of years.

The local collection from which the American specimen was obtained belonged to a man living near Tombstone, Arizona, who had gathered together his minerals within a radius of about two hundred miles, so that although the exact locality and mode of occurrence are unknown, it is almost impossible that this specimen can be also Cornish.

From the typical character and appearance of the associated clinoclase and liroconite the British Museum specimen (although no label or history is attached to it) can be pronounced to be without the least doubt from the St. Day district, near Redruth, in Cornwall.

The American specimen is described as "a rounded mass of impure cuprite which was mostly covered with hexagonal crystals of spangolite, associated with a few crystals of azurite and some slender prismatic crystals of a copper mineral containing chlorine, probably atacamite"; it therefore differs considerably from the Cornish specimen as regards the associated minerals.

The only apparent difference between the spangolite on the two specimens is in the habit of the crystals, which in the American mineral are short prisms with bevilled edges and a large base, quite unlike the acute Cornish pyramids in aspect. The pyramid angle found by Penfield is 53° 11½', and the specific gravity 3·141. Penfield further made some interesting observations concerning the etched figures of spangolite; he describes and figures certain beautiful triangular markings produced upon the basal plane by the solvent action of very dilute acids. We have found that precisely the same characteristic figures are engraved upon a cleavage flake of the Cornish mineral when it is immersed for a few minutes in dilute acid.

The American crystals attain considerable dimensions; the largest had a length of 5½ mm. and a breadth of 8 mm., and by sacrificing half the specimen Penfield was able to obtain more than 3 grams (!) of pure material for analysis. The Cornish crystals are not more than 2½ mm. in length and ¾ mm. in breadth, and it will be difficult to obtain sufficient material for a complete analysis, unless other specimens can be found. This is unfortunate, for the composition is so peculiar that, although Penfield's analysis is without doubt perfectly reliable, it would have been interesting to confirm his formula from a new locality. The preliminary examination serves, however, not only to establish the identity of the mineral, but also to prove the most important point—that the aluminium and chlorine are essential constituents.

The formula deduced by Penfield is

$$Cu_6AlClSO_{10}.9H_2O.$$

in which, as he remarks, the aluminium is just sufficient to satisfy the quantivalence of the total acids, thus:—

$$(AlCl)SO_4.6Cu(HO)_2.3H_2O.$$

The mineral is therefore closely related to connellite, a very rare sulphate and chloride of copper also found in the St. Day district, which, moreover, it somewhat resembles in appearance, having the same black colour when viewed by reflected light alone. The colour by transmitted light, together with the perfect basal cleavage are, however, sufficient to distinguish spangolite from all known minerals; further, the basal plane is as common on spangolite as it is rare on connellite.

It is to be hoped that search will be made among old collections and upon copper ores from St. Day for further specimens of this interesting mineral. H. A. MIERS.

DESULPHURISATION OF IRON.

THE elimination of sulphur from iron and the chemical reactions, whereby sulphur, in the presence of powerful basic materials, is removed from crude iron, has recently attracted considerable attention. There are many reasons for this; pure ores have become comparatively scarce, and to some extent the same may be said of the fuel or coke used in the process of smelting. And even if this be not strictly applicable in all districts where the manufacture of iron is pursued, yet it cannot be gainsaid that excessive competition, with concurrent low prices, have had an influence in rendering the strictest economy in the manufacture absolutely necessary, and thus in a measure preventing the free use of pure high-priced materials.

I may even go further and assert that under favourable conditions, that is, as regards general manufacturing expenses, localisation of plant, &c., the cost of pure good materials, unquestionably suitable for smelting purposes, may become quite prohibitive. In numerous instances manufacturers have therefore been compelled to use cheaper fuel and ores falling within the margin of economic working. At this point, however, other fresh difficulties have to be combated; for when the problem of the production of iron and steel at a reasonable rate has been solved, it is too often found that the metal thus manufactured fails to meet demanded requirements. It is often the case that when iron thus produced is converted into steel, a want of uniformity in quality can be distinctly traced throughout the manufactured product. Though the steel can hardly be termed bad, nevertheless, as a general rule, it compares unfavourably with the metal smelted from purer ores with good fuel or coke.

The causes tending to the production of this inferior metal or steel are well known, and may be summed up in a few words. (1) The use of inferior coke in the blast furnace is at once a cause of deterioration, for the heat is less intense, and this tends to the production of a low grade iron.

(2) It is evident that the use of inferior cheaper ore causes a further deterioration in quality, whilst any attempt to remedy this by lightening the furnace burden of ore—in other words, using a greater quantity of coke—is, in many instances, counterbalanced by the inevitable additional impurities charged, *i.e.* sulphur and phosphorus, and other additional incombustible matter or ash.

It follows as a matter of course that the blast furnace can only work in this direction within a very narrow limit, either plus or minus attempts to limit the quantity of coke used resulting, as before said, in the production of low grade iron. On the other hand, an increased quantity of fuel with the use of inferior ore increases the total amount of impurities.

