THURSDAY, AUGUST 31, 1876

PHYSICAL SCIENCE IN SCHOOLS

AT a meeting of the British Association five years ago, the subject of science teaching in our higher schools excited unusual interest. Not only were papers read and followed by enthusiastic discussion, but a committee was privately formed, including more than twenty leaders of the association, all of whom undertook to combine in pressing the claims of science on our head-masters, and in offering counsel as to systems and methods, apparatus, and expenditure. Technical difficulties prevented the formal nomination of the committee in that year; and before the next meeting came round the Science Commission was in full work, and the ground was covered. Five years have passed; the Commission has reported; and the British Association, if it deals at all with the problem that lies at the root of our scientific progress, will have to face the fact that only ten endowed schools in England give as much as four hours a week to the study of science; in other words, that in spite of ten years of talk, the *éclat* of a Royal Commission, a complete consensus of scientific authority, and the loud demands of less educated but not less keen-sighted public opinion, the organisation and practical working of science in our higher schools has scarcely advanced a step since the Schools Inquiry Commission reported in 1868.

Are the causes of this strange paralysis discoverable, and are they capable of present remedy? We believe that they are notorious, and that it is in the power of the British Association at the present moment to overrule them. It is therefore in the hope of rekindling a productive enthusiasm at a critical moment in the history of our science teaching that we appeal with all the earnestness of which we are capable to the leaders of the great parliament, whose session will have opened before this day week.

The first obstacle to be understood and reckoned with, is the amazing confusion in the minds of unscientific leaders of opinion as to the very nature of education. An ex-Lord Chancellor gives away prizes to a school, declares in stately terms that Greek and Latin must always form the backbone of high intellectual training, and that the sciences can only be tolerated as a sort of ornament or capital to this great central vertebral column. On the following day an ex-Chancellor of the Exchequer gives away prizes at another school, assures the boys that modern scientific teaching is their being's end and aim, and envies them by comparison with himself, who at Winchester and Oxford basked only in the "clarum *antiquæ* lucis jubar." In all such public utterances chaos reigns supreme. Men take side with one or other branch of mental discipline, unconscious of the Nemesis which waits on the divorce of literature from science, or of science from literature, forgetful of the fundamental truths that all minds require general training up to a certain point, and that the period at which special education should supervene is the problem which awaits solution.

The hostility of the clergy ranks high among the difficulties we have to recognise. To the great public schools this is matter of indifference; but the vigorous head-master of a young and rising county school, who attempts, being himself a clergyman, to make real science compulsory in his school, is rattened by the vulgar heresy-hunters, who swarm in every diocese. The hint and shrug in society, the whisper at clerical conferences, the warning to parents attracted by the school against "atheistic tendencies," keep down his numbers and wear out his energies, till his enterprise becomes a warning instead of an example to his admirers at other schools. In a neighbourhood of rural squires and clergy, untempered by a large town's neighbourhood, and unchecked by any man of education and intelligence holding sovereignty by virtue of superior rank and wealth, a school which treads doggedly in the ancient paths and is flavoured with gentle "High Church tendencies," will certainly succeed even in second-rate hands, while a school which under superior chieftainship asserts the claims of science, and whose theology is therefore suspect, will as certainly long struggle for existence, if it does not finally succumb.

The head-masters, with no inveterate intention, but by the force of circumstances, are potent allies upon the side of nescience. Their position is peculiar. Enlightened, able, high-minded, and most laborious, to speak of them with disrespect would be to forfeit claim to a hearing. But of their whole number not more than two or three know anything at all of science; they have gained honours and supremacy by proficiency in other subjects; to teach well these subjects which they know, forms their happiness and satisfies their sense of duty; and they feel natural dismay at the proposal to force upon them new and untried work which they have not knowledge to supervise, and which must displace whole departments of classical study. Bifurcation they do not mind, for they hope that the dunces will be drafted into the modern school, and the clever boys retained upon the classical side; but the momentous recommendation of the Royal Commission that six hours a week of science teaching should be given to every boy in every school has taken away their breath; it was only once alluded to at the last head-masters' meeting, and then with something between a protest and a sneer. They are too clear-sighted not to see that the demand for science teaching is real, and too liberal not readily to accede to it, if some central authority, which they respect, at once puts pressure on them, and tenders such assistance and advice as they can trust. But, until these two things are done, they will pursue a policy of inaction.

Nor is there any hope that this reluctance of head-masters will be stimulated by exuberant energy on the part of governing bodies. The instances in which these pet creations of the Endowed Schools Commission have appeared before the public hitherto, make it evident that absolute inactivity is the service they are best calculated to render to the cause of education; but their probable devotion to science may be guessed from an incident reported in our columns some months ago, where a body of trustees, composed of country gentlemen of local mark, having to arrange a competitive examination under a scheme of the Charity Commission, adopted the machinery of the University Leaving Examination, but inserted a distinct proviso that no scientific subject recognised by the University Regulations should under any circumstances be taken up by the candidates, either as an alternative or a positive branch of work.

Will the Universities help or impede the spread of school science teaching? The Universities adhere at present to their fatal principle that only one-sided knowledge shall find favour within their walls. A boy who knows nothing but classics, nothing but mathematics, nothing but science, may easily win a scholarship; a boy who knows all three must seek distinction elsewhere; and this rule shapes inevitably the teaching of the schools. The science scholarships at Oxford, of which we hear so much, fall mainly to three distinguished schools; two so large and wealthy that they can overpower most competitors by their expenditure on staff and apparatus, the third planted in Oxford, with access to the University museum and laboratory, and with a pick of teachers from the men of whom examiners are made; and these schools ensure success in science by abandoning other subjects almost or altogether in the case of the candidates they send up. No school which should carry out the recommendations of the Commissioners, by giving six hours a week to science, and the rest of its time to literature and mathematics; no school which should realise its function as bound to develop young minds by strengthening in fair proportion all their faculties of imagination, reason, memory, and observation, could offer boys for any sort of scholarship under the present University system with the faintest chance of success.

What these institutions are powerful to avert or helpless to bring about is, we repeat, within the scope of the British Association to effect. All institutions, political or educational, will bow to a strongly formed committee of scientific men, formally commissioned by the Association and speaking with authority, delegated as well as personal, on scientific subjects. Let such a Committee be revived as died on paper in 1871, including the acknowledged leaders of pure science, and weighted with the names of such educationalists as have shown themselves zealous for science teaching. Let their functions be—first, to communicate with the head-masters and governing bodies, calling attention to the recommendations of the Duke of Devonshire's Commission, asking how far and how soon each school is prepared to carry these out, and tendering advice, should it be desired, on any details as to selection and sequence of subjects, teachers, text-books, outlay. Secondly, let them appeal to the Universities, to which many of them belong, as to the bearing of science scholarships and fellowships upon school teaching, and the extent to which such influence may be modified or ameliorated in that re-arrangement of College funds which next session will probably be commenced. Thirdly, let them be instructed to watch the action of Government in any proposal made either in pursuance of Lord Salisbury's bill, or as giving effect to the Duke of Devonshire's Commission, and let them be known to hold a brief for school science in reference to all such legislation. A single meeting of such a committee before the Association separates would settle a basis of action and compress itself into a working subcommittee. The time for papers and discussions is past; they have done their work. What the schools and the head-masters want is authoritative guidance; the guidance not only of a blue-book, but of a living leadership, central, commanding, and accessible, to which they may look with confidence, and bow without loss of prestige.

The precision of its dicta will clear up public confusion; its ability, conscientiousness, and popularity will overawe the clergy; schools and universities will listen respectfully to suggestions echoed by their own best men; and the three great departments of intellectual culture, equal in credit, appliances, and teaching power, will bring out all the faculties, and elicit the special aptitudes of every English boy.

"Hinc omne principium, huc refer exitum!"

HANBURY'S REMAINS

Science Papers; chiefly Pharmacological and Botanical. By Daniel Hanbury, F.R.S., &c. Edited, with Memoir, by Joseph Ince. (London: Macmillan and Co., 1876.)

A NOT inconsiderable contingent to the army of workers in science has been furnished by London trade. The ranks of our geologists, zoologists, and biologists, have been recruited to a larger extent than many might suppose from city counting-houses. But one would still hardly expect to find the same wholesale chemist's shop in an obscure court out of Lombard Street send forth, in two successive generations, two Fellows to the Royal Society. Except, however, in their common love of science, Daniel Hanbury was a very different man from William Allen, the druggist and Quaker preacher, the lecturer on chemistry and intercessor on behalf of the rights of conscience with almost all the "crowned heads" of Europe.[1] Retaining through life a warm attachment to the religious body in which he was born, Hanbury's religion was nevertheless of the closet rather than the forum; few of his friends ever heard him speak on religious subjects; and anything in the shape of proselytising was altogether alien to his mental constitution. Essentially a specialist, he was at the same time, what the best specialist must always be, an educated gentleman.

From the time when, as a very young man, he contributed his first essays to the *Transactions* of the Pharmaceutical Society, till his death at the early age of forty-nine, when a long career of usefulness seemed to be before him, the object to which Hanbury set himself was the clearing up of uncertain or disputed points regarding the botanical origin of drugs known to the pharmacopœias of this and other countries. Notwithstanding what he and fellow-workers on the Continent have done, it is surprising to find in how great obscurity the history is still involved of many medicinal substances which are daily prescribed by physicians and dispensed by druggists. The larger portion of the present volume is occupied with papers bearing on questions of this nature; those which will probably be found of the greatest value to posterity are:—"On the Different Kinds of Cardamom used in Commerce," "On Liquid and Solid Storax," "On the Source of Balsam of Peru," "Historical Notes on the *Radix galangæ* of Pharmacy," and "On the Determination of *Pareira brava.*"

Hanbury's inquiries were characterised, above all things, by extreme thoroughness. No amount of research,

[1] Mr. Luke Howard, F.R.S., the eminent meteorologist, was also, for a short time, a partner with Allen.

no amount of personal labour, was spared to clear up or elucidate the smallest point bearing on the subject he was engaged in investigating. A good illustration of his mode of working is furnished by a paper read before a meeting of the British Pharmaceutical Congress held at Brighton, in 1872, "On Calabrian Manna." Manna is stated, in the "British Pharmacopœia" of 1867, to be "a concrete saccharine exudation from the stem of *Fraxinus Ornus*, L., and *F. rotundifolia*, D. C., which trees are cultivated for the purpose of yielding it chiefly in Calabria and Sicily." Never having heard of manna plantations in Calabria, nor seen Calabrian manna, Hanbury determined, after having acquainted himself with the literature of the subject, ancient and modern, to visit Italy himself in order to set the question at rest. At Florence he found the article almost unknown. Reaching Rossano, a town in Calabria Citra, he there found that the manna trees grow on some of the adjacent mountains, but are not cultivated; and that the collecting of the manna is a very small and insignificant branch of industry. "The habits of the Calabrian peasantry," he naïvely observes, "are such that it is impossible for travellers to quit the high roads without personal danger." At Corigliano, which, according to Murray's "Handbook," produces "the finest manna in Calabria," the industry is altogether extinct. At Cozensa, the capital of the province, anciently renowned for manna, he found the substance almost unknown to the druggists, one of whom assured him that its collection had been prohibited for the last six or seven years. Finally, a prominent English merchant at Messina was ignorant of the existence of such a commodity. The conclusion to which Mr. Hanbury came was that Calabrian manna has practically ceased to exist as an article of commerce, and that its collection in that part of Italy is on the verge of extinction. With regard, also, to De Candolle's species of manna-ash, *Fraxinus rotundifolia*, Hanbury's observations on the spot induced him to believe that while the *F. Ornus* is a very variable plant, there is no special form of it, and still less any distinct species, answering to the characters of *F. rotundifolia*.

By similar exhaustive investigations, Mr. Hanbury determined various other pharmacological questions of greater or less importance, of which two may be specially mentioned. In his paper on Storax, he shows that while the substance known under this name in ancient times was obtained from the *Styrax officinale*, L., it has altogether disappeared from the commerce of modern days, the resin now known as liquid storax being—notwithstanding erroneous assertions to the contrary in some writings of high authority—the product of a totally different tree, *Liquidambar orientale*, Mill., a native of the south-west of Asia Minor, where the drug is collected. The drug known in the British Pharmacopœia as "*Pareira brava*," was referred by most writers, without question, to the stem and root of *Cissampelos Pareira*, L., a climbing plant of the order Menispermaceæ, growing in the tropical regions of both the Old and New World. A scarcity of the article induced Mr. Hanbury, some years ago, to endeavour to obtain a supply from the West Indies. Having been furnished with the stems and roots of the plant in question, not only from Jamaica, but also from Trinidad, Ceylon, and Brazil, he soon discovered that the accepted statement was altogether erroneous. He then set himself to discover what "*Pareira brava*" really is; and a careful examination of the different descriptions by botanists and travellers, and of specimens obtained from various correspondents, led him to identify it with *Chondodendron tomentosum*, Ruiz et Pav., a native of Brazil, belonging to the same natural order. Mr. Hanbury was in the habit of preserving and carefully labelling, in his own museum, specimens of anything that could bear on the subjects of his inquiries; and his investigations were greatly assisted by unusual opportunities for growing foreign plants furnished by an extensive garden with abundance of glass, cold and heated, in one of the suburbs of London. Here was a true "botanic garden" to delight the heart of a pharmaceutist.

Mr. Hanbury's presence is sorely missed by his fellow-members of the various learned societies to which he belonged, especially of the two from the meetings of which he was seldom absent—the Pharmaceutical and the Linnean; where his varied information was constantly giving life to the discussions, his urbanity of manner smoothing down any difference of opinion, and his business habits ready to assist at a critical moment. The last few months of his life saw the publication of his most substantial contribution to literature, the "Pharmacographia," brought out in joint authorship with his friend Prof. Flückiger, of Strasburg, to the importance of which these pages have already called attention.

DYNAMITE

Die Dynamite, ihre Eigenschaften und Gebrauchsweise. Von Isidor Trauzl. (Berlin: Verlag von Wiegandt, Hempel, und Parey, 1876.)

THE instructive brochure published under the above title affords an interesting illustration of the wide-spread applications now received by those violent explosive agents, nitroglycerine and gun-cotton, the practical value of which was regarded as doubtful even twelve years ago, by all but the few who devoted themselves indefatigably to the development of the manufacture, purification, and application of those substances. Capt. Isidor Trauzl has for some time past been intimately connected with the dynamite industry on the Continent, and is a very intelligent exponent of the properties and uses of the nitroglycerine preparations which owe their origin to the sagacity, ingenuity, and untiring labours of Alfred Nobel. The endeavours of Nobel to overcome the uncertainty and danger attending the application of nitroglycerine in its undiluted condition as an explosive agent, were eventually crowned with success by his elaboration of the plastic nitroglycerine preparations known as *dynamites*, of which the earliest, and that specially known as Nobel's dynamite, consists of the infusorial earth, *kieselguhr*, mixed with about three times its weight of nitroglycerine, which it holds absorbed, even under considerable variations of temperature, if the preparation be carefully manufactured. This material is the most violent nitroglycerine preparation now in use; it closely resembles Abel's compressed gun-cotton in explosive power as well as in regard to its action, and it is now very extensively used in all parts of the world, for mining, engineering, and other industrial purposes.