The working limit on either side is soon reached, and any further attempts at improvement either way become simply useless. Certainly, very highly heated air or blast might to some extent obviate some of the difficulties, but as in modern practice this is already thoroughly carried out, the employment of a higher temperature of blast would appear to be practically impossible, and it is very likely that the attempted use of abnormally heated blast or air would entail other serious practical difficulties.

This is the common experience of those engaged in the manufacture of iron and steel, more especially in blast furnace smelting operations, showing that under the unfavourable conditions before mentioned, it is practically impossible to produce a high-class iron containing the minimum percentage of sulphur and phosphorus together, with the requisite quantities of silicon and graphite necessary to ensure the production of good steel.

Thanks to the painstaking investigations of Mr. Stead, we can now form a tolerably clear idea of the reactions involved in the elimination of sulphur, both in the blast furnace and by other or secondary processes. These may be broadly summed up in his statement that sulphide of iron is dissolved out of the metal in the first instance by free or loosely attached lime, in a highly reducing atmosphere at a high temperature, as by the Saniter process, where lime dissolved in calcium chloride is used; and in the blast furnace by the excess of lime in solution in the slag, or even a mixture of ordinary blast furnace slag and lime, the latter being capable of eliminating sulphur from iron, and may be substituted for Saniter's mixture. The results, however, so far as can be ascertained, are somewhat irregular with either of these methods. Finally, there can be little doubt, as suggested by Mr. Stead, that if lime alone is brought into intimate contact with molten iron by suitable mechanical appliances, neither calcium chloride nor slag is needed, these having little or no direct chemical action on the metal, but merely forming vehicles for the transmission and mixing of the lime with the iron, and consequent washing out of solution of iron sulphide, followed by the subsequent conversion into calcium sulphide and iron oxide.

"The reactions in this process are, however, exceedingly complex, and there are changes which occur of which we know little or nothing. It is, however, my opinion that the sulphide of iron is dissolved out of the metal in the first instance by the free or loosely-attached dissolved lime; but I do not care at present, without more extended investigations, to hazard an

opinion as to what the subsequent reactions may be."[1] Subject to what may be said of particular instances or occasional exceptions, the statements made by me as to the result of many years' observation and experiment of others and myself are on the whole practically accepted. Probably Mr. Stead is correct when he assumes that the dissolved iron sulphide is resolved into calcium sulphide, and iron oxide, as by the Saniter process, or in the blast furnace, by the excess of lime in solution in the slag.

In this connection, as regards the blast furnace, heat plays a double part, firstly for the intensification of the chemical affinity of sulphur for the alkaline base (lime, of the slag; secondly, for the adequate liquefaction of this highly basic slag, overcharged with lime and requiring a high temperature for its perfect fusion, which otherwise would remain in and clog up the blast furnace, thus obviously checking the proper working of the furnace and the uniform descent of the materials charged above.

Phosphorus is apparently not eliminated in sensible quantities under the above conditions. Practically the whole is retained and passes into the pig iron. Blast furnace slags are, however, never quite free from phosphorus, and some species of the latter contain sensible quantities, the amount depending on the excess of phosphorus present in the ores, and the working conditions. Usually such slags contain an excess of iron oxide as compared with ordinary grey iron slags, the latter being generally free from iron oxide or, at any rate, the amount does not exceed ½ per cent. in good slag.

Metallurgical experts have for some time been engaged in devising methods for the removal of sulphur. It is needless here to recapitulate in detail the very many processes tried by them, and for the most part abandoned. All are based on the use, in one way or another, of alkaline or basic materials. However, the experience thus acquired seems to have been utilised, and has led to valuable tangible results, for of late several processes have been worked out with some degree of success, but in our opinion there is still room for improvements, both in cost and general efficiency. In addition, the time and trouble involved in these processes ("which may be classified as methods of secondary purification," *i.e.* methods by which the iron is to some extent freed from sulphur after its production in the blast furnace) are important items seriously impeding further progress. It really seems that the proposed methods of secondary purification may ultimately prove too tedious and expensive, the limit betwixt loss or gain being just now very small. Recognising this, attempts have been made to cheapen the processes, all, however, based on the use of alkaline or basic material, but so far it appears the results are somewhat uncertain.

Mr. Saniter's lime and calcium chloride method, "one of the first recently proposed and tried," has been worked, as the writer can testify, with some success, but the costs, by general consent, are considered somewhat heavy. It is only fair to say that the inventor is not of this opinion, and he quotes reasons to the contrary which should be well weighed before a final opinion is held as to the merits of this process. Secondary processes must from their very nature be costly and troublesome when dealing with the production of thousands of tons of metal continuously flowing from the blast furnace throughout the year.