Capt. Trauzl's volume is specially and mainly devoted to the consideration of one particular class of operations to which dynamite, like gun-cotton, has recently been applied with considerable success, namely, to the removal of tree-stumps from forest-ground which is being cleared, as also to the felling of trees, the removal of piles, and similar operations. By the judicious application of these explosive agents, tree-stumps may be removed with much greater expedition than by manual labour, and the experimental results collected by the author, with special reference to this utilisation of dynamite, will be found valuable to large landowners or to those engaged in clearing land in new settlements. Many of the data given by him in regard to this application of dynamite, are confirmed by corresponding results obtained in this country in extensive experiments with both gun-cotton and dynamite.

The special information with regard to the removal of tree-stumps, &c., is prefaced by a concise account of the properties of dynamite and of the methods of preparing and exploding dynamite charges. Capt. Trauzl has done well to direct special attention to the necessity for care in handling dynamite, and especially in carrying out the essential operation of thawing frozen dynamite, the careless or ignorant performance of which has given rise to many frightful accidents. It has unfortunately been the practice with many whose interests are identified with the sale of explosive preparations of this class, to lay undue stress upon their great safety in transport and use, as compared with gunpowder, and thus to foster, to a very lamentable extent, the tendency to recklessness which is specially prevalent among the class of people who have to employ those explosive agents.

Capt. Trauzl concludes with a chapter on the application of dynamite to the breaking up of ground for agricultural purposes. It appears doubtful whether even the less violent forms of dynamite, the employment of which is suggested for this purpose (for which a comparatively gradual explosive effect is most advantageous) are likely to prove superior to gunpowder for this special application.

OUR BOOK SHELF

The Crimea and Transcaucasia; being the Narrative of a Journey in the Kouban, in Gouria, Georgia, Armenia, Ossety, Imeritia, Swannety, and Mingrelia, and in the Tauric Range. By Commander J. Buchan Telfer, R.N. Maps and Illustrations. Two Vols. (London: King and Co., 1876.)

THE author of this work took advantage of a three years' residence in Southern Russia to make acquaintance with the region to which his work refers, and which is pretty adequately indicated in the title. He does not, however, give a regular narrative of the visit he made to various places at various times, but arranges all the information he has collected along a route supposed to occupy ninety-two days. In this way a large tract of ground is gone over systematically, commencing at Sevastopol, visiting the surrounding district, coasting and touching at several places in the Crimea, crossing over to Circassia, coasting south to Poti, and penetrating through Mingrelia, Imeritia, and Georgia, south to Mount Ararat, and as far north as the country of the Ossety and the Swannety. Although no doubt many travellers pass through these countries, yet they have really been little explored, and in Commander Telfer's work will be found much information that, we are sure, will be new to the majority of readers. His account of the Swannety, especially, a curious mongrel, half savage people, to the north of Mingrelia, will be somewhat of a surprise to many. But the author has trusted not only to his own observations; he has taken evidently great pains to make himself master of all that is known of the history and antiquities of the region to which his work refers. This information he judiciously mixes up with his own observations, and the result is a work which may be regarded as a standard book of reference for the extremely interesting districts to which it refers. With its two good maps and its many illustrations, and its substantial and attractively put together information, it ought to take a prominent place among works of travel.

LETTERS TO THE EDITOR

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

The Basking Shark

IN NATURE, vol. xiv. p. 313, Prof. E. Perceval Wright gives some account of the Basking Shark, with especial reference to the curious pectinated appendages which lie along the branchial arches of that huge fish. His paper is illustrated by a characteristic woodcut from a drawing by Prof. Steenstrup, who had recently described these appendages, and who finds that they were alluded to by Bishop Gunnerus, about 100 years ago. Prof. Wright also gives a very interesting original figure of one of the branchial arches with the appendages attached.

Prof. Wright's notice will be welcomed as a further contribution to the history of a very remarkable and little-known structure. In one point, however, his description will need correction, for he speaks of the appendages in question as composed of a whalebone-like substance. They are nevertheless essentially different from whalebone, and were it not for their whalebone-like colour and for their pectinated arrangement, somewhat like that of the balene-plates of a whale, their comparison with whalebone would scarcely have suggested itself. Though elastic, they are hard and brittle, and when bent beyond a very limited angle, they snap like a plate of steel.

In consequence of the rarity of the opportunities afforded to anatomists for the examination of the Basking Shark, the pectinated appendages have hitherto received but little of the notice which is due to such a singular anatomical character, and the readers of Dr. Wright's communication might easily believe that since the days of Bishop Gunnerus no one but Prof. Steenstrup and himself had called attention to their existence.

It is now more than thirty years ago that in a communication to the Dublin Natural History Society I placed on record the capture of a Basking Shark on the south coast of Ireland and described the pectinated appendages as fully as the mutilated state of the specimen would allow. Since then I have in vain watched for an opportunity of further investigating the anatomy of the great shark.

The following is the abstract of this communication, published at the time in *Saunders's Newsletter*, which was then the vehicle for the proceedings of the Society. It contains perhaps little which has not been since noticed by Prof. Steenstrup and Prof. Wright, but I may nevertheless be permitted to quote it in order to show that the subject has not been so entirely ignored as the readers of Dr. Wright's paper might suppose:—

"A paper was read by Mr. Allman upon the recent occurrence on the Irish coast of the great Basking Shark, *Selachus maximus*, Cuv. This fish had been entangled in the trammels of the fishermen, and towed into the strand at Coolmain, on the southern coast of the county of Cork, when it was almost immediately cut in pieces by the country people with the expectation of obtaining oil from it. . . . The principal object of Mr. Allman's communication was to notice an interesting fact in the anatomy of this fish, which had not been hitherto described. The fact alluded to was the existence along each of the branchial arches of a very curious and beautiful pectinated structure consisting of a series of narrow elastic laminæ arranged with great regularity, and constituting along each gill a kind of grating bearing a close resemblance to the teeth of a comb. The laminæ of which this grating is composed become gradually narrower from their fixed to their free extremities; they are of a dark olive colour, of a hard texture, and highly elastic, but at the same time brittle, and easily snapping off when urged beyond a certain point.

"The office which Mr. Allman assigned to these branchial appendages was that of strainers, by which the water before coming in contact with the branchiæ is freed from extraneous bodies, which would otherwise interfere with the functions of respiration. The objection which might be urged to this view, namely, that the other sharks are without any such arrangement appeared to him of no weight, as we know but little of the habits of the Basking Shark, and as those which we do know would lead us to believe that the structure just described is admirably adapted to the fish's peculiar mode of life. The Basking Shark must be entirely free from the voracious disposition so characteristic of the allied genera. Its teeth are little more than tubercles, and quite unfit it for the life of carnage led by other sharks. Its food must accordingly be found among the less resisting inhabitants of the ocean; and as the Basking Shark will therefore be driven to feed near the bottom and among seaweeds the existence of the branchial appendages will admit of an easy explanation. We must thus at once perceive the admirable adaptation of this interesting arrangement to the habits of an animal which would otherwise be subjected to the constant annoyance of having its branchiæ clogged with the floating fronds of sea-weeds, a circumstance which the anatomical structure alone would otherwise render more liable to occur in this than in the other sharks, as the openings to the branchiæ in the *Selachus maximus* are of enormous size, and the branchiostegous membranes particularly loose." GEO. J. ALLMAN

The Birds of Kerguelen Island

MY attention has been called to a review of Dr. Kidder's "Report on the Ornithology of Kerguelen Island," in NATURE of the 10th instant (p. 317, *supra*). Will you kindly permit me to express regret that the reviewer should have alluded to priority of publication of the results of the American and English expeditions to that island? To many persons his remarks on this point will appear to be ungenerous and needlessly sarcastic to the foreign naturalists. The subject is a delicate one, and I am sorry to have occasion to mention it, especially as an Englishman should be the last to approach it.

The reviewer will doubtless admit that when three naturalists are simultaneously sent to work independently of one another in the same neighbourhood, it is almost inevitable that one will anticipate the work of the others, and yet that there is nothing to boast of if he does. In the present instance, being bound to regard the interests of my employers in my collection, I hastened the issue of preliminary diagnoses of the novelties contained in it, to secure their types from alienation to foreign museums. The result of this was the acquisition by the English of the types of all the new species in my collection excepting those of one bird (which has recently been described as new by the Germans), and those of two Annelids, and three lichens, and perhaps a moss pre-occupied by the Americans. We could well have afforded to lose nine or ten times as many, and should still have retained a fair proportion of the whole number for English museums. The reviewer, therefore, might have done well if he had censured the rapacity of the English in grasping the lion's share of the type-specimens; but it was rather too bad of him to attribute to my fellow-workers small feelings of jealousy with reference to the Americans being the first in the field with their final reports, of which they are not conscious. The Americans have kept us fully informed as to the progress of their reports during the period of their preparation, by letter and by the transmission of advance sheets; and the English final reports will no doubt be ready at the time appointed by the Royal Society. If the Germans publish their results in the meanwhile, we shall have the advantage of including references to their work among our citations.

The reviewer is perhaps unaware of the publication of another Bulletin by the Americans, containing, amongst other information relating to Kerguelen Island, further ornithological particulars. It was issued more than a month ago.

A. E. EATON
Naturalist accompanying the English Transit of Venus Expedition to Kerguelen Island in 1874

Aug. 24

Antedated Books

I AM ready to give the Editor of the Zoological Society's *Transactions* credit for desiring to set a good and not a bad example; but, since a man seldom thinks that which he does to be wrong, the simple assertion of his opinion that it is the former and not the latter is not enough. Whether the papers in those *Transactions* are antedated by one month (as he admits) or by several months is merely a matter of detail. The practice of antedating is equally faulty in principle. If their editor would add the correct date of publication on the covers of the several parts, as is done with the *Proceedings* of the Royal and the *Journal* of the Linnean Society, he might give whatever date he pleases anywhere else as that of his latest revision.

ANOTHER F.Z.S.

Earthquake in Nithsdale, Scotland

ON the morning of the 12th current, at 3 o'clock, Mr. Robson, of the schoolhouse of Penpont, Dumfriesshire, was awakened by a sharp shock of earthquake and heard its detonations. On inquiry the same shock had been felt at the schoolhouse of Tynron, by Mr. Laurie; and over an area of several parishes around the upper course of the Nith the shock was felt, causing walls to vibrate and cupboard dishes to tingle. Two concussions of less violence were felt between 11 and 12 o'clock on the previous evening. The morning papers of the 14th report that a severe shock of earthquake had been felt at Athens on the morning of the 12th. It would be interesting to know the exact time when the shock was felt in Greece. On April 16th, 1873, at 9.55 P.M., a similar shock to that experienced last week was felt in the same districts of Nithsdale. I recollect communicating a short notice of it to NATURE at the time, as I had heard the strange sound, but on this occasion I did not hear it.

Tynron Schoolhouse, Aug. 23 JAMES SHAW

P.S.—Since writing the above I have received confirmation of the event from several other reliable witnesses. It seems to have been most plainly felt in the parishes of Morton, Penpont, Keir, Tynron, and Glencairn, to the west of the Nith. J. S.

The Cuckoo

THE usual manner in which the cuckoo in June "alters his tune," is by doubling his first syllable, and the "cuc-cuckoo, cuc-cuckoo" is then usually, if not always, followed by the single "cuc." This is certainly the case both near London and in the Midlands. E. H.

ABSTRACT REPORT TO "NATURE" ON EXPERIMENTATION ON ANIMALS FOR THE ADVANCE OF PRACTICAL MEDICINE[1]

VII.

THERE occur to me a few other illustrative series of researches, in which scientific and practical medicine have been advanced by experimentation on the lower animals. Some of these I will state in terms as brief as possible in the present paper.

Experimentation in respect to the Disease called Cataract.

Dr. Weir Mitchell, of Philadelphia, in the year 1869, made the original and remarkable observation that if a part of the body of a frog be immersed in simple syrup, there soon occurs in the crystalline lens of the eyeball an opaque appearance resembling the disease called cataract. He extended his observations to the effects of grape sugar, and obtained the same results. He found that he could induce the cataractic condition invariably by this experiment, or by injecting a solution of sugar with a fine needle, subcutaneously, into the dorsal sac of the frog. The discovery was one of singular importance in the history of medical science, and explained immediately a number of obscure phenomena. The co-existence of the two diseases, diabetes and cataract, in man, had been observed by France, Cohen, Hasner, Mackenzie, Duncan, von Graafe, and others, and von Graafe had stated that after examining a large number of diabetic patients in different hospitals, he had found one-fourth affected with cataract. Before Mitchell's observation there was not

[1] Continued from p. 341.

a suspicion as to the reason of this connection, and a flood of light, therefore, broke on the subject the moment he proclaimed the new physiological fact. Still more Mitchell showed that the cataract he was able to induce by experiment was curable also by experiment, a truth which will one day lead to the cure of cataract without operation. Then, but not till then, the splendid character of this original investigation, and the debt that is due to one of the most original, honest, laborious workers that ever in any age cultivated the science and art of medicine, will be duly recognised.

When the news of Mitchell's discovery reached us here, I took up the investigation at the point where he had left it. The fact he had announced was found to be indisputable. From a patient in one of our large hospitals, who was suffering from diabetes and double cataract, a specimen of the sugar excreted was obtained, and from that specimen the cataractous disease was induced in the frog, and afterwards removed. The experiment was conducted with the animal kept in an anæsthetic atmosphere, and was found to answer just as well as in the ordinary atmosphere; in fact, the experiment succeeded best with frogs when it was rendered free of all pain, as spasmodic movements, which may occur if the process of production of cataract is rapid, and which may suddenly kill, are prevented. Since the introduction of chloral hydrate, that anæsthetic has become a still more useful agent in this research, since its own action runs in line with the experiment, and the anæsthetic can be introduced in actual combination with the substance producing the cataract.

In warm-blooded animals I learned that the cataractous change could be brought about immediately after death. Several of the experiments were made therefore on the head of the sheep after the animal had been killed at the slaughter-house in the ordinary way, the fluid being injected through an artery. In other warm bloods the death was first induced by one of the anæsthetic vapours, and the fluid used was either injected into the peritoneal cavity or through the aorta.