The earlier attempts to purify crude iron from sulphur, &c., merely paved the way for recent developments, and, on the whole, merely suffice to prove that alkaline or basic substances only can effectively be used. It is now generally admitted that lime is the only base which can be applied with anything approaching economic results, and the methods now being practised have resolved themselves into endeavours to use this reagent efficiently and economically. Manganese as another reagent is an effective desulphuriser, but this requires to be separately investigated.

Lime is, and always has been, used in the blast furnace for the elimination of sulphur from iron; and it is well known that a non-sulphury pig-iron cannot be manufactured unless an excess of lime be charged into the furnace over and above the lime required for the formation of a fluid slag or lime silicate. It is evident, however, that the use is limited owing to the infusibility of the basic slags formed. These are facts which need no further comment, as they are universally acknowledged on all sides. If some modification could be introduced into ordinary blast furnace charging whereby this infusible slag containing an excess of lime could be continuously cleared out of the furnace, we should have at our command a continuous *direct* method of eliminating sulphur from iron at a minimum expenditure, and at a great saving in the time and labour involved in the processes of purification.

JOHN PARRY.

[1] Stead, Iron and Steel Institute.

THE METEOROLOGICAL OBSERVATORY ON BEN NEVIS.

THE Directors of the Ben Nevis Meteorological Observatory have prepared a guide book which will be of great use to the tourist who desires to scale the top of the Ben and feast his eyes upon the crag and mist beneath, and also to the large number of people interested in meteorology. By the kindness of the publishers (Messrs. John Menzies and Co., Edinburgh and Glasgow) we are able to give three illustrations of the Observatory, with an account of its foundation and the work carried on there. For many years it has been recognised that the best means of obtaining definite information as to the vertical variation of atmospheric conditions was to establish meteorological stations differing considerably in altitude but in the same locality. In this connection we read that "in 1877 Mr. Milne Home, then Chairman of the Council of the Scottish Meteorological Society, pointed out the singular advantages of Ben Nevis as a high-level station. It is the highest mountain in the British Islands (4406 feet); its summit is, in horizontal distance, about four miles from a sea-level station at Fort William, and is situated in the track of the south-west storms from the Atlantic, which exercise such a preponderating influence on the weather of Europe, especially in autumn and winter. Its advantages are therefore unique, and observations made there have proved to be of the greatest interest and value to meteorology."

Unfortunately, though a plan of an observatory was prepared by the late Mr. Thomas Stevenson in 1879, for the Scottish Meteorological Society, the work could not be proceeded with for want of the necessary funds. From June to October, 1881, however, Mr. Clement L. Wragge made observations at the summit simultaneously with Mrs. Wragge at Fort William, and an elaborate series of simultaneous observations at different heights on the mountain were successfully made in the two following years. The discussion of these observations led to very important results, and was the means of exciting the interest in the public mind essential to the obtaining of subscriptions. An appeal for funds to enable an observing station to be erected was promptly responded to, a sum of £4,000 being soon collected. A feu of an acre of land was obtained on the top of the mountain from Mrs. Cameron Campbell, of Monzie, and upon it an observatory was erected from plans by Mr. Sydney Mitchell. "The observatory was opened by Mrs. Cameron Campbell on October 17, 1883. Observations were begun in the following month, and have been carried on ever since. At the same time a sea-level station was opened at the public school, Fort William, under charge of Mr. C. Livingston, where comparison readings were taken five times a day with great punctuality and accuracy. But a few years showed the necessity of having a continuous record at sea-level as well as on the summit, and in 1889 the directors resolved to carry out the original plan which want of funds had hitherto prevented, and set up a low-level observatory. Aided by a grant from the Edinburgh Exhibition of 1886 and contributions from the public, they were able to erect a suitable building close to sea-level, on ground feued from Mr. Cameron, of Lochiel, in the beginning of 1890. The Meteorological Council of London equipped this station with self-recording instruments, and increased their annual grant to the directors from £100 to £350. Observations began in the middle of July, 1890, and since then there has been a continuous record of barometric pressure, temperature, humidity, rainfall, &c., by day and by night, both on the summit of Ben Nevis and at sea-level. The distance between the high and low-level observatories is only 4¾ miles, and their heights above sea-level respectively 4407 and 42 feet. Mr. Livingston also continued his observations for a year after the commencement of the low-level observatory, so that there might be a satisfactory comparison of the two sea-level stations. The telegraph wire from the summit has been extended to the low-level observatory, and the observers can communicate with each other at any time, and reports from both stations are sent daily to the newspapers. The high and low-level stations are worked as one observatory, the observers being inter-

changeable, and the low-level serves also as a depôt for stores, &c., which are carried up during the summer to the top." The original buildings on the hill-top were found too small for the double purpose of carrying a set of anemometers and of providing a convenient exit when the winter snows have closed the ordinary doorway.

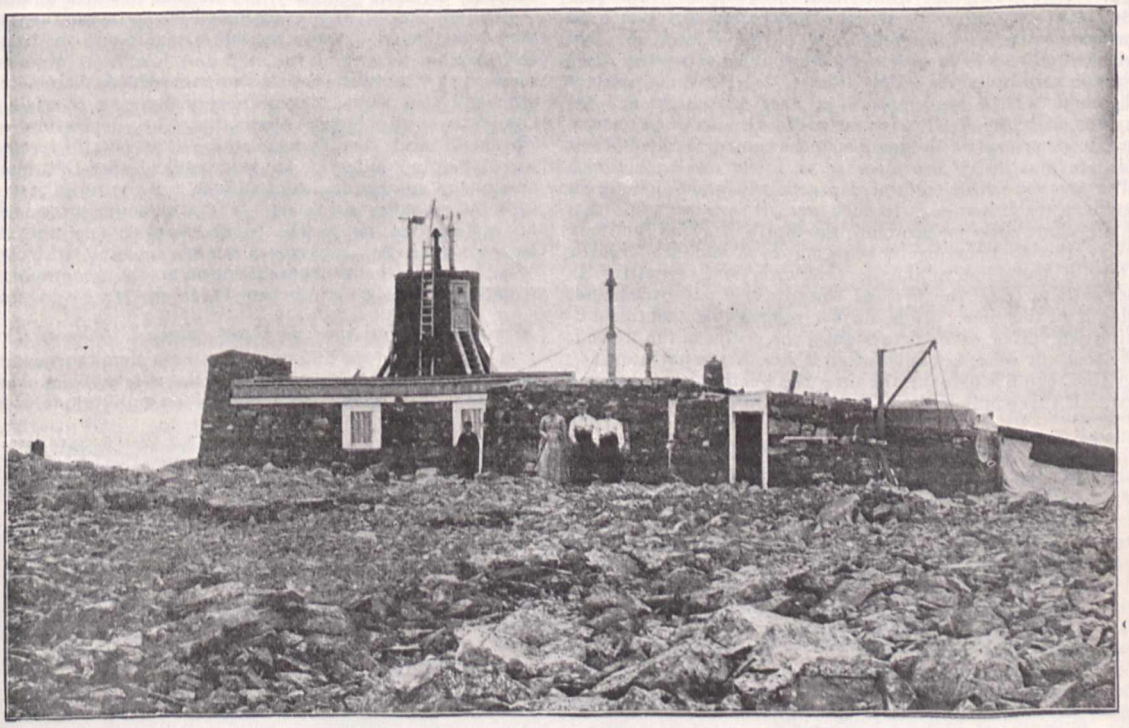


FIG. 1.—The Observatory in Summer.

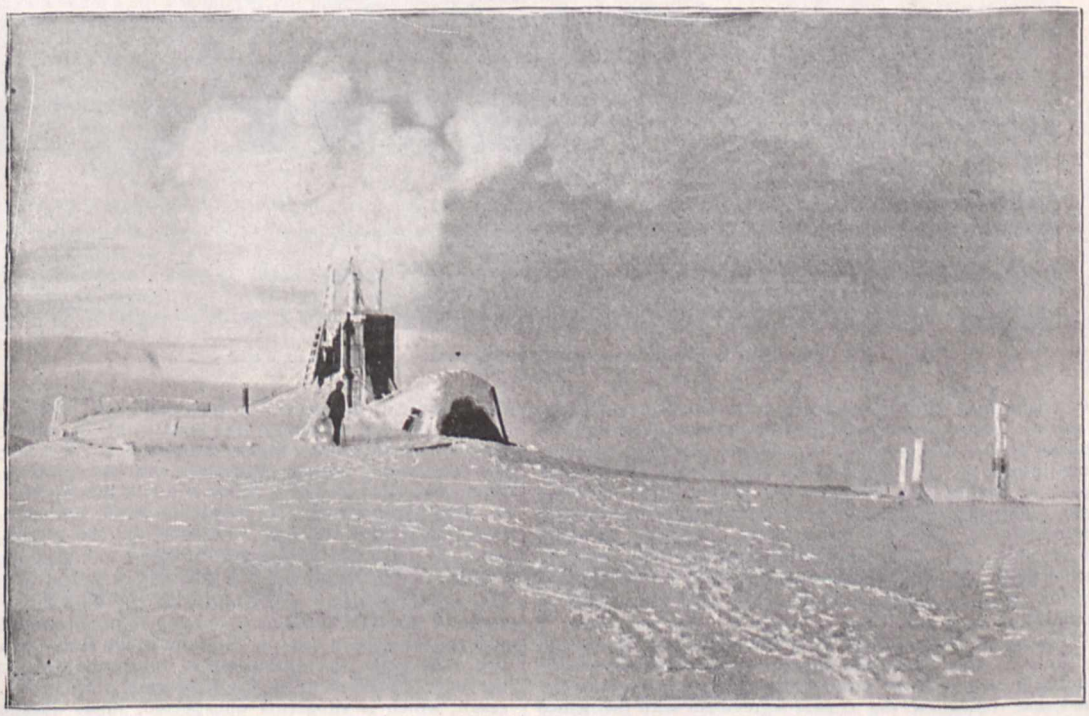


FIG. 2.—The Observatory in Winter.

satisfactorily carrying on the work of the observatory, so in the summer of 1884 large additions were made, the most important being the erection of a tower about thirty feet high, which serves

The Winds of Ben Nevis.