The line of research which I carried on in continuation of Dr. Mitchell's discovery was for the purpose of determining the cause of the cataractous change and the influence of other agents in producing it. It occurred to me that the change was possibly due to the influence of saline matter on the pure colloidal lens, and if this were true the cataract ought to be induced by other substances than sugar. Any of the soluble crystalloids might produce it, and as there are many of these in the blood, there might be other cataracts than such as are produced by sugar in the diabetic subject. The research was therefore pursued with all the soluble salts belonging to the blood, and with the result of producing cataractous change with them all. In the end it was deduced that whenever the specific gravity of the blood is raised, by the presence of saline matter in it, to 10 degrees above the normal standard, and is sustained in that state for a short time, cataract is the result, and is maintained so long as the blood continues of the same specific weight. It was also found that the cataractous condition caused by the soluble blood salts was removable on the elimination of the added saline and the reduction of the blood to its natural equilibrium. At the same time there was observed to be a difference in the characters of the cataracts produced. Some of the saline cataracts were harder than the sugar cataracts and less easily curable. Those salts which are most fixed in their chemical constitution and at the same time are most soluble, produce the hardest cataracts. Those salts which are most easily decomposed, such as urea, are least effective in inducing the pathological change.

The change was found to commence, as a rule, in the posterior part of the lens, and after beginning as an imperfectly defined hazy spot it extended gradually through the whole structure, causing a pearly whiteness and complete opacity. In the process of cleaning of the lens the posterior part was the last to become transparent, but without exception the whole structure of the lens regained its crystalline clearness and its perfect function when the specific weight of the blood was reduced to its natural standard, if the circulation of fluid through the lens continued.

In these experiments two illustrious scholars, now lost to science, took the warmest interest, the late Professor Graham and the late Sir David Brewster. Both lent to me their valued observation. Graham saw in the experimental facts the first application in physiological pathology of his great discovery of the mutual action of colloidal and crystalloidal substances. Sir David drew some most ingenious inferences as to the physical cause of the opacity, tracing it to a process of crenation on the margins of the fibres of the lens. The greatest interest was naturally excited throughout the medical profession. In this production of cataract the first visible demonstration was offered of the synthesis of a well-known disease. It is now certain that if the specific gravity of the blood be raised rapidly a few degrees by a crystalloidal substance, cataract is the direct result. Recently Dr. Sansom saw this event in the case of a young woman suffering from diabetes, who became, in a few days, stone blind from cataract in both eyes; and, indeed, the cause of diabetic cataract is now made quite plain. But the end of the discovery is not reached with this fact, important though it be. The mode of production, in man and the lower animals, of the slowly advancing cataract, from which so many persons are rendered permanently blind, is after the same process, with a different saline, acting in a slower degree; and the inference is fair that some particular forms of diet are conducive to the disease. When the whole series of facts which Mitchell commenced to unfold are completed, the disease cataract will be understood in full. Its physical pathology is already understood, and if the operative art of the surgeon be not quenched by another mode of cure resulting from his discovery, it will be by the better art of prevention of the disease.

Experimentation on Pectous Changes.

The observations on cataract above described led me to follow out other lines of inquiry in respect to the action of saline substances on living and dead colloidal matter. I thus found that when a saline solution of a colloid, such as albumen, is brought into contact with a living colloidal structure like the peritoneum, the saline solvent is rapidly removed into the circulation, and the colloidal plastic substance is left on the true membrane as a false membrane, by which contiguous membranes are agglutinated together. I found further that if the blood or serous part of the blood in a fluid saline condition exudes into a serous cavity, the same simple physical process goes on, the saline and watery parts, including the colouring matter of the blood, passes back into the circulation through the membrane and the colloidal fibrine and albumen are left in form of false membrane or of band, on the true membrane. The experiment illustrates how inflammatory exudations, as they are called, are produced, and how adhesions and adhesive constrictions are formed after inflammatory serous diseases. The experiments on animals by which these results were arrived at, were all conducted under anæsthesia, and were perfectly painless.

In another analogous series of inquiries conducted in the same manner, I found that if the blood were surcharged with urea, a portion of albumen would pass out of the body by the urinary secretion without the institution of any marked morbid change in the structure of the kidney. This fact led me to ask whether albumen diluted with water and charged with urea would pass through a dead membrane, by dialysis, and I found it would. These facts have bearings of the most singular kind on the disease albuminuria. They show, amongst other things, that the presence of albumen in the renal secretion is not, of necessity, a sign of structural disease of the kidney as has been supposed, and they account for the anomalous illustrations that are met with of temporary albuminuria as a disease. The experiments explain also the cause of that coagulation of the blood which occurs during those exhaustive diseases, such as cholera, in which the saline and watery parts of the blood are drained away.

The same line of research suggested to me a new experimental reading, conducted by experiment on dead animal matter, of the cause of the pectous change called, commonly, coagulation. This change I find is always produced in fluids containing soluble crystalloidal matter, colloidal matter, and water, whenever the relationship between the colloid and the water is disturbed by modification of the crystalloid. The crystalloid forms the connecting link by which the water is held in fluid combination with the colloid. If the crystalloid be withdrawn, then the molecular attraction of the colloid for its own parts commences, and the contraction called coagulation is set up with expulsion of water from the clot by the contraction of cohesion. If, on the other hand, crystalloid be added in excess, so as to absorb an excess of water, coagulation is also set up. Or again, if water held by condensation in a saline solution of a colloid—as the fibrine is held in the living blood for example—be allowed to escape, coagulation is the result.

Connected with these studies, but carried out long before them, are some experiments I made with urea, in which, by hypodermic injection of that animal salt, in free quantities, into the body of an animal, symptoms of unconsciousness and convulsion, like the symptoms of uræmic poisoning which occur in some cases of scarlet fever, were induced. The result to practice from these researches was to discover that the symptoms were removable by the abstraction of a little blood, and the application of this practice in examples of uræmia in man, has been the means of directly saving several lives. The result to physiological science was the fact that when from any circumstance the living blood is charged with a soluble saline body much beyond what is natural, the effect is a convulsion which recurs at intervals, as if the blood surcharged with the salt were conducting some exciting current to the muscles so rapidly that the reserve store of force in the nervous centres ran down or was completely discharged at once and had to wait to be re-supplied, at the end of each discharge, before another convulsion could be excited.

Dilution of the Blood and Feeding by the Veins.

In two great epidemics of cholera which I observed, it was impossible not to see that the cause of rapid death was, in most cases, the sudden reduction of the amount of water in the body. In some instances where all consciousness appeared to have passed away and death was declared, the recurrence of movements in the limbs of the apparently dead, suggested that in the strict sense of the word there was remaining life. In some instances the effect of injecting saline solutions into the veins had such an astounding temporary effect in bringing back the consciousness, it seemed as if we had in our hands a sure remedy, if we knew how to use it, for the worst forms of the fearful malady. The practice led me to experiment on the possibility of introducing water into the body by other channels than the veins, so that it might be gradually absorbed and might re-supply what was being lost by the watery discharges from the bowels. I therefore, in 1854, injected distilled water into the cellular tissue of anæsthetised animals subcutaneously, and also into the peritoneal cavity. The difficulty of introducing any sufficient quantity into the cellular tissue prevented that method from being followed; but with the peritoneum it was different. Into the peritoneal cavity I found not only that water, at the temperature of the body, can be introduced, through a hollow needle, without any danger whatever, but that the fluid is rapidly absorbed, and may be absorbed until as much as amounts to the fifth part of the weight of the animal is introduced into the organism. The difficulty I encountered in bringing into practice this simple means of re-supplying the body with water in cholera, lay in the fear that was expressed respecting injuries to the peritoneum. The plan was nevertheless once tried in a hopeless case in the human subject in 1854, and with perfect success in promoting recovery. At the present time, with our improved instruments for injection, and better knowledge of operations on the peritoneum, the method would be certainly applied in another outbreak of acute cholera, and I believe with most successful results. Beyond the directly practical, physiology gained a point by these researches. The experiments showed that when the blood is diluted by the addition of water, beyond a fifth of the weight of the animal, *i.e.*, by the addition of a pound of water to the blood of an animal weighing five pounds, an unconscious condition of the body is induced, with sleep, with paralysis of muscle, with reduction of temperature, and with death, if the natural balance be not quickly restored. Still further by pursuing the investigation into a comparison of the specific weight of the blood, and the specific weight of a fluid excretion such as the urine, I found that in some forms of serous dropsy attended with a very low specific weight of the fluid excretions, the blood when reduced in specific weight approaching to the specific weight of the secretions, is thrown out with the utmost ease into the serous cavities by the pressure of the circulation, is not returned by the osmotic ingoing current back into the circulating channels, and so accumulates in the serous sacs, giving rise to the phenomenon of serous dropsy.

Experimentation on the Action of Alcohol.

A very large number of my researches by experimentation have had reference to the action of medicines or of chemical substances intended to be applied as foods or as medicines to the animal body. Some of these, such as chloroform, methylene-bichloride, and nitrite of amyl, have already been noticed, but they are a small number compared with all that have been physiologically investigated. By subjecting animals of different species to the action of alcohol, I made clear what had only been surmised previously, that alcohol reduces the animal temperature. I also found that, like nitrite of amyl, alcohol produces what is called its stimulant action, by paralysing the vessels of the minute circulation. By the same course of experiment I learned that the exposure of an animal to a degree of cold that is perfectly harmless when the animal is free of alcohol, is certainly fatal when the animal is narcotised from the action of alcohol. By pursuing the research so as to include in it the heavier alcohols, such as butylic alcohol and amylic alcohol (fusel oil), I learned for the first time that the more injurious effects of some of the common alcoholic drinks sold for the uses of man are due to these exceedingly poisonous compounds; and by observing the action of alcohol, when the action is long-continued, on the visceral organs, the various organic changes it specifically engenders, independently of all other coincidental causes of disease, were accurately determined. In a word, all my researches of a physiological kind on the action of alcohol, from which so much has been gathered in respect to the utter uselessness and the great harmfulness of that potent poison, have been made from observation of its effects on the inferior animals. Its effects in reducing temperature, in reducing vascular tension, in reducing muscular power, in destroying the action of the animal membranes, in impairing the structures of vital organs, could never have been certainly demonstrated if the lower animals had not formed the field of experimental investigation. In these experiments the lower animals suffered neither more nor less than millions of those human animals who indulge in alcohol, and I am sorry to say that, like the human animals, many of them became too fond of the agent that was producing their certain deterioration. I can but feel sure that a great number of facts of the most practical kind sprang from these researches on alcohol. To them also should be added one other addition to physiology. I traced out, in watching the effects of the heavier alcohol from the lighter of the series, the singular law that the physiological action of an organic chemical substance is intensified by the increase of its specific weight. Thus butylic alcohol is more pronounced in its action than methylic, chloroform than chloride of methyl, and so on through all the series of organic compounds.

Experimentation on Septine.

In 1864 the death from diphtheria of one whose life was dearer to me than my own, led me to study more carefully than I had before, the process of secondary absorption of secretions from diseased abraded surfaces. In the case in question I felt sure that the death was due to the absorption of poisonous secretion from the ulcerated throat and from the nasal passages. There was at that time no light to guide me to he truth except the experiments of Gaspard, Majendie, and Sedillot, which bore rather on the action of purulent matter and of decomposing blood upon the body, than on secretions formed during disease. I felt it right, therefore, to seek for further information by experiment, and this gave rise to the first steps of a research which has since assumed great importance. In the latter part of 1864 some fluid secretion had to be removed from the peritoneum of a patient suffering from surgical fever, on whom Mr. Spencer Wells had performed ovariotomy. The fluid, which was quite free from decomposition, was applied by inoculation to a healthy lower animal—a rabbit. It produced a special form of disease analogous to that from which the human patient was suffering. The secretions of the infected lower animal were tested in turn on another healthy animal, and were found to be equally and specifically poisonous. The same was extended through four series with like results. Some of the original fluid was next treated with the view of ascertaining if the poisonous principle in it could be isolated, and a series of salts were obtained which were found to possess a poisonous and progressive poisonous action like the original fluid. A poisonous organic base seemed, in fact, to be present in the peritoneal secretion, to which poison, whatever its nature might be, I gave the name of *septine*. I afterwards made a series of experiments to determine what agents destroy the activity of the poison, and from the whole of the inquiry, I was brought to a theory of the epidemic diseases which I have specially announced, and which will, I believe, hold its own, viz., that these diseases, are all glandular diseases, and that their poisons are specifically nothing more than the secretions of the glandular structures in a modified condition; that they may be produced with or without infection, and that they act in producing the acute symptoms of disease, after their absorption, by their effect, primarily, on the nervous system, and secondarily, on the blood. Recently, I have endeavoured to demonstrate that the fever which the septinous poisons produce is brought about by their power of liberating oxygen from the blood, and that those agents which counteract this action most effectively are the true febrifuges. As yet all such counteracting agents—one of which, quinine, is the best example—are clumsy and slow in their neutralising effect. But chemistry has agents much more potent, and the day, I am quite sure, is not far off when we shall have given to us neutralising agents for the contagious fevers which will be as refined and potent as the poisonous agents that produce the fevers, and which will cure fevers by inoculation from the lancet-point, as certainly as small-pox, or other infectious malady, is now producible by the process of inoculation of small-pox septine. By-and-by, and this will probably be the earliest step, we shall find a vapour, to inhale which will have the desired effect, and will be rapid in operation. This principle made perfect, there will be no such thing as a necessary death from an infectious disease.

At present, the view that the poisons of the spreading diseases are merely animal secretions, like the poisonous secretion of the cobra or the changed saliva of the dog under rabies (canine madness), removes all the mystery that surrounds them, and the various plans for preventing the distribution of the poisons and of infection is rendered common sense and simple to the extremest degree.

Experimentation on Painless Extinction of Animal Life

The latest experimental researches which I have conducted on lower living animals have had for their object the discovery of a ready, cheap, and innocuous method for killing without pain those animals which are destined, as yet, for the food of man. If the labour of the physiologist be allowed to progress, the day will soon arrive when the slaughter of animals for food will become unnecessary, since he will be able to so transmute the vegetable world as to produce the most perfect and delicious foods for all the purposes of life without calling upon the lower animal world to perform the intermediate chemical changes. But until this time arrives, animals will have to be slaughtered, and my research has been directed to make a process which at present is barbarous and painful, painless in the most perfect degree. For this purpose the various modes of rapid destruction of life—by powerful electrical discharges, by rapid division of the medulla oblongata, and by the inhalation of various narcotic vapours, have been carried out. The experiments, which have been exceedingly numerous, have led me to the conclusion that the most perfect of the painless methods of killing is by the inhalation of carbonic oxide gas. So rapid and complete is the action of this gas, that I may say physiological science has done her part, as far as it need be done, for making the painless killing of every animal a certain and ready accomplishment, an accomplishment also so simple that the animal going to its fate has merely to be passed through the lethal chamber, in order to be brought in senseless sleep into the hands of the slaughterer. The application of teaching and the putting into practice this humane process lies now with the world outside science; but to insure its acceptance, all the force of selfishness, of prejudice, and of practical apathy for the sufferings of the animal creation, have to be overcome. There is a great deal of talk and a great deal of sentiment abroad on the question of the sufferings of the lower animal kingdom, but when an attempt is made to relieve those sufferings by the invention of methods for operating, surgically without the infliction of pain, or for painless killing, the true and vital sympathy which one would expect in support of such practical and humane efforts, until they are made perfect and universal, can scarcely be said to be found at all. With the exception of a few, not a dozen altogether, of really humane ladies and gentlemen, I have found no one, out of the ranks of science, in the least interested in the saving of sufferings to which I am now directing attention. The man of science stands and wonders at the strangeness of the psychological problem before him; and, in spite of himself, is forced to the conclusion that, practically, the noise that is made at him in the name of humanity is, after all, sounding brass and tinkling cymbal.