In addition to the routine work, other observations and researches have been carried on by the observers on Ben Nevis.

"An exhaustive examination of the 'Winds of Ben Nevis' has been made by Messrs. Omond and Rankin, and the results published in the 'Transactions of the Royal Society of Edinburgh.' It is shown that while the sea-level winds in this part of Scotland are, with respect to the distribution of pressure, in accordance with Buys Ballot's 'Law of the Winds,' the Ben Nevis winds do not fit in with such a distribution of pressure, but, on the contrary, point to a widely different distribution of pressure at the height of the observatory—4407 feet above the sea—as compared with the distribution at sea-level. In large storms, with a deep barometric depression in the centre, the Ben Nevis winds are practically the same as at lower levels; but with smaller storms, whose central depression is much less, great differences are presented. In such cases it is remarkable that with a cyclone covering Scotland, the North Sea, and Southern Norway, the winds frequently blow, not in accordance with the sea-level isobars, but in the opposite direction, suggesting an upper outflow from the cyclone towards the anti-cyclone adjoining it at the time. It is further remarkable that this outflowing seldom or never occurs when the centre of the storm is to the south or west, but only when it lies to the north or east, or in the region where at the time the weather is coldest and driest. If the wind on the hill-top is not at a right angle or a greater angle from the sea level wind, it is usually nearly the same as it. The supposed veering of the wind at great heights—required by the theory that a cyclone is a whirling column, drawing the air in spirally below and pouring it out spirally above—is so seldom observed as to be the exception, and not the rule. This important result, and the analogous observation that frequently in great storms of winds prostrate trees lie practically in one direction over wide regions, show impressively how much observation has yet to contribute before a satisfactory theory, or even a merely correct description of storms can be propounded.

"The winds at Säntis, Puy de Dôme, and other high-level European observatories, which may all be practically regarded as situated in anti-cyclonic regions, have been examined, and it is found that they show the closest agreement with the winds at low levels in the same regions. This result separates the Ben Nevis Observatory from other observatories, constituting it a class by itself, the differentiating cause being the circumstance that Ben Nevis alone lies in the central track of the European cyclones. This consideration emphasises the value of the Ben Nevis observations in all discussions of weather and atmospheric movements. It may be added that, with respect to the relation of the winds to the low-level isobars, Ben Nevis Observatory is more pronouncedly a high-level observatory in winter than in summer, or, more generally, in cold than in warm weather."

The influence of high winds upon barometric pressure has also been investigated. A comparison of readings of the barometer and anemometer at both the high and low level observatories shows that "in calm weather the two reduced barometers are practically the same, but with every increase of wind which sweeps past the higher observatory the depression of the barometer inside steadily augments. It is not till a velocity of more than 20 miles an hour is reached that the depression amounts to one-hundredth of an inch. At 57 miles it is 0·050 inch, at 77 miles 0·104 inch, and at 99 miles 0·150 inch. In forecasting weather it will be necessary to keep this effect of high winds on the barometer constantly in mind, with the view of arriving at a better approximation to the geographical distribution of pressure at the time the forecasts are being framed."

Relation of Differences of Temperature to those of Pressure.

A discussion of the differences between simultaneous readings of pressure and temperature at the two observatories shows that "during the period of occurrence of an anti-cyclone, when the temperature at the top of the mountain, with reference to that at Fort William, is highest, the pressure at the top, reduced to sea-level, is 0·047 inch higher than at Fort William; and, on the other hand, when the temperature at the top is very greatly lower than the average as compared with that at Fort William, the pressure at the top, reduced to sea-level, is 0·029 inch lower than that at Fort William. There is, therefore, a mean difference of 0·076 inch of pressure for these two distinct types of weather. The broad result is this, and it is clear and explicit, that when the higher observatory has the higher temperature, and also when the differences of temperature are small, then the reduced pressure at the top of the mountain is the greater of the two; but when the differences of temperature are large, then the reduced pressure at the top is the lesser of the two. . . . The result, which is altogether unexpected, raises questions of the greatest importance, affecting the theory of storms, the effect of vertical movements of great masses of air on the barometric pressure which accompanies cyclones and anti-cyclones, and the necessity there is for some accurate knowledge of the absolute amounts of aqueous vapour at different heights in the atmosphere under different weather conditions, and how this know-

FIG. 3.—Observatory covered with Fog Crystals—an Observer at Work.

ledge may be arrived at from the readings of the dry and wet bulb thermometers under different atmospheric pressures. Ben Nevis, with its two observatories, one at the top, the other at the foot of the mountain, would, with a third half-way up the hill, afford unique facilities for the prosecution of this all-important hygrometric inquiry, which would, however, require considerable additions, for the time it is carried on, to the observatories' present appliances and staff."

St. Elmo's Fire and Thunderstorms.

"Cases of St. Elmo's Fire are not infrequent occurrences on Ben Nevis. The cases observed have mostly occurred during the night, and during the winter months from September to February. A careful discussion of these cases shows that the weather which precedes, accompanies, and follows has quite peculiar characteristics not only on Ben Nevis but also over the West of Europe generally; indeed, so well marked is the type of weather, and so notorious is it for its stormy character, that it is familiarly known at the observatory as 'St. Elmo's weather.' It is further observed that in almost every case another cyclone, with its spell of bad weather, follows the particular cyclone on the south-eastern side of which St. Elmo's Fire is observed.

"The winter thunderstorms are observed under the identical weather conditions under which St. Elmo's Fire occurs; that is, they invariably occur on the south-east side of the cyclone's centre, with the easterly passage of which they appear to be intimately connected. The thunderstorms and cases of sheet-lightning of Ben Nevis are essentially autumn and winter occurrences, 70 per cent. of the whole having occurred from September to February."

Electric Currents.

"Prof. C. Michie Smith has shown that on the edge of a dissolving mist the potential is lower than the normal, but higher on the edge of a condensing mist. Now, almost always when the top of Ben Nevis becomes clear for a short time, a strong current comes up the telegraph cable, while as soon as the summit is again enveloped the current is reversed. The connection between the moisture of the atmosphere and the earth currents is still further shown by the rainfall. During a fall of rain or snow the current nearly always passes down the cable; and in the case of a sudden shower the current has sometimes driven the mirror of the galvanometer violently off the scale. A cessation of the rain or snow generally has an exactly opposite effect. If it be assumed that the summit of Ben Nevis takes the potential of the masses of vapour covering it, and if we consider the earth-plate at the base as the earth, or zero of potential, it is obvious that the results confirm the theory advanced by Prof. Michie Smith, a conclusive proof of which would be of the greatest importance in investigations connected with thunderstorms."

Dust Particles in the Atmosphere.

Observations of the numbers of dust particles in the atmosphere have been made by means of the dust-counting apparatus devised by Mr. John Aitken in 1889. The results show a well-defined diurnal period, the number of particles being above the average in the afternoon, and below it in the morning.

"From the whole of the observations on Ben Nevis, the mean is 696 per cubic centimètre, the maximum being 14,400, while on several occasions the minimum fell to 0. In a large number of observations made by Mr. Aitken at Kingairloch, on the west shore of Loch Linnhe, the average number was 1600 particles per cubic centimetre; in London he found, on one occasion, 100,000, and this number was exceeded in Paris."

Many other investigations of a high scientific value have been made by the Ben Nevis observers, and the observations have furnished matter for discussion to a number of meteorologists. But though much has already been done, it is evident from the reports issued by the directors of the observatory from time to time that still more important results can confidently be expected.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE seventh session of the Edinburgh summer meeting ended on Saturday. As regards number of students and scope of studies this meeting is still on the increase. Among the scientific courses may be noticed contemporary social evolution, by Prof. Patrick Geddes, comparative psychology by Prof. Lloyd Morgan, bionomics by Messrs. J. Arthur Thomson and Norman Wyld, history and principles of the sciences by Prof. Cargill Knott, Prof. Geddes, Mr. Bosanquet, and others, physiology of nutrition by Dr. Louis Irvine, a regional survey of Edinburgh and neighbourhood by Mr. J. G. Goodchild, Dr. Beard, Mr. Robert Turnbull, and Mr. S. H. Capper. A healthy sign is the attention given to practical work; thus the afternoon classes of botany, zoology, and geology were wholly practical. The less strictly scientific part of the month's miniature curriculum shows an almost equal development, indeed, so many excellent subjects were offered to the students that it must have been difficult to choose a course of study. Whatever the course selected, however, there is no doubt that the students derived considerable benefit from it.