BENJAMIN W. RICHARDSON

STANLEY'S AFRICAN DISCOVERIES

MR. STANLEY, in the work he has already done, has made a substantial contribution to African geography, and the last letters from him which have recently appeared in the *Daily Telegraph* raise eager hopes that shortly we shall hear of his having accomplished work of even greater value. We do not propose to recapitulate the narrative with which most of our readers must be familiar from the interesting letters in the *Telegraph*, but briefly to point out, with the aid of the accompanying map, how much Mr. Stanley has in these letters added to our knowledge. Of course our map does not pretend to rigid accuracy, its object being simply to show Mr. Stanley's route, the amended outline of the Victoria Nyanza, and the main features of the country traversed by him. It is not our desire to take up space with conjectural geography, nor to reconcile Mr. Stanley's statements with those of previous travellers, nor to discuss what is likely to be the tendency of future discoveries. All this seems to us unnecessary at present, as there is every probability that we shall not have long to wait for accurate and full information from the various travellers that are now in the field.

One of the most satisfactory parts of Mr. Stanley's work is undoubtedly his circumnavigation of the Victoria Nyanza, and the filling in of its outline with something approaching to accuracy. Previous to Mr. Stanley's visit we were dependent mainly on conjecture for the configuration and dimensions of this important lake, supplemented by the observations at one or two points of Speke, on whose name Mr. Stanley's discoveries have shed additional glory. Anyone comparing the map which we have drawn up from Stanley's information with that of Speke will be able to see how much the latest traveller has done. The outline of the shore all round is given with what we must regard as a fair approach to accuracy, to be supplemented ere long, we hope, by careful survey. The long branch lake on the north-east has been cut off, probably to become a separate lake or marsh further east; the eastern shore has been brought considerably westwards, while the southern and western shores have received important modifications. The "numerous islands" of Speke's map have many of them been visited and most of them been seen and named, and are found to extend almost all round the lake at a short distance from the shore. The names at least of many of the tribes that inhabit the shores and the islands have been obtained, and not a few details concerning their customs and physique. Stanley's account of his visits to Mtesa are in the highest degree interesting, and cannot but raise our admiration of the excellent diplomacy of the determined commissioner of the *Telegraph* and the *Herald*. As to the extent of the lake, the conjecture that it is about 1,000 miles in circumference is probably not far from the mark; from the observations of Stanley its height above sea-level is calculated to be 3,800 feet, very near to one, at least, of the observations obtained by Speke.

Probably after the circumnavigation of the Victoria Nyanza, the most satisfactory piece of work done by Stanley has been the tracing of a large portion of the lacustrine river Kagera, the same which Speke had under an apparent misconception named the Kitangule. Stanley during his circumnavigation ascended the mouth of the river and found it to enter the lake about twenty miles further north than was conjectured by Speke. What is, however, of more importance, is the careful exploration of this curious river further up its course, confirming and extending the discoveries previously made by the careful Speke. Speke's Lake Windermere has been found to be only one of a series of at least seventeen lakes, which are in reality one, which are fed and drained by the river Kagera, and which Stanley with considerable reason regards as "the real parent of the Victoria Nile," and along with the Shimeeyu River on the south, the main feeder of the Victoria Nyanza. Stanley's account of his exploration of this lake-river is of such importance that we shall quote his own words:—

"While exploring the Victoria Lake I ascended a few miles up the Kagera, and was then struck with its great volume and depth—so much so as to rank it as the principal affluent of the Victoria Lake. In coming south, and crossing it at Kitangule, I sounded it and found fourteen fathoms of water, or 84 feet deep, and 120 yards wide. This fact, added to the determined opinion of the natives that the Kagera was an arm of the Albert Nyanza, caused me to think the river worth exploring. I knew, as all do who understand anything of African geography, that the Kagera could not be an effluent of Lake Albert, but their repeated statements to that effect caused me to suspect that such a great body of water could not be created by the drainage of Ruanda and Karagwe, and that it ought to have its source much further, or from some lake situate between Lakes Albert and Tanganyika. When I explored Lake Windermere I discovered, by sounding, that it had an average depth of 40 feet, and that it was fed and drained by the Kagera. On entering the Kagera, I stated that it flashed on my mind that it was the real parent of the Victoria Nile; by sounding I found 52 feet of water in a river 50 yards wide. I proceeded on my voyage three days up the river, and came to another lake about nine miles long and a mile in width, situate on the right hand of the stream. At the southern end of this lake, and after working our way through two miles of papyrus, we came to the island of Unyanyubi, a mile and a half in length. Ascending the highest point on the island, the secret of the Ingezi or Kagera was revealed. Standing in the middle of the island I perceived it was about three miles from the coast of Karagwe, and three miles from the coast of Kishakka west, so that the width of the Ingezi at this point was about six miles, and north it stretched away broader, till beyond the horizon green papyri mixed with broad grey gleams of water. I discovered, after further exploration, that the expanses of papyri floated over a depth of from 9 to 14 feet of water, that this vegetation, in fact, covered a large portion of a long shallow lake; that the river, though apparently a mere swift-flowing body of water, confined seemingly within proper banks by dense tall fields of papyri, was a current only, and that underneath the papyri it supplied a lake varying from five to fourteen miles in width, and about eighty geographical miles in length. Descending the Kagera again some five miles from Unyanyubi, the boat entered a large lake on the left side, which, when explored, proved to be thirteen geographical miles in length by eight in breadth. From its extreme western side to the mainland of Karagwe east was fourteen miles, eight of which was clear open water; the other six were covered by floating fields of papyri, large masses or islands of which drift to and fro daily. By following this lake to its southern extremity I penetrated between Ruanda and Kishakka. I attempted to land in Ruanda, but was driven back to the boat by war-cries, which the natives sounded shrill and loud. Throughout the entire length (eighty miles) the Kagera maintains almost the same volume and nearly the same width, discharging its surplus waters to the right and to the left as it flows on, feeding, by means of the underground channels, what might be called by an observer on land seventeen separate lakes, but which are in reality one, connected together underneath the fields of papyri, and by lagoon-like channels meandering tortuously enough between detached fields of this most prolific reed. The open expanses of water are called by the natives so many "rwerus," or lakes; the lagoons connecting them and the reed-covered water are known by the name of "Ingezi." What Speke has styled Lake Windermere is one of these "rwerus," and is nine miles in extreme length and from one to three miles in width. By boiling point I ascertained it to be at an altitude of 3,760 feet[1] above the ocean, and about 320 feet above Lake Victoria. The extreme north point of this singular lake is north by east from Uhimba, its extreme southern point. Karagwe occupies the whole of its eastern side. South-west it is bounded by Kishakka, west by Muvari, in Ruanda, north-west by Mpororo, north-east by Ankori.

At the point where Ankori faces Karagwe the lake contracts, becomes a tumultuous noisy river, creates whirlpools, and dashes itself madly into foam and spray against opposing rocks, till it finally rolls over a wall of rock ten or twelve feet deep with a tremendous uproar—on which account the natives call it Morongo, or the Noisy Falls."

[1] There is evidently an inconsistency between this statement and the height (3,800 feet) above given for the Victoria Lake. The latter, however, is Capt. George's computation from Stanley's readings. Stanley's observations will no doubt be revised when his readings for Lake Windermere are sent home. Meantime we must let his statement stand.

Mr. Stanley does not exaggerate the importance of this discovery. That the river has any connection with Tanganyika is in the highest degree improbable, as the Victoria into which it drains is more than 500 feet above the level of Tanganyika; but the question of the connections of this lake Mr. Stanley, we hope, has by this time solved. He afterwards traced the Kagera upwards in a south and west direction, the direction in which trend all the ranges in this region, as, indeed, run all the great ridges, troughs, basins, and valleys from Alexandria to the Nyassa Lakes. In Southern Kishakka, however, a valley struck in from the north-west, through which he found issuing into the Kagera, a large lake-like river called Akanyaru. Above the confluence the Kagera was seen to be a swift-flowing stream of no great depth or breadth. From the Mlagata hot springs Stanley obtained a good view of the region to the north-west, including the Ufumbiro mountains, two sugar-loaf cones and a ridge-like mass, reaching a height of 12,000 feet. From this point of view, also, he saw three other lofty ridges separated by broad valleys. Between two of these ridges flows the Nawarongo river rising in the Ufumbiro mountains, and flowing south by west to join the Akanyaru lake-river. Another large lake he heard of as lying to the westwards, but of this he could obtain no certain information.

Of Stanley's visit to Lake Albert Nyanza little need at present be said, as he succeeded in obtaining only a glimpse of it, when he felt himself compelled to return. Some important observations, however, he did succeed in making, and collected many scraps of information. His statements about "the king of mountains," Gambaragara, and its pale-faced, brown-haired inhabitants, the chief medicine-men of the notorious Kabba Rega, have roused curiosity to the utmost. This mountain, which appears to be situated somewhere on the north of Unyampaka, in height between 13,000 and 15,000 feet, Mr. Stanley conjectures to be an extinct volcano, as "on the top of it is a crystal-clear lake, about 500 yards in length, from the centre of which rises a column-like rock to a great height. A rim of stone like a wall surrounds the summit, within which are several villages, where the principal medicine-man and his people reside." Stanley's route to the Albert Lake was partly through Unyoro and partly through an uninhabited tract of Ankori, his camp being pitched near the edge of the plateau which borders the lake, in the district of Unyampaka. During his march he made important observations on the contour of the plateau which separates the two lakes, the structure of the mountains and ridges, the course of the watersheds and of the rivers Katonga and Rusango. The general correctness of Baker's map, so far as the east coast is concerned, has been confirmed, and although the actual lake may not extend south of the equator, it is probable that there are long stretches of papyrus swamps at its head. The kingdom of Unyoro, under Kabba Rega, occupies a large extent of the eastern shore of the lake, and includes many minor states, the names of which, and of others on the west side, Mr. Stanley succeeded in collecting. The extensive promontory of Usongora, forming Beatrice Gulf, on the shores of which Mr. Stanley encamped, is the great salt-field whence all the surrounding countries obtain their salt, and rumour makes it a land of wonders, with a mountain emitting fire and stones, a salt lake of great extent, hills of salt, and a breed of large savage dogs and long-legged natives. Mr. Stanley gives the latitude of his camp on Lake Albert as 0° 25′ N. and longitude 31° 24′ 30″ E. It is difficult to reconcile this last datum with previous observations, and indeed with the length of Stanley's own march between the two lakes. If his own map of Victoria is correct, the two lakes must be within thirty miles of each other. It is probable, we believe, that Sir Samuel Baker's map places the east coast of the lake too far west, and that its position will have ultimately to be changed, but if to so great an extent as is indicated by Stanley's statement, must be solved by further observations. At present we cannot reconcile Signor Gessi's narrative with that of Stanley. Gessi states that he was stopped in his navigation by a "forest of Ambatch," some thirty miles to the north of Stanley's Beatrice Gulf, and that the natives declared the lake extended no farther south. The statements of the two travellers are equally positive, and we have no reason to distrust either, and therefore we can only wait for more information, which, it is likely, will now soon reach us, either from Mr. Stanley or Mr. Lucas, an independent traveller, who is actuated purely by a love of exploration, and who, by last accounts, was on his way to the lake.

On his return from this expedition Mr. Stanley set out southwards through Karagwe for Ujiji, his purpose being, if possible, to reach Lake Albert from the west and make as thorough an exploration of it as he has done of the Victoria Lake. The chances are that he will be successful. It was while in Karagwe that, by the assistance of the hospitable old king Rumanika, he was able to explore the Kagera lacustrine region. On completing this exploration he visited the hot springs of Mlagata, two days' march from Rumanika's capital, in a deep-wooded gorge clothed in the most luxuriant vegetation. These springs reach a temperature of about 130° Fahr., and are greatly resorted to for their supposed curative effects, which Mr. Stanley seems to doubt.

Mr. Stanley's last letter is dated April 24, 1876, from Ubagwe, Western Unyamwezi, fifteen days' journey from Ujiji, which, if all has gone well, he will have reached long ago. Before setting out for Lake Albert again, he proposed to explore the hitherto unvisited portion of the north-west shore of Tanganyika. From this exploration some authorities expect important results to follow; it is indeed thought possible that in this direction will be found the real outlet of Tanganyika, and that Cameron's river Lukuga may ultimately be discovered to be after all only an indentation of the lake, and that moreover a connection will be found between Tanganyika and the Albert Nyanza. However this may be, both explorers have done work of the highest importance in African geography, and the last published letters of Stanley must be regarded as a really valuable contribution to the solution of the great Nile problem and to an accurate knowledge of Central Africa. He has proved himself an explorer of the greatest capability, and the expedition he leads reflects credit on the enterprise and public spirit of the proprietors of the two newspapers who have sent him out.

COFFEE IN CEYLON

CEYLON is perhaps best known to Europeans through being one of the chief coffee-growing countries in the world, and indeed, after its production of cinnamon, which gives it a position that is quite unique, its chief claims to notice from the ordinary untravelled Englishman are derived from its coffee. The plant is supposed to have been introduced into the island by Arabs from the Persian Gulf more than 200 years ago, as there are traditions extant among the Singhalese of its flowers having been offered at the shrine of the sacred tooth of Buddha in Kandy at a remote date. The art, however, of preparing any beverage from its berries was unknown to the natives, or at least unpractised by them until recent times, and it was only in 1827 that the first plantation was opened—by Sir Edward Barnes, the then Governor—with the idea of exporting coffee to the European market. This estate was situated not far from Kandy, and at an elevation of some 1,800 feet above the sea. Thirteen years afterwards the first rush of speculators in coffee occurred, when the average quantity exported was 54,000 cwts., and its value about 150,000*l*. The effect of this sudden impulse to the enterprise was seen six years afterwards, in 1846, in the export rising to 178,000 cwts. In 1855 it was close upon half-a-million, and in 1868 somewhat over a million cwts., valued at the low rate of about 50*s*. per cwt., and grown on an area, including native coffee gardens, of about 200,000 acres. In the following year "leaf disease" (*Hemileia vastatrix*), a species of fungus covering the under surface of the coffee-leaf with an orange-red coloured dust composed of the ripe spores of the fungus, appeared on a newly-opened estate in Madulsima, and within a very short time spread over all the coffee-producing districts in the island. The ravages of the pest have been so great that the annual production of coffee has been reduced to less than two-thirds of what it ought to have been, and the loss to the colony can only be estimated at many millions of pounds sterling. But this subject will be referred to later; at present we must attempt to give some idea of the character of the country in which the great staple of the island grows. Ceylon, as is pretty generally known, consists, roughly speaking, of a large central mass of mountains, attaining an elevation in one case of more than 8,000 feet, and surrounded on all sides by low country. This mountain region, as well as the low country, is composed almost entirely of primary rock (gneiss), and bears such a striking resemblance to the Western Ghaut Range of Southern India, that the island may be considered as an isolated portion of that continent, separated, perhaps, during the upheaval of both by the strong monsoon currents that set continually along the coasts of India, according as the sun is north or south of the line. It is not improbable that other stratified rocks have once overlaid the ancient gneiss, but no rock less tough could long withstand the torrential rains of the south-west monsoon and the injurious effects of a tropical sun. If any such have formerly existed, every trace of them has long ago been washed down to the low country or the sea. It is true that at one spot on the western coast, apparently protected from the violence of the monsoon rains, and where, consequently, the rainfall is very slight, the remnant of a fossiliferous limestone of very limited extent is to be met with, but this, I believe, is the one solitary exception, and its relation to the gneiss formation of the rest of the island and to the coast of Southern India, has not, I imagine, been sufficiently explained. At the present time the soil of Ceylon is formed exclusively by the disintegration of gneiss rock, the *débris* of which settles in protected spots and on slopes not too steep for its accumulation. In its natural state it is nearly always very strongly tinged with red, and to an ordinary observer appears to be of a very poor character. This no doubt is really the case, but it affords standing-ground for trees and other forms of vegetable life, and a forcing climate does the rest. With a rainfall over the greater part of the mountain zone of more than 100 inches, in some places more than 200 inches in the year, distributed chiefly between the middle of May and the end of December and with such a rapid descent from the upper mountain slopes to the low country—the great river of the island, the Mahawelli-ganga, descends at the average rate of ninety feet per mile for the first sixty or seventy miles of its course—it was only to be expected that extremely deep valleys, steep slopes and precipices, and a general waterworn aspect should be met with on every side. These features are so marked throughout the coffee-producing districts, that it is by no means unusual to find the upper portion of a block of 300 acres some 1,800 or 2,000 feet above the lower, and the whole estate nothing more than a series of rounded spurs and deep ravines, with here and there a precipice of considerable height, with an accumulation of rocks about its base. It is at the foot of these cliffs that the best soil for any purpose of cultivation is found, whilst the worst is generally on the most exposed parts of the spurs. This is no doubt due to the accumulation of vegetable mould, and the nutritive properties of the decaying rocks, which is possible in the one case, but not in the other, to any great extent. It is to the former of these substances, to the result of ages of forest growth and decay, that coffee estates owe their chief value; without it they are almost worthless, as may be seen in the case of old estates, whose surface-soil has been washed away through want of drainage or on the grassy slopes of *patanas*, where jungle has never grown, and where of course there is no humus. On either it is next to impossible to grow coffee profitably. As these patanas or patches of poor grass land in the midst of luxuriant forest form one of the most striking features of the mountain scenery of Ceylon, and as no satisfactory explanation has as yet been given of them, it may be well to mention that a band of quartzite (metamorphosed sandstone) several hundred feet in thickness, occupies a definite place in the gneiss series of the mountain zone, and that wherever this is found cropping out, and by its disintegration forming the surface-soil, there we are certain to find the ground of such miserable quality that nothing but a coarse and all but worthless grass will grow. This, however, does not fully explain the phenomenon. It may be noticed as against the theory that these patanas are due to the frequent burnings by the natives after the land has once been cleared of jungle, and then allowed to fall into grass, that, however land that has once been jungle may be exhausted by bad cultivation, its tendency is not to run into grass, but to relapse into a kind of scrub, and thence in time into jungle—a tendency which is never seen in patana land. The best estates, the climates being similar, are where the humus is deepest, or where its constituents have been carried furthest by percolation into a friable soil. The protection of this humus and upper soil is the first and most important duty of the planter on a new estate, and the drainage, therefore, at the outset, is rendered as complete as possible.

An idea of the rate at which the surface soil even of old and well-worn estates is carried away, may be formed from the fact that $\frac{1}{80}$th part by weight of the surface-water passing down a stream in Pussellawa—one of the oldest and best coffee districts—after a heavy shower was found by the writer to be earthy matter; a startling observation indeed, but one that fairly agrees with an estimate made, after considerable experience, that one of the above-mentioned old estates had suffered denudation since it was opened more than thirty years ago, at the rate of about one-third of an inch per annum. This is a startling fact and suggests the inquiry, When will the land available for coffee in Ceylon be used out or washed away? It is already nearly all occupied, and it seems that before long, that is, within a score or two of years, in spite of all the exertions of the modern planter, all its fertile properties will be irrecoverably lost. Forest growth and decay have created the wealth of the Kandyan Province, and the ignorant or careless planter of the past has as truly wasted the natural resources of the country as if he had destroyed all its coco-nut trees, only in the one case the evil would be temporary—twenty years would repair it; in the other ten times that period of absolute rest would probably not restore the fertility to the mountain slopes and bring them again to the state in which the European found them. Land suitable for coffee lies generally between 2,000 and 5,000 feet above the sea, but the climate of the district and the aspect count for a good deal. Estates from 3,000 to 4,000 feet in altitude are considered the best, the plants then being neither burnt up by the hot sun of lower elevations nor ruined by the black-bug—really a fungus, *Capnodium*, thriving on the honey-dew secretion of the bug *Lecanium Coffeæ*, and often mistaken for it—which is a sure visitor of high and wet estates. An eastern slope is generally preferred, but what effect the early sun produces I have never been able to discover—unless it saves the plant to a great degree from the chills of early morning.

As to climate the variety in this respect is most marked. On one side of a small range the coffee exposed to the south-west monsoon is mostly ripe about November. On the opposite side, four miles away, where it is subject to the influence of the north-east rains, it is generally picked three if not four months later, whilst in the most favoured districts in the southern part of the mountain zone where the rainfall is considerably influenced by mountains that lie in the track of the monsoon the crop time lasts through nine months, *i.e.*, from September to May—buds, flowers, green and ripe fruit, being on the tree all at the same time.

Young plants are generally put into the ground soon after the rainy season has commenced, stumps being used in the southern part of the province and where the weather is uncertain. Under the influence of a plentiful supply of moisture and an average temperature of 70° to 75° F., the roots soon strike and the tree grows so rapidly, that at the end of two years a small quantity of fruit may sometimes be gathered. In its fourth year the tree bears a good crop, and two years later it may be considered to be in its prime. About 1,200 to 1,600 are generally planted on an acre, and each tree, when it attains a height of four or five feet, is cut down to 3 ft. 6 ins., and even lower in exposed places and on poor soil, according to the taste of the planter. The lateral branches are kept most carefully pruned, and the tree thus cared for forms a cylindrical mass of foliage into the centre of which the sun's heat can penetrate and ripen the fruit. The trees are planted six feet by five feet or six feet apart, and when fully grown in good soil, present a mass of intervening branches through which it is somewhat difficult to make one's way. When an estate has attained an age of twenty years it is considered to be well past its prime, and only to be kept profitable by means of a plentiful supply of manure, and indeed the main question with planters now is not so much how to treat the tree itself, but how to obtain good fertilising material and apply it in the best manner possible. The tree responds to kindly treatment with the utmost readiness, and will bear almost any ill-usage and yet recover and yield good crops. Ten cwts. to the acre, or nearly one pound per tree of prepared coffee, used formerly to be considered a good crop, but now, owing to the ravages of the "leaf disease," it is regarded as extraordinary, and half the amount only is more frequently obtained. At present prices this represents about 25*l.* per acre with which to pay all the working expenses of the estate. Amongst these is the cost of Tamil coolies from the south of India, who have to be maintained during the greater part of the year at the rate of one labourer to every acre of coffee in full bearing, their pay averaging 9*d.* per day of ten hours, viz., from 6 A.M. to 4 P.M. Besides this main charge there are artificial manures, tools, bullock-waggons, bullocks specially kept for making manure, road-making, &c., to be paid for, together with assessments for grant-in-aid roads, and other public purposes, so that to manage an estate well is a very expensive affair, and can only be done where there is a large incoming of gross profits.

No mention has yet been made as to how the land is acquired by the planter and under what title it is held. When the English took possession of the Kandyan province in 1815, they agreed, by a convention, to respect both the religion and the private property of the natives. This latter consisted chiefly of rice-fields, whilst the jungle-covered mountains having never been considered of any value were not claimed, and consequently passed into the hands of the British Government. As soon, then, as their value began to be appreciated for coffee cultivation, they were put up for public sale at an upset price of 5*s.* per acre, and many estates were purchased at that rate. At the present time the upset price is 1*l.*, and the land not unfrequently realises as much as 15*l.* or 20*l.* per acre, so prosperous has been the enterprise of late years and so great the influx of English capital. The blocks of land when put up for sale are mostly of convenient sizes—200 or 300 acres—and the competition is frequently very keen for the more suitable pieces. As none but jungle land, except in very rare instances, is planted with coffee, the forest and undergrowth have to be cleared away and the ground thoroughly opened before the plants can be put in. This is done in November or December by Kandyan woodmen, who are very skilful with the axe, and the remains of the forest having been dried by an eight or ten week's exposure to the sun during the hot season are burnt off about February. As soon as the rainy season comes, holes 18 inches square and deep are dug, and the plants, having had their rootlets carefully trimmed, are deposited in them. At this period of its formation the estate is generally quite free from weeds on account of the recent fire, and very great care is used to prevent any, especially ageratum or couch grass, getting a hold on the soil.

As to the general statistics of the enterprise I find by Mr. Ferguson's very valuable directory that there are at the present moment 257,000 acres of cultivated coffee, divided into slightly more than 1,200 estates, and giving employment to 1,050 managers and superintendents, nearly all of whom are Europeans. Some 50,000 acres of these estates are not in proper bearing, through being either too young or too old, and therefore 210,000 acres may be taken as the extent of the plantations of the island, which are accountable for the present year's crop (ending in September), estimated at 630,000 cwts. Last year the yield, with 8,000 acres less in cultivation, was 873,000 cwts.

The value of the whole plantation interest is roughly estimated at nine millions sterling of English money.

The extent of native coffee, *i.e.*, of the gardens of the Singhalese, which are generally situated in the immediate neighbourhood of their villages, where the trees are allowed to grow as they will, is probably between 40,000 and 50,000 acres, and the average annual production may be estimated at from 140,000 to 150,000 cwts. The value of this native property is set down roughly at three-quarters of a million sterling.

In 1849 the value of the former variety of coffee when prepared was 33*s.*, and of the latter 18*s.* per cwt. At the present moment so great has been the rise in the prices of both kinds that plantation fetches as much as 100*s.* and native 85*s.* per cwt.

A comparison of the statistics of the coffee enterprise for the year 1852 (the earliest for which I have any reliable information) and the present year furnishes several points of interest both to the planter and the European consumer. The former was a fairly good year, better than 1853, but not to compare with any of the immediately succeeding years. The latter year is distinctly a bad year, but whether exceptionally so or not is the chief point of interest and anxiety. In 1852 about 40,000 acres were under plantation cultivation, and 255,000 cwts. were produced, nearly 6½ cwts. per acre. In the present year about 257,000 acres are cultivated—one-fifth perhaps not being in full bearing, as was probably the case in 1852—and 630,000 cwts. are expected to be obtained, an average of less than 2½ cwts. per acre. The native coffee produced in the same two years will most probably be about the same in quantity, viz., 150,000 cwts. A fairer mode of comparison, no doubt, is that of taking the last five years, say from 1872 to 1876 inclusive, and comparing the average annual production per cultivated acre during that period with that of the five preceding years from 1867 to 1871, for it was in 1872 that the falling-off due to the "leaf disease" began to be seriously felt. During the earlier five years the rate of production per acre was 4·6 cwts. During the later period only 2·9 cwts., a decrease of somewhat more than one-third. It may naturally be asked, What is the cause of this falling-off in the average production? One reason, no doubt, is that some estates are becoming old, and when an unfavourable season occurs their cultivation is temporarily unprofitable. But the main cause is most certainly the fungus (*Hemileia vastatrix*) on the leaves of the plant. This appeared first in 1869, and in 1872 was recognised as a firmly-established coffee pest. It is generally admitted that the injury is caused through the weakening of the tree by the absorption of the juices of the leaf, for no plant has ever been known to be absolutely killed by the attack or even by a succession of them. The first symptom of the disease is a palish discoloration in spots or patches, easily detected when the leaf is held up to the light. These quickly assume a faint yellow colour, and presently become covered with yellow dust, which soon turns into a rich orange. These are the ripened spores of the fungus aggregated in little clusters, and attached to branching filaments, that have found their way from the air-spaces within the leaf, where they have been feeding on its juices and ruining its vitality. It is estimated that there are sufficient of these spores on a badly diseased leaf to infect 100,000 plants, and therefore it is no wonder that the pest, when once it had come to maturity under the favourable conditions of a coffee estate, should spread in an incredibly short space of time over the whole mountain zone, and that probably within less than two years from its first appearance every coffee-tree in the island had been more or less affected by it. The injury in the first instance appears to be done solely to the leaf, which, at a certain stage of the attack, dies of exhaustion, and the tree being an evergreen has to throw out another mass of foliage, which also in its turn becomes affected and dies. Consequently the strength of the plant, which ought to be spent in bearing fruit, is chiefly devoted to putting out new flushes of leaves, whilst a certain percentage of the crop that is at last ripened is found to have suffered from the general weakness of the tree. For a disease of this kind it is impossible to suggest any remedy, such as sulphuring the leaves. Imagine such an operation as sulphuring more than 250,000,000 trees, and then only obtaining a temporary relief! Manure gives a tree strength to bear fruit as well as leaves, and therefore is the most approved of all the remedies tried as yet.

With regard to the origin of the disease, nothing is known, except that it first appeared on a new estate in Madulsima, a district in the south-east of the mountain zone, and bordering on the low country. Mr. Thwaites, the botanist, believes that it has been introduced into the island in imported manure, which is a probable explanation of its origin, so far as Ceylon is concerned. Against this supposition, however, is to be set the fact, according to the writer's belief, that *Hemileia vastatrix* is found in no other country in the world except Southern India, and on no other tree except the coffee-tree. It is, therefore, possible that it may have existed in a modified form, and without attaining any great development on some of the trees in the low country jungle to the eastward, and from them may have been carried by the wind to a neighbouring coffee estate. Be this as it may, it is not now likely that its origin will ever be known, unless future research into the nature of fungi throws a light on the subject which it is impossible to anticipate. As to the future of the coffee enterprise in Ceylon, it is useless to predict. Let us hope that the same Providence which has ordained that masses of plants, animals, or men, may not be unnaturally aggregated together without some disease becoming epidemic among them, may also in this case apply the same law for the destruction of the disease itself, by developing among its countless myriads of spores a principle of death, which may cause the plague to disappear as suddenly and mysteriously as it came.