THE following list of successful candidates for Royal exhibitions, national scholarships, and free studentships, has been issued by the Department of Science and Art:—National Scholarships for Mechanics—William Buchan (Glasgow), Frederick C. Lea (Crewe), James Eagles (Bury, Lancashire), Richard H. Cabena (Glasgow); National Scholarships for Chemistry and Physics—Albert Howard, (Much Wenlock, Salop), Francis R. Penn (Northampton), Andrew N. Meldrum (Aberdeen), William A. Bradley (Lee, Kent), Robert H. Jones (Manchester); National Scholarships for Biological subjects—Arthur O. Allen, (Walthamstow), Robert Sowter, (Brighouse, Yorks); National Scholarships—Charles F. Smith (Glasgow), John B. Chambers (London), John W. Hinchley (Lincoln), Henry J. Loveridge (Southsea, Portsmouth), Bernard C. Laws (Southsea, Portsmouth), Henry T. Davidge (London), Joseph B. Butters (Brighton), Henry H. Clements (Anahilt, Co. Down), Christopher Outhett (Burnley), William Macdonald (Manchester), William N. Platt (Chester); Royal Exhibitions—George S. Blake (Manchester), William H. Atherton, (Newcastle-on-Tyne), Ernest H. Bagnall (Manchester), Frank H. Newman (London), William A. Taylor (Crewe), Joseph H. Ivey (Camborne), Joe Crowther (Brighouse, Yorks); Free Studentships—John Schofield (Huddersfield), Joseph Jeffery (Birmingham), George A. Robertson (Oldham), Charles Kelly (Belfast), John Robinson (Belfast), Edmund F. W. Mondy (London).

SCIENTIFIC SERIALS.

American Journal of Science.—August.—We notice the following papers:—The use of cupric nitrate in the voltameter, and the electro-chemical equivalent of copper, by Frederick E. Beach. Copper nitrate solution of density 1·53 possesses certain advantages over the sulphate in voltameters. It is best to add one drop of saturated NH_4Cl solution. The dependence of the amount of copper deposited upon the current density does not appear until a density of 0·25 ampères per sq. cm. of electrode is reached, and then it is counteracted by adding more NH_4Cl. With the nitrate, the weight of copper deposited is practically independent of the temperature between 10° and 35°. The solution may be used a number of times. The equivalent of copper as determined from the nitrate voltameter agrees to four figures with that calculated from the best chemical determinations. But it is essential that the solution should be pure, and especially free from traces of nitrite.—On Mackintoshite, a new thorium and uranium mineral, by Wm. Earl Hidden; with analysis by W. F. Hillebrand. This is the original mineral of which thorogummite, discovered in 1891, is the alteration product. It is an opaque black mineral of hardness 5·5, and resembles zircon and thorite in form. It differs from thorogummite by the further oxidation of the uranium and the assumption of one molecule of water. It contains three molecules of silica, one of urania, three of thoria, and three of water.—On the reduction of nitric acid by ferrous salts, by Charlotte F. Roberts. The volume of nitric oxide disengaged, swept along by carbon dioxide and collected over caustic soda, was measured for the estimation of nitrates. The best results were obtained by passing the gas through KI solution before collecting, and estimating from the total volume of gas collected. Nitric oxide, being slightly soluble in caustic soda solution, must not be left long in contact with it. When the reaction takes place at high temperatures, some higher oxides of nitrogen may be formed, but this is corrected by the KI solution.—Concerning the struc-

ture of caoutchouc, by Hermann F. Lueders. Caoutchouc has no definite structure *per se*, and all apparent structure is only the result of the conditions under which its coagulation take place.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 21.—M. Lœwy in the chair.—On the equations of motion of a solid body moving in an indefinite liquid, by M. C. Maltézos.—On the alternations of colours presented by gratings, by M. Georges Meslin. If the achromatic fringes previously obtained by the author by means of a grating are observed more and more closely to the latter, they become more and more delicate, and certain colours begin to appear. The black fringes remain dark, but of two consecutive bright fringes the one appears violet and the other yellow; the same phenomena occurs along the whole field, which is covered with these two alternate colours. On moving the microscope slowly forward, a great variety of colours is observed, but the most usual are a mauve-violet associated with yellow, green combined with pink, or blue accompanied by white. The two colours in juxtaposition are thus nearly complementary, and during this displacement the same appearances recur several times, becoming more complex as the distance diminishes. The black fringes become very fine, the interval between two of them closes up, whilst the adjoining interval opens out and splits into coloured bands with a blue, pink, or yellow axis. In every case the phenomenon retains its periodic character. M. Meslin has succeeded in obtaining some very instructive photographs of these fringes.—On two new diseases of the mulberry, by MM. G. Boyer and F. Lambert. One of these diseases is caused by a bacterium, the other by a fungus. The disease caused by the *Bacterium mori*, chiefly affects young nursery mulberries, and arrests the development of their branches. It is manifested by dark brown patches at some points on the under side of the leaves and on the branches. Artificial patches in the parenchyma and in the veins of the leaves have been produced by inoculation. The bacterium when isolated and cultivated on artificial solid media, gives hemispherical colonies passing from white to yellow. The fungus disease is the more common of the two. The buds and leaves wither and dry up. The disease proceeds from the twigs to the branches and the trunk, and finally attacks the roots. The grey colour assumed by the wood is caused by the mycelium of a parasitic fungus not yet completely isolated. The mycelium is varicose, septiferous, and ramified. Its colour passes from white to a pale yellow, and finally to brown.—On the geogeny and stratigraphy of the coal basins of Central France, by M. A. Julien.—The Cambrian of the Herault, by MM. de Rouville, Delage, and Miguel. The authors have recognised three groups in the Herault Cambrian which they provisionally name Anteparadoxidian, Paradoxidian, and Postparadoxidian, corresponding to the Longmynd, Menevian, and Tremadoc groups respectively. In the third group, corresponding to the Tremadoc slates and Lingula flags, traces of Linguläe have been found. An important fact concerning the stratigraphy of the country has been discovered in certain inversions extending over great lengths, unaccompanied by any indication of violent dislocation or rupture.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The State of Para; Notes for the Exposition of Chicago (New York).—A Short Course in the Theory of Determinants: L. G. Weld (Macmillan).—A Treatise on the Theory of Functions: J. Harkness and F. Morley (Macmillan).—A Select Bibliography of Chemistry, 1492-1892: H. C. Bolton (Washington).—Cyclone Memoirs, No. V.: J. Eliot (Calcutta).—Rainfall in South Australia and the Northern Territory, 1892: C. Todd (Adelaide).—Observations of the Transit of Venus, December 9, 1874: H. C. Russell (Sydney).—Alembic Club, Reprints No. 3—Experiments on Air: Hon. H. Cavendish (Edinburgh, Clay).