Since the above was written, the blossoming season has proved so favourable that it is estimated that the crop for the year ending September, 1877, will exceed a million cwts., but whether the plants have suffered so seriously from the attacks of the "leaf disease" as to be unable to bring this crop to maturity time alone can prove.

June, 1876 R. ABBAY

OUR ASTRONOMICAL COLUMN

61 CYGNI.—The following formulæ for the difference of right ascension and declination of the components of 61 Cygni are founded upon a comparison of Bessel's measures with the Königsberg Heliometer (mean epoch, 1835·47) and Baron Dembowski's between 1871 and 1875, on forty-two nights :—

$$\Delta\alpha = +\ 22''{\cdot}1727 + [8{\cdot}74448]\,(t - 1870)$$
$$\Delta\delta = -\ \ 7{\cdot}4928 - [9{\cdot}27780]\,(t - 1870)$$

If the angles of position and distances are calculated from the differences of right ascension and declination thus obtained for the epochs of the older observations, collected by Bessel in his earlier memoir, it will be found that there remains but a very doubtful deviation from rectilinear motion. Bradley's observations, 1753·8, exhibit the largest difference, 3°·9, but having regard to the discordance between the result from Piazzi's observations for 1806·3 and Bessel's for 1812·9, both of which can hardly be correct, this difference is not excessive. It appears that the only suspicion of curvature of path must depend upon these early and more uncertain data, as, indeed, was inferred by Mr. Wilson, of Rugby, some time since.

TUTTLE'S COMET.—The calculations of Clausen and Tischler have placed the theory of this comet upon a very satisfactory foundation. Discovered in the first instance by Mechain, at Paris, on January 9, 1790, it was observed until February 1; a parabolic orbit was computed by the discoverer, which subsequently figured in all our catalogues, but there appears not to have been at that time any suspicion of its comparatively short period; indeed, the short extent of observation might well prevent this. On January 4, 1858, the comet was re-detected by Mr. Tuttle, of the U.S. Navy, at the Observatory of Harvard College; the first elements calculated in this year presented so great a resemblance to Mechain's for the comet of 1790, that the identity of the bodies was immediately inferred, and successive approximations to the period of revolution by Pape and Bruhns, showed that in the sixty-eight years' interval there must have been performed several revolutions, the latter finally concluding that the comet had returned to perihelion four times since 1790, though on every occasion it passed unobserved. Clausen (Dorpat Observations, vol. xvi.) calculated the perturbations due to the attraction of Jupiter between 1858 and 1790, and thus carrying back the elements deduced from the observations of 1858 to 1790, found but small differences from those obtained from observation in the latter year, which difference was still further reduced after he had included the effect of Saturn's attraction from 1805, January 30, to 1816, August 24, and from 1831, July 17, to 1843, October 22. Tischler's results are published in his "Inaugural Dissertation"—*Ueber die Bahn von Tuttle's Comet*, Königsberg, 1868. In this able investigation of the young astronomer (who unfortunately lost his life before Metz) elements founded upon the observations of 1858 were used for the calculation of the perturbations, on the method adopted by Bessel for the comet of 1807, from 1858 to 1844, including the effect of Venus, the Earth, Mars, Jupiter, Saturn, and Uranus, and for all the remainder of the interval the effect of Jupiter and Saturn for every 100 days. With these perturbations of the first order, the elements were found for every 600th day, and with these corrected figures the perturbations by Jupiter, Saturn, and Uranus, were recalculated. Thus the value of the semi-axis major at perihelion passage in 1790 was determined. Tischler's work, however, did not close here; he subsequently computed the planetary perturbations from 1858 to the last perihelion passage towards the end of 1871, and hence derived elements for that appearance which were found amongst his papers after his death. It may perhaps be convenient, for the sake of reference, if Tischler's orbits for the three perihelion passages at which the comet has thus far been observed, are here transcribed:—

	1790	1858	1871
T	Jan. 30·8702	Feb. 23·5169	Nov. 30·4642
	° ′ ″	° ′ ″	° ′ ″
π	115 42 0	115 50 56	116 4 36
☊	268 36 34	269 3 4	269 17 12
i	54 6 26	54 24 30	54 17 0
ϕ	55 1 4	55 12 9·9	55 11 25·6
Log. a	0·7619723	0·7585361	0·7601603

The motion is direct. T is the time of perihelion passage for meridian of Greenwich; that for 1871 being the *predicted* time, which appears to have required a correction of $+ 1^{d}\cdot333$ nearly. ϕ is the angle of eccentricity ($e = \sin \phi$), and a the semi-axis major.

It is stated that the calculation of the perturbations of this comet to the next appearance in 1884 has been undertaken by Mr. Stone, of Washington.

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

M. DUMAS in his presidential address made some striking remarks on the important place filled by physical science in modern times as contrasted with its former supposed inferiority to literature, philosophy, and art. "Natural science is no longer content with the contemplative attitude which sufficed for Newton and Laplace. Science is now mixed up with all the personal acts of our existence; she interferes in all measures of public interest; industry owes to her its immense prosperity; agriculture is regenerated under her fostering care; commerce is forced to take her discoveries into account; the art of war has been transformed by her; politics is bound to admit her into its councils for the government of states. How could it be otherwise? Have not mechanics, physics, chemistry, the natural sciences, become intelligent and necessary agents for the creation of wealth by labour? Have they not opened the way to all the institutions by which hygiene watches over the health of workers and the salubrity of cities? If comfort is more universal, the life of man more prolonged, wealth better distributed, houses more commodious, furniture and clothing cheaper, the soldier better armed, the finances of the State more prosperous, is it not to the sciences that all this progress is due? It is they that discover in the ground the first new materials, that show to agriculture the most suitable productions, the most efficacious manures, and the most appropriate implements; they that, inventing new processes for industry, put into its hands untiring machines, sometimes gigantic, rivalling in brute force the giants of fable, sometimes delicate, rivalling in nimbleness the hands of fairies. It is the sciences, in fine, that have given to the world the rapid means of communication by land and sea, by the aid of which man takes possession of the terrestrial globe, creating new peoples and flourishing cities where our fathers knew only of barren deserts and uninhabited regions. . . . Science follows you everywhere: breathe, there is chemistry; walk, there is mechanics; at every moment, without thinking of it, we cannot help having to do with her. Whether we wish it or not it is necessary to accept science as a companion, to possess her or to be possessed of her; if you are ignorant you are her slave, if you are skilled she obeys you. The future belongs to science; unfortunate are the people who shut their eyes to this truth."

The work of the various sections was carried on actively throughout the week, and a fair average of good papers seem to have been read, as usual, the section devoted to the medical sciences filling a large space. In the section of Anthropology, M. Tubino read an interesting paper on the Iberian Peninsula, in which he brought out strikingly the great differences which exist between the inhabitants of the various provinces of Spain and Portugal. There is found in the Spanish races no unity of origin or of physique. There is not only dissimilarity, but also antithesis and opposition. M. Tubino endeavoured to show that the same diversity existed in the region of morals, in language, in art, and in the ideas of right and law, and that thus there is really no Spanish race and no means of establishing in the Iberian Peninsula a centralised state. An interesting discussion followed in which M. Broca, while agreeing with M. Tubino's main statements, showed that the same diversities exist in every country that are found in Spain. The only great barriers of states are geographical limits; the idea of race is a delusion and a snare, and no doubt civilisation will come to Spain as it has come to France.

In the Botanical Section Prof. Lanessan explained the results of his organogenic and histologic researches on the foliar appendages of the *Rubiaceæ*. Prof Haeckel spoke of some facts relative to the structure of the glands of some plants called carnivorous. The glands described by Darwin as dissolving and absorbing, are found on the inferior face of *Pinguicula vulgaris* and of *Nuphar pumilum*, where they are unicellular. The cellules of these glands present the phenomenon of protoplasmic aggregation under the influence of slight solutions of ammoniacal salts (one-half per cent.). The same facts are presented in the glandular hairs of *Petunia*, *Sparmannia*, and *Pelargonium*, which dissolve flesh after hypersecretion of the glands. He regards the phenomenon of protoplasmic aggregation as characteristic of absorption, and thinks that there will, perhaps, be room for distinguishing physiological aggregation from the morbid aggregation produced under larger doses of reagents. M. Merget explained the result of his researches in the production of phenomena of gaseous synthesis in vegetables.

An excursion was made on Tuesday morning to the top of the Puy-de-Dôme, in which most of the distinguished members of the Association, several ladies, and a number of English men of science took part. An excellent banquet was provided in a small valley at a short distance from the top. Eleven hundred guests had been invited by the Council-General; eight hundred were present. Many healths were proposed and speeches made.

The construction of the observatory cost 225,000 francs, and 100,000 more are required for the completion of the work, although it is in working order. The expenses have been sustained by the department, and the instruments have been constructed by the government. The house of the keeper and director is a massive building situated at a small distance from the top, and partly protected by rocks. Three lightning conductors have been adapted to it. The observatory is a tower standing on a platform, the communication between which and the house is by a well-staircase seventeen metres deep, and a tunnel thirty-five metres long. On the top of the tower is a movable platform. The view is magnificent, but special precautions will be required in constructing an anemometer which will be able to bear the pressure of the storms. It will be a self-registering one.

The concluding sitting of the session took place at the Hotel de Ville on Friday last, under the presidency of M. Dumas. M. Kuhlman was nominated vice-president for 1877 and president for 1878; M. Perier vice-secretary-general for 1877 and secretary-general for 1878. The city for the meeting in 1878 has not been officially determined upon, but the intention of the committee is unanimously to propose Versailles or Paris, in order to take advantage of the interest created by the Universal Exposition.

The 1877 meeting will take place at Havre under the presidency of Dr. Broca, the celebrated anthropologist; M. De Lairain, the agricultural chemist, will be the general secretary.

The recommendations to Government have been few but interesting. The section of Mathematics asked the Government to give Commandant Perier and his fellow-workers the sum sufficient for continuing their present work of triangulating France. On Monday, the 21st, a lecture was delivered by M. Perier at the theatre on the geological work executed under his direction by staff officers, and the determination of the longitude of Puy-de-Dôme by electricity. The work is proceeding at the present time, and a temporary astronomical observatory has been established side by side with the meteorological one for that purpose.

The meteorological section asked government to organise a general issue of agricultural warnings (which M. Leverrier is preparing to do), to establish a national institute of meteorology, and to assist General Nansouty in the establishment of an observatory on the Pic du Midi, at an altitude exceeding by 3,000 feet the Puy-de-Dôme.

The "encouragements" to scientific workers are not determined by the General Meeting, but by the Council, according to the wants which may be made known from time to time during the year, and a report of the manner in which the money has been spent is presented yearly at the inaugural session of the Association.

NORDENSKIÖLD'S EXPEDITION TO JENISEJ, 1876

THE following plan of the expedition to the mouth of the Jenisej, fitted out by Messrs. Oscar Dickson, of Gothenburg, and Alexander Sibiriakoff, of St. Petersburg, has been published in the *Göteborgs Handels Tidning*:—

As it was desirable that the inquiries into the natural history of middle and north Siberia, and specially of the Jenisej valley should be recommenced during an earlier part of the year, a number of the members of the expedition were obliged, in the month of April, to travel by land *viâ* St. Petersburg, Moscow, Jekaterineburg, &c., to the town of Jeniseisk, thence to proceed down the river by boat to its mouth. For naturalists who had before made themselves familiar with the animal and plant world of northern Scandinavia, such a boat journey offered an excellent opportunity for comparative studies of the natural history of Siberia and Scandinavia, which will not only be of great moment for a knowledge of the flora and fauna both of Russia, and specially of Siberia and of Scandinavia, but also, as I have before pointed out, of true practical value in judging of the fitness of middle Siberia for cultivation. The land expedition is also entrusted with the task of carrying out the soundings necessary for ascertaining whether the Jenisej is navigable, and other hydrographical work, and specially of examining the navigable waters in the lower course of the Jenisej between Dudino and Mesenkin, in order to be able, on the arrival of the vessel at the last-named place, near the mouth of Jenisej, to pilot it to its proper destination, Dudino. I have given the leadership of this division of the expedition to Zoology-Docent Hj. Théel, from Upsala. Besides him there take part in it two botanists, Rector M. Brenner, from Helsingfors, and Docent H. W. Arnell, from Upsala, and two zoologists, Dr. J. Sahlberg, from Helsingfors, and Dr. F. Trybom, from Upsala.

It is, perhaps, already known through the newspapers that these gentlemen have arrived at Jeniseisk, and commenced the intended boat journey from that place to the mouth of the river.

For the main division of the expedition, which is to make its way by sea to Jenisej, I have chartered the steamer *Ymer*, of Gothenburg. The *Ymer* is a strong freight vessel, built of oak, of the first class in Veritas, of 400 tons burden, fully rigged with sails, and having a steam-engine of 45 horse-power. This part of the expedition is accompanied, besides the undersigned, by Docent F. Kjellman and Dr. A. Stuxberg, both members of the expedition of 1875, the former also of that which wintered in Mussel Bay in 1872-3.

The expedition now departing in the *Ymer* is not, as will be seen from the above, a commercial enterprise, but a scientific expedition, whose main object is to survey the navigable waters between Obi-Jenisej and northern Norway. But the Russian government having in the most accommodating way removed the obstacles which threatened to arise to the bringing in of goods to those regions where naturally no custom-house officers are to be found, I have considered that I ought, in order thereby practically to open the new commercial route, to take with me a small quantity of goods suitable for north Siberia, for the most part sent as samples by Swedish manufacturers, and, if opportunity offers, I shall also endeavour to obtain return cargo from Siberia to Europe.

During May, June, and the greater part of July, it is not possible to count on finding open water east of Novaya Zemlya, and it was therefore unnecessary for the *Ymer* to leave Sweden sooner than the beginning of July, the calculation being that she would enter the Kara Sea in the end of the month or the beginning of August. If all goes well the vessel ought in that case to be in a few days at Mesenkin, where a meeting has been fixed with Dr. Théel's party. If there be sufficient depth of water the voyage is to be continued to Dudino, where the cargo will be discharged and a new one taken on board.

By the end of August the *Ymer* ought to be again clear to return the way she came, possibly with some short excursion towards the north-east in order as far as possible without coming among ice to examine the sea between the mouth of the Jenisej and Cape Tscheluschkin. In the latter half of September I count on being again in Norway. A. E. NORDENSKIÖLD

NOTES

THERE is little to add in reference to the arrangements for the Glasgow meeting of the British Association to the information we published some weeks since (vol. xiv., p. 170). Everything has evidently been done by the local secretaries and committee to render the meeting a success so far as they are concerned. The class-rooms at the University, where the sections, with one exception—the Geographical—will be accommodated, have been for some time in the hands of workmen, and the necessary alterations will be completed in good time. The lower hall of the museum, which is situated a little to the east of the north or main entrance of the university, will be fitted up as the reception-room, and in connection with this will be the post and telegraph offices, general inquiry office, a stall for the disposal of newspapers and scientific literature. In this portion of the building there will also be located the offices and rooms of the local committee, and a ladies' retiring-room. Adjoining the reception-room will be the ticket-office, and from this will be the entrance to the refreshment-room. The sections will be distributed over the university, and the local committee contemplate issuing a diagram of the building, showing the class-rooms allotted to each department and their situation. The arrangements have been carried out so that the committee-rooms will adjoin all the sections. At the Queen's Rooms the arrangements are well forward for the accommodation of the Geographical Section.

MOST of the time of the International Congress of Orientalists which meets at St. Petersburg during the first ten days of September will be devoted to researches connected with Russian Asia. Of the four *séances* claimed for Asiatic Russia, we learn from the *Times* the first will belong to Eastern and Western Siberia, the second to Central Asia, so far as it is under Russian sway, together with the independent principalities of Ouzbekistan; in the third will be treated Caucasia, with the Crimea, and the other countries of European Russia which are inhabited by Asiatics; in the fourth, Trans-Caucasia (Georgia and Armenia, according to their ancient limits). In the three following *séances* the Congress will concern itself with the rest of Asia in three groups—1. Eastern Turkestan, Tibet, Mongolia, including Mantchuria and Corea, China Proper, and Japan; 2. India Cis-Gangetic and Trans-Gangetic, Afghanistan, Persia, and the Indo-Chinese Archipelago; 3. Turkey, including Arabia and Egypt. The subjects to be treated in these seven *séances* are the cartography, ethnography, linguistic science, history, and literature of the respective countries. The last two *séances* will be devoted (1) to the questions relative to the archæology and numismatics, (2) to their religious and philosophical systems. An exhibition of objects illustrative of the antiquities and actual present condition of the Eastern peoples will be a novel and interesting feature. The Emperor of Russia has given to the St. Petersburg committee a sum of 75,000 roubles to defray the expenses of the meeting.

IN connection with the remarks on the influence of temperature on the herrings, in last week's NATURE (p. 352), we have read with much interest, in the *Scotsman* of August 25, the fishing report of the fishery district officer for North Sunderland. From this report it appears that for the week ending Saturday the 19th, the sea thermometers furnished to the fishermen by the Scottish Meteorological Society indicated a temperature on that coast of from 58° to 59°, but that on Monday evening, the 21st, when the nets were shot, the temperature had fallen to 55°, and this was the first night the herrings were caught. Since then the shoals of herrings have been so dense that several crews have sustained heavy loss by the weight of the herrings taking the nets to the bottom. The writer states that all this season during the warm weather the herrings were found low in the nets from Northumberland to Peterhead, and it was only when they came close upon the shore into shoal water, or from fifteen to eighteen fathoms, that the herrings were got. He thinks it premature to say that the Fraserburgh and Peterhead fishing will be a short one, as probably an inshore fishing, and a heavy one, may yet be made, the herrings having been approaching the shore at a depth below the nets. Evidently the remarkable weather and fishings of this herring season will furnish data for a contribution of no little interest to this difficult but important inquiry.

FROM a programme before us we gather that the exploration of the Cresswell Caves, carried on last year by the Rev. J. M. Mello, assisted by Mr. Heath, is now being conducted by a committee, of which Sir John Lubbock, Bart., M.P., is president, and Prof. Boyd Dawkins, F.R.S., is secretary. The superintendence of the work is in the hands of the Rev. J. M. Mello, the secretary, and Mr. Heath. The results are now being classified in Owens College, and we can confidently inform our readers that when the report by Mr. Mello and the secretary is presented to the Geological Society of London, it will add as much to our present knowledge of palæolithic man as the discoveries in Brixham did to the knowledge of 1857. The names of the members of the committee are a sufficient guarantee that the work will be carried out as well as it can be.

M. LEVERRIER has sent a circular to the several presidents of departmental councils notifying them that the Director of Government Telegraphy has agreed to send telegraphic messages to each head town of the departments (eighty-seven in number) if a proper organisation has been established to spread the warnings and to use them in the proper way. Departmental councils wishing to establish agricultural warnings are consequently to communicate with M. Leverrier, who will help them in doing so. The conditions required for the establishment of a departmental meteorological service are the appointment of a local meteorological board, which is to modify, according to local circumstances, the general information sent to the chief town, and to disseminate it in the several districts. The state telegraph circulates, free of charge, these local warnings. But in each district there must have been established a public barometer, thermometer, and rain-gauges, regularly inspected, verified, constructed according to the official pattern, and a competent local observer must have been appointed.

THE *Turkestan Messenger* states that M. Severtsow proposes to undertake, this autumn, a journey of exploration in the valley of Fergana and the neighbouring mountains. Next summer he will explore the Altai and the mountains of Southern Khokand, pushing on in the autumn of 1877 as far as the Pamir. M. Severtsow will be accompanied by an astronomer, a mining engineer, and a botanist.

THE steamship, which intends to cross with preserved meat from Buenos-Ayres, set sail from Rouen on August 23, M. Tellier, the inventor of the system, being on board. The cold is to be obtained in the hold of the ship by constant circulation of air, refrigerated by contact with tubes in which methylic ether is constantly evaporating.

THE Secretaries of the British Pharmaceutical Conference, whose thirteenth annual meeting commences at Glasgow on September 5, have already issued a list of papers which are promised for reading. We think it would be well if the British Association took a leaf out of the book of the Pharmaceutical Conference.

THE Lords of the Committee of Council on Education being of opinion that the subject of Physical Geography, as now defined in the Science Directory, is not one towards instruction in which the special aid of the Science and Art Department should be continued, intimate that the outlines of the syllabus of a subject which will take the place of physical geography, are now under consideration. The subject (physiography) will embrace those external relations and conditions of the earth which form the common basis of the sciences of nautical astronomy, geology, and biology, as treated in the Science Directory. At the same time it is proposed to allow payments for the next two years for those students who have already been under instruction by any science teacher in physical geography, but not for any others, nor for any examination held after May, 1878.

FROM the *American Journal of Microscopy* we learn that arrangements have been made with Prof. Huxley to deliver three lectures in New York on the 18th, 20th, and 22nd of September, the subject being "The Direct Evidence of Evolution."

MR. F. J. FARADAY, the Secretary of the Manchester Field Naturalists' and Archæologists' Society, has also been appointed Secretary to the Manchester Aquarium.

IN a pamphlet recently issued by the Russian Government, detailed statistics are given with reference to the damage done by wolves throughout that empire. There are said to be not less than 170,000 of these animals, which, during last year were the cause of death to not less than 200 people; whilst the destruction of cattle and poultry by them is enormous, almost as much as by the cattle-plague.

THE number of visitors to the Loan Collection of Scientific Apparatus during the week ending August 26 was as follows:—Monday, 2,926; Tuesday, 2,460; Wednesday, 323; Thursday, 305; Friday, 322; Saturday, 4,361; total, 10,697.

M. ABEL TRANSON, a Professor in the Polytechnic School, Paris, has died at the age of seventy years. He was the author of numerous memoirs in the *Journal de Mathématiques*, edited by Lionville. He had been successively a disciple of Saint Simon and Fourier, and had attracted public notice by the part he played in the propagation of these eccentric doctrines of social reform.

THE Paris Exposition of Practical Insectology was opened last Sunday on the terrace of the Tuileries Gardens, although the preparations are far from being completed. It promises to be an interesting and successful undertaking.

IT is well known that among the first enterprises in the form of original research undertaken by the Smithsonian Institution, was the organisation of a body of correspondents in meteorology for the purpose of securing reliable data in regard to the climatology of North America. This work was prosecuted as thoroughly as the means of the Institution would permit, and was conducted with unintermitting zeal from about 1848 until within a few years past, when the expenditure of ample means by the Signal Service for the same purpose rendered it unnecessary for the Institution to continue its efforts. A period of full twenty-five years or a quarter of a century is embraced in these records. The Institution has recently been engaged in working up and discussing these results for the purpose of obtaining reliable laws in regard to American climatology. Several years since this material was drawn upon by Prof. Coffin in the preparation of his work on the "Winds of the Northern Hemisphere," and published by the Smithsonian Institution. This was followed a few years subsequently by the publication of the tables of rain-fall prepared by C. A. Schott. We now have to report the appearance of a third volume of the series, that of the "Atmospheric Temperature," forming a work of about 360 pages, illustrated by three plates, one showing the summer temperatures, one those of winter, and one the means of the year. The new edition of the work on the winds, commenced by Prof. Coffin, and finished after his death by his son, with the assistance of Prof. Wojeikoff, will, it is understood, make its appearance in a short time.

The fourth number of the second volume of the *Bulletin* of the Geological and Geographical Survey of the Territories is occupied by several zoological papers by Mr. J. A. Allen, of Cambridge. The most important of these is one upon "The Geographical Variation among North American Mammals, especially in respect to Size." Referring to the generalisation that was made some years ago, that the American Mammals as well as birds increase in size with the latitude of their birthplace, as also with altitude, Mr. Allen remarks that this does not apply in the case of some of the carnivora, and that the following propositions more nearly express the facts: 1. The maximum physical development of the individual is attained where the conditions of environment are most favourable to the life of the species. 2. The largest species of a group (genus, sub-family, or family, as the case may be) are found where the group to which they severally belong reaches its highest development, or where it has what may be termed its centre of distribution. 3. The most "typical," or most generalised representatives of a group are found also near its centre of distribution, outlying forms being generally more or less "aberrant" or specialised.

A COMMISSION composed of members of the Institute and other men of science has been appointed by M. Teisserene de Borg, the French Minister of Commerce and Agriculture, to draw up the regulations for the National School of Agriculture which has been re-established by a vote of the Senate. That establishment was abolished by Napoleon III. in the beginning of his reign; it was created by the French Republic of 1848.

M. NADAULT DE BUFFON, a French *savant*, has sent to the Society of Acclimatisation, through M. Drouyn de Lhuys, the herbarium collected by Daubenton, the great friend of his illustrious ancestor. The herbarium was collected at Montbard, when Daubenton was busy in the erection of a sheep-house, which led to the introduction into France of the first *merinos*.

A NOTEWORTHY feature in the *Iowa Weather Review* for June, No. 6, is the five weather maps accompanying it—one showing the position of the ninety-seven stations now established in the State, while the other four show the distribution of the rainfall during each of the three decades of May and during the whole month. Dr. Heinrichs aims at establishing other twenty-two stations in order to secure that the greatest distance between any two stations shall not reach fifty miles, and about 100 stations for rainfall and other non-instrumental observations which he properly regards as necessary for an accurate study of the atmospheric conditions of Iowa. A rapid summary of the weather of March, April, and May, with tabular matter, in several respects of an original and highly practical character, completes an interesting number.

WE have on our table the following books:—"The Law of Storms, considered Practically," W. H. Rosser (Charles Wilson). "The Yorkshire Lias," Ralph Tate and J. F. Blake (Van Voorst). "Wine and its Counterfeits," James L. Denman. "The Sun; Ruler of the Planetary System," third edition, Richard A. Proctor (Longman). Arnott's "Elements of Physics," seventh edition, edited by Bain and Taylor (Longmans). "The Andes and the Amazons," James Orton (Harper Brothers). "Comparative Zoology," James Orton (Harper Brothers). "On Mixed Languages," J. C. Clough (Longmans). "Weather Charts and Storm Warnings," R. H. Scott, F.R.S. (H. S. King and Co.). "Geological Survey of Canada for 1874-5." "Lectures on Astronomical Theories" (John Harris). "Dental Student's Note-Book," Oakley Coles (G. Butcher). "United States Geological Survey," Vols. ix. and x. The following German works may be had in London from Messrs. Williams and Norgate:—"Lehrbuch der Pathologischen Anatomie," von Dr. F. v. Birch-Hirschfeld, Erste Hälfte (Leipzig, F. C. W. Vogel); "Handbuch der Zoologie," von Gustav von Hayek (Wien, Carl Gerold's Sohn).

THE latest additions to the Royal Aquarium, Westminster, include the following:—John Dorey (*Zeus faber*), Scad, or Horse Mackerel (*Trachurus trachurus*), Small-mouthed Wrass (*Acantholabrus exoletus*), Gemmeous Dragonets (*Callionymus lyra*), Sea Sticklebacks (*Gasterosteus spinachia*), Red Bream (*Pagellus centrodontus*), Three-bearded Rockling (*Motella mustela*), Large Spider Crabs (*Maia squinado*), Mexican Axolotl (*Axoloteles guttatus*), presented by Mr. Jabez Hogg.

THE additions to the Zoological Society's Gardens during the past week include two Green Monkeys (*Cercopithecus callitrichus*) from West Africa, presented by Mr. Henry Richardson; a Sloth Bear (*Melursus labiatus*) from India, presented by Messrs. Royle and Gray, Lieutenants R.N.; two Russell's Vipers (*Vipera russelli*) from Ceylon, presented by Mr. Henry S. Saundens; three Dark-green Snakes (*Zamenis atrovirens*), four Dahl's Snakes (*Zamenis dahli*), a Clifford's Snake (*Zamenis cliffordi*) from Dalmatia, presented by Lord Lilford; a Hoffmann's Sloth (*Cholopus hoffmanni*) from Panama, deposited; a Macaque Monkey (*Macacus cynomolgus*), born in the Gardens.

SCIENTIFIC SERIALS

PART 4 of vol. xxvi. of the *Zeitschrift für Wissenschaftliche Zoologie* (March, 1876) opens with a long communication from O. Bütschli on the free Nematodes and on the Gastrotrichous genus Chætonotus. He gives many additional particulars respecting forms already made known by Bastian and others. He comes to the conclusion that the Gastrotricha are intimately related to Dujardin's genus Echinoderes; and he combines them into a group Nematorhyncha. He then considers the relations of these forms to Vermes and Arthropods, and constructs a supposed phylogenetic tree. The paper is beautifully illustrated.—Dr. Hermann von Ihering has a controversial article on the development of Cyclas and the homology of the blastodermic layers in Mollusca. He especially calls in question the observations of Ray Lankester, Haeckel, and Ganin, and approves the modified form of the Gastræa theory no more than the original.—F. E. Helm describes in detail the silk-glands of Lepidoptera, and their retrogressive changes after full function.—Herbert Ludwig, giving an account of the formation of the blastoderm of spiders, states that his observations are in entire accordance with Haeckel's views.