PAMPHLETS.—Reprint on the Operations of the Department of Land Records and Agriculture, Madras Presidency, 1891-92 (Madras).—The State of São Paulo: A. A. Pinto (Chicago).—Meteorology at the Paris Exposition: A. L. Roth.—The Value of Hypnotism: T. Crisfield (London).—The Geometrical Properties of the Sphere; W. Briggs and F. W. Edmondson (Clive).

SERIALS.—L'Anthropologie, tome iv. No. 3 (Paris, Masson).—Journal of the Franklin Institute, August (Philadelphia).—Astronomy and Astro-Physics, August (Northfield, Minn.).—Quarterly Journal of the Royal Meteorological Society, July (Stanford).—Meteorological Record, Vol. xii. No. 48 (Stanford).—Katalog der Bibliothek der Kaiserlichen Leopoldinisch-Carolinischen Deutschen Akademie der Naturforscher, Liefg. 1 to 3 (Williams and Norgate).—Katalog der Bibliothek der Kaiserlichen Leopoldinisch-Carolinischen Deutschen Akademie der Naturforscher, Vrierte, Liefg. Band II. 8 (Williams and Norgate).—Sitzungsberichte der k. Akademie der Wissenschaften. Math.-Naturw. Classe Enthält die Abhandlungen aus dem Gebiete der Chemie. Abthg. II b. 1892, June, July, October to December (Williams and Norgate).—Sitzungsberichte der k. Akademie der Wissenschaften. Math.-Naturw. Anatomie and Physiologie, &c., 1892, June, July, October to December (Williams and Norgate). Sitzungsberichte der k. Akademie der Wissenschaften. Math.-Naturw. Mineralogie, Krystallographie, &c., 1892 July, October, November, and December (Williams and Norgate).—Sitzungsberichte der k. Akademie der Wissenschaften. Math.-Naturw. Mathematik, Astronomie, &c., 1892, June, July, October, November, and December (Williams and Norgate).—Register zu den bänden 97 bis 100 der Sitzungsberichte der Mathematisch. Naturwissenchaftlichen classe der k. Akademie der Wissenschaften xiii. (Williams and Norgate).—The Journal of the College of Science, Imperial University, Japan, Vol. v. Part 4 (Tokyo).—Journal of the Royal Microscopical Society, August (Williams and Norgate).—Journal of the Marine Biological Association, new series, vol. 3, No. 1 (Dulau).—Journal of the Polynesian Society, Vol. 2, No. 2 (Wellington).—Transactions and Proceedings of the N.Z. Institute, 1892, Vo. xxv. (Wellington).—Ergebnisse der Meteorologischen Beobachtungen, Jahrg. 3 (Bremen).—Journal de Physique Aug. (Paris).—Zeitschrift für Physikalische Chemie, xii. Band, 2 Heft (Leipzig).—Botanical Gazette, August (Bloomington, Ind.).—Bulletin of the U.S. Geological Survey, Nos. 82 to 86, 90 to 96 (Washington).—Jahrbuch der k. k. geologischen Reichsanstalt, Jahrg. 1893, xliii. Band, 1 Heft (Williams and Norgate).—Morphologisches Jahrbuch, 20 Band, 2 Heft (Williams and Norgate).—Mittheilungen von Forschungsreisenden und Gelehrten aus den Deutschen Schutzgebieten, vi. Band, 3 Heft (Berlin, Mittler).—The Asclepiad, No. 38, vol. x. (Longmans).—Journal of the Royal Horticultural Society, vol. xvi. Part 1 (London).—Meteorologische Zeitschrift, 1893 January to August (Wien).—Himmel und Erde, September (Berlin).—Bulletins de la Société d'Anthropologie de Paris, tome quatrième, ive série, No. 7 (Paris).

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