Gegenbaur's Morphologisches Jahrbuch.—Part 3 opens with a long and important communication by Oscar Hertwig on the formation, fecundation, and division of the ovum in the Echinid *Toxopneustes lividus.* He considers chiefly the fate of the germinal vesicle and the connection between it and the subsequent development of the ovum. From his observations he supposes that when the germinal vesicle is resolved the germinal spot is saved and gets to the centre of the ovum; he finds that a nuclear body which may be the head of the spermatozoon approaches this and coalesces with it, and that the resulting body assumes an hour-glass shape and finally divides into two, and really originates the cleavage of the ovum. Unfortunately the author has to make assumptions at the most critical points, and consequently his views cannot be accepted without confirmation.—Dr. G. Born has a contribution on the sixth toe of Anura, referring to the cartilages considered by Cuvier and Meckel as a rudiment of a sixth member of the hind limb. Another lengthy memoir in this part is by R. Wiedersheim on the anatomy of *Phyllodactylus europæus*, a member of the group of lizards of which the gecko is the type, found in the Island of Sardinia, as well as in the islet Tinetto, on the western horn of the Gulf of Spezia. He considers very fully the relation of the *aqueductus vestibuli* to the *sacculus endolymphaticus* in the Ascalabota generally.

In Part 4 Dr. B. Gabriel describes a new genus and species of Rhizopod living in moist earth about the roots of mosses. This form, which he names *Troglodytes zoster*, has a shell-like investment and emits pseudopodia at one pole only. The life-history of this form has been traced, and it is of great interest. Two adult specimens conjugate by their pseudopodia and afterwards separate; this is followed by an encysted stage, during which a large number of minute granules grow up into germs which are liberated from the investment, and grow up into a minute monostigma form. These germs subsequently conjugate in pairs constituting a diplostigma, and ultimately they slowly coalesce, and then assume the parent form.—T. W. Engelmann has an elaborate article on development and reproduction in Infusoria, in which he gives an account of the stages of *Opalina ranarum* and of budding and conjugation in Vorticella and Epistylis. He further examines and criticises many observations of other authors, and some of his principal conclusions are as follows:—That the conjugation of Infusoria does not lead to reproduction by means of ova, but to a peculiar development of the conjugated individuals, which he terms reorganisation; that the nucleus, neither in conjugation nor in any other circumstance, plays the part of a germ-producing organ; that its significance is merely that of an ordinary cell-nucleus.—Max Fürbringer continues his monograph on the comparative anatomy of the shoulder-muscles, by a chapter of 180 pages, on the bony shoulder-girdle and sternum, the brachial plexus, and the muscles related to the shoulder in Lacertilia and Crocodilia.

SOCIETIES AND ACADEMIES

PHILADELPHIA

Academy of Natural Sciences.—Session 1875–6.—Prof. Cope's contributions to palæontology and philosophic biology have been numerous and important. In successive communications he has given accounts of the Eocene mammals of the Rocky Mountains, possessing characters which at first led to their being assigned to the Carnivora. Prof. Cope has demonstrated their insectivorous affinities, but finds that the definition of existing insectivora is insufficient to include them. Other forms supposed at first to be of lemurine affinities are found to be yet more generalised, and to range with the previously mentioned animals. He proposes the name Bunotheria for the order, with sub-orders Creodonta, Mesodonta, Insectivora, Tillodonta, and Tæniodonta (*Proc.* 1876, p. 88). Prof. Cope has also endeavoured to equate the North American Eocene to the European zones. The Bridger formation of S.W. Wyoming he calls Middle Eocene, characterised by Palæosyops, Tillodonta, and Dinocerata; and the Wahsatch group in N.E. New Mexico and S.W. Wyoming is assigned to the Lower Eocene, with Coryphodon, Tæniodonta, Phenacodus, and Diatryma.—Mr. Robert Ridgway contributed (*Proc.* 1875, p. 470) a valuable monograph on the North American hawks of the genus Micrastur. An examination of the perplexingly-various plumage shows that there is no appreciable sexual difference; there are two well-marked growth-stages with plumage distinctions; certain species are notably dimorphous, some deeply rufescent, others clear plumbeous, without reference to age, sex, or season.—Other contributions to zoology include the establishment of a new genus of Procyonidæ from Costa Rica, by Mr. J. A. Allen; observations on the habits of manatees kept in confinement in the Zoological Garden at Philadelphia, by Dr. H. C. Chapman; Dr. Wilder on fishes' brains, and Prof. Leidy on Rhizopods, and Mr. H. K. Morrison on American Noctuidæ.—Dr. Isaac Lea has continued his researches on the microscopic structure of gems, and has found that in addition to the internal crystalline forms which they possess, there are in most gems, cavities, often tens of thousands in number.—Mr. George Hay, in his chemical contributions gives an account of the decomposition of stannous chloride vapour in a Geissler's tube; and of the solubility of tin, arsenic, and antimony in concentrated nitric acid at 36° F., when the oxidation is in the ratio of their several volatilities.—Prof. Persifor Frazer and Dr. Kœnig have been the principal contributors in geology and mineralogy.—Mr. Thomas Meehan among several botanical notices has given accounts of interesting hybrids, of certain insectivorous plants, and of a certain maple tree which flourished although all its leaves became reversed, so as to expose its stomata to direct sunlight. The propagation of *Tillandsia usneoides*, the epiphytic, not parasitic Florida or Spanish moss was described as being principally by means of small branches scattered during storms or by other means, but very rarely by seeds.—An interesting observation was made on the large number of cases in which double Chinese peaches of the season 1875 bore two or three fruits on each flower; thus showing their solidarity with the polycarpellary Rosaceæ.

VIENNA

Imperial Academy of Sciences, March 9.—On the nature of the soft or half liquid state of aggregation; on regelation and recrystallisation, by M. Pfaundler. After dividing the bodies in question into mixtures of small solid parts with true liquids, soft bodies proper, containing no dissimilar parts, and mixtures of the two classes, he gives a hypothesis on the process of melting and the soft state. The common ideal melting process, where the temperature remains the same from beginning to end, is not according to fact. The mean temperature of the body beginning to melt is about $t + t'$ lower than that of the already melted mass, if $\pm t$ and $\pm t'$ denote the amounts of divergence of temperature of the separate molecules in the solid and liquid condition. Hence the true melting point is different from the temperature at the beginning and the end of the melting process. M. Pfaundler extends his hypothesis to soft bodies of compound nature, and to regelation and recrystallisation.—On the difference of tension between the left ventricle and the aorta, by M. Gradle. The blood pressure in the aorta is usually higher than the maximal pressure in the left ventricle. The difference disappears when the points of the semilunar valves are torn through.—On the physical nature of vegetable protoplasm, by M. Velten. The retention of form (in hair cells, leaf cells, &c.) and simultaneous mobility of particles, indicate that at least two bodies with different aggregate states exist in protoplasm. The dense parts do not envelop the liquid parts, but solid and liquid particles are arranged beside each other in small spaces. In considering the ball formation of plasma, which is the principal argument for its liquid nature, M. Velten distinguishes normal and abnormal ball formations; the former could not prove the viscous nature of plasma, while the latter unmistakeably point to a semi-liquid state of aggregation of the whole body.—On nitro-glycerine and the most important nitro-glycerine preparations, by M. Beckerhin.—On the condition of heat equilibrium of a system of bodies with reference to gravity, by M. Loschmidt. Gravitation affects only the vertical component of molecular velocity, leaving the horizontal untouched; this destroys the symmetry of distribution of velocity in gases.—Communications from the Mineralogical Museum of the University, by M. Schrauf. This relates to certain minerals from the graphite deposits of Mugrau.

March 16.—On the influence of temperature on galvanic conduction of tellurium, by M. Exner. The alteration of conductivity through heat is due to a change of molecular structure;

thus too are explained the turning points Matthiessen found in the curve representing resistances of tellurium at different temperatures.—On the geometric-symmetric forms of the earth's surface, by M. Boué. The rotation force of the earth forbids comparison of the clefts on its surface to those of a clay-lump produced by contraction. The earth took its present form under several forces, especially the centrifugal force of rotation, wave-motion of the still plastic and hot zones under the crust, and infiltration of water. The orography of the earth is somewhat similar to a chess-board.—On the relation of the coefficient of internal friction of gases to temperature, by M. Obermayer. The coefficient of friction of the permanent gases is approximately proportional to the $\frac{3}{4}$ power of that of the coercible gases, and to the 1 power of the absolute temperature.—Researches on the relations of nutritive matters to transpiration of plants (first part), by M. Wiesner. Dilute acids accelerate, dilute alkalies retard, the transpiration. Very dilute solutions of the salts that were employed (0·05, 0·1, 0·2, 0·25 per cent.) accelerate the transpiration; more concentrated solutions (0·5, 1 per cent.) retard it. In solutions of nutritive matter, even with such a degree of concentration as, where solutions of the separate salts were used, accelerated the transpiration, the latter was less than in distilled water. Aqueous humus extracts also diminish the transpiration.

March 23.—On elevation of animal temperature after section of the spinal cord, by M. Schroff.—New propositions of the mechanical theory of heat (second part); on forces determining the volume of bodies, by M. Puschl. Theory leads him to conclude, that at the end of a cycle-process in a body, not only the heat, but also the other forms of force present and jointly determining its volume have done a positive or negative external work. The results of Edlund's experiments on the heating of contracting metallic wires are a first experimental proof of this theoretical deduction.—On æthyl propylcarbinol, by M. Völker.—On the ground-forms of linear geometry, by M. Frombeck.

April 20.—The principle of dissimilar molecular states applied in explanation of supersaturated solutions, superfused bodies, retardation of boiling, spontaneous explosions, and crystallisation of amorphous bodies, by M. Pfaundler.—The theoretical basis of the Foucault pendulum experiment, by M. Pick.

GENEVA

Physical and Natural History Society, May 4.—Prof. F. A. Forel, of Morges, described the traces obtained by him in his native town, situated on the north shore of the Lake of Geneva, by means of a registering limnimetre. This automatic apparatus indicates constantly the height of the water of the lake on an endless paper band, which is unfolded at a rate of about a millimetre per second, by means of clock-work. By means of the tracings thus obtained may be investigated the oscillations of level known as *seiches*. M. Forel has thus verified, in a very satisfactory manner, the theory which maintains that these *seiches* are rhythmic isochronous movements, waves of fixed oscillation (the stationary, mononodal waves of Guthrie). He proves that the water of lakes oscillates almost constantly from one bank to the other, and that in two principal directions, along the great axis and along the smaller diameter of their surface. These two movements, which are often simultaneous, are what M. Forel calls longitudinal *seiches* (lasting for seventy minutes on the Lake of Geneva) and transversal *seiches* (ten minutes induration). The comparison of these tracings with meteorological circumstances will show what relations exist between the movements of the *seiches* and the variation of atmospheric pressure.

PARIS

Academy of Sciences, Aug. 21.—Vice-Admiral Paris in the chair.—The following papers were read:—Meridian observations of small planets, made at the Observatory of Greenwich (sent by the Astronomer-Royal, Sir G. B. Airy) and at the Paris Observatory, during the second trimestre of 1876, by M. Le Verrier.—Theorems relating to curves of any order and class, in which are considered couples of rectilinear segments having a constant length; examples of the variety of different solutions furnished, in each question by the principle of correspondence, by M. Chasles.—Thermal formation of hydroxylamine or oxyammonia, by M. Berthelot. Thermal observations confirm and define the unstable properties of oxyammonia, an instability due to the exothermal character of its different modes of decomposition.—An effect of lightning during the storm of Aug. 18, by M. Trécul. While writing at his open window between even and eight A.M. he observed, simultaneously with some loud thunder, small luminous columns descending obliquely on his paper; about 2 metres long, 1½ decimetre broad at the widest part, obtuse at the further end, but gradually thinning towards the table. They had mostly a reddish yellow tint; near the paper the colours were more intense and varied. In being extinguished, they left the paper with a slight noise like that made by pouring a little water on a hot plate. M. Trécul felt no bad effects.—Results obtained by the treatment of phylloxerised vines, by means of sulpho-carbonates and the distributing pale, by M. Allibert.—On the invasion of winged phylloxeras at Mancey (Saône-et-Loire) on June 25. They deposit their pupæ in the down of the leaves. Four or five could be counted on a single leaf.—Observations of the planet (165) Peters, made with the equatorial of Paris Observatory, by MM. Paul and Prosper Henry.—Observations of planet (165) at Leipsic, by M. Bruhns.—Discovery of the planet (166); despatch from Mr. Joseph Henry, of Washington, to M. Leverrier.—Electric regulator to maintain the motion of pendulum, by M. Bourbouze. To the upper part of the pendulum is fixed a magnetised bar which can oscillate freely within a rectangular bobbin with two wires like that of a galvanometer. At each oscillation a current of constant intensity is passed into the bobbin, but alternately in different directions; and this maintains the motion. The reversal is effected by means of a beam having at each of its ends a bridge which dips in two cups containing mercury.—On chaplet (or beaded) flashes of lightning, by M. Planté. This name is given to a phenomenon observed in Paris on Aug. 18. The lightning, coming from the cloud to the ground, described a curve like an elongated S, having the aspect of a chaplet of brilliant grains along a very thin luminous thread. This results from passage of the electric fluid through a ponderable medium. The case is analogous to that of the chaplet of incandescent globules presented by a long metallic wire fused by a voltaic current, or to the swellings and nodes in the flow of any liquid vein. Such agglomerations, naturally, are dissipated more slowly than the line collecting them. We have here a transition form of lightning between that of the ordinary sinuous and straight lines and the globular form. Fulminating globes may be considered as derived from a chaplet flash.—On equivalent substitution of mineral matters which enter into the composition of plants and animals, by MM. Champion and Pellet. In the ashes of flesh of different animals and hen's eggs the phosphoric acid is nearly constant, as also the quantity of acid capable of saturating the bases. With different compositions of ashes the weight of sulphuric acid saturating the bases is higher the more there are of bases with small equivalents. The ashes of veal contain more soda than those of beef, so do those of hen's eggs and the adult hen.—On the fermentation of urine; reply to M. Pasteur, by Prof. Bastian. M. Pasteur explains his negative result by the potash having been heated to 110° C., Prof. Bastian only by the fact that the potash has been added in excess. That all Bacteria germs are killed in potash solutions heated to 100° appears from two facts: (1) boiled potash solution has not a fertilising influence if only two or three drops of it be added to a demilitre, at least, of boiled urine; (2) the boiled potash solution is also inactive if it be introduced in strong enough proportion to render the boiled urine a little alkaline.—Researches on the gases contained in fruits of the bladder-nut tree, by MM. Saintpierre and Magnien.—Observations of falling stars during the nights of August 9, 10, and 11, by M. Chapelas.

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Sir William Thomson

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