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THURSDAY, OCTOBER 28, 1875

SIXTH REPORT OF THE SCIENCE COMMISSION

THREE times within the last twelve years a Royal Commission has reported on the science teaching of our higher schools. In 1864 the Public Schools Commission announced that from the largest and most famous schools of all it was practically excluded. In 1868 the Endowed Schools Commission declared that the majority of school teachers had accepted it as part of their school work. The Science Commissioners of 1875, in their Sixth Report, on Science Teaching in Schools, testing this statement by inquiry, reports that of 128 endowed schools examined by them not one-half has even attempted to introduce it, while of these only 13 possess a laboratory, and only 10 give to the subject as much as four hours a week. And this statement is curiously illustrated by the statistics of the recent Oxford and Cambridge School Examination, which show that out of 461 candidates for certificates from 40 first-class schools, while 438 boys took up Latin, 433 Greek, 455 Elementary Mathematics, 305 History; only 21 took up Mechanics, 28 Chemistry, 6 Botany, 15 Physical Geography.

In a volume whose research and condensation make it not only a monument of conscientious toil, but an invaluable handbook to all who are labouring to work out practically the great problem of which it treats, the Commissioners investigate the obstacles which have caused the endowed schools to defy the weighty recommendations of former Commissions, the unanimous verdict of educational authorities outside the scholastic profession, and the increasingly urgent demands of English public opinion. They find the schoolmasters' excuses to be threefold; absence of funds, want of time, and scepticism as to the educational value of science in comparison with other subjects. A large portion of the Appendix is devoted to the consideration of these difficulties; to sifting the allegations on which they rest, and to balancing against them the experience of those teachers who have faced and successfully met them. Showing in detail the comparatively trifling cost at which indispensable apparatus can be obtained, the Commissioners nevertheless admit the rarity, in the present state of English culture, either of independent science teachers suited to the larger schools, or of men, such as poorer schools desiderate, combining literary with scientific knowledge. This, however, is an evil of the past rather than of the future, since not the least amongst the advantages expected from a reformed system of school teaching is the creation of a race of able teachers, general as well as special. The relative value of science as an implement of mental training is next discussed. Its peculiar excellence is briefly vindicated, as cultivating in a way attainable by no other means the habits of observation and experiment, of classification, arrangement, method, judgment; and its suitability to the capacities of the very youngest boys is testified to by Faraday, Hooker, Rolleston, Carpenter, and Sir W. Thomson. Lastly, it is shown that, if this be so, the argument from want of time is no argument at all; that the hours are already wasted which condemn the half of a boy's faculties to stagnation and render education one-sided and incomplete; and that the claims of different branches of instruction may be easily adjusted by economy of time, improvement in methods, and excision of superfluous studies.

On a review of all these objections and of the answers offered to them, and taking into account the dicta of former Commissioners and the practice of other countries, the Report advises that literature, mathematics, and science should be the accepted subjects of education up to the time at which boys leave school, and should all three be made compulsory in any School Leaving-Examination or University Matriculation; but that after entering the University students should be left to choose for themselves amongst these lines of study, and need pass no subsequent examination in subjects other than the one which they select. As regards the teaching of science, they recommend that it should commence with the beginning of the school career; that not less than six hours a week should be devoted to it, and that in all school examinations as much as one-sixth of the marks should be allotted to it.

These recommendations possess the two great excellences of authoritativeness and clearness. They are supported by a host of experienced witnesses, as well as by the eminent names whose signatures follow them. Their ideal of school education is simplicity itself. The supremacy of Classics is to be dethroned; the artifices of stratification and bifurcation are to be discarded; literature, mathematics, and science are to share a boy's intellect between them from the very first, until a leaving-examination which shows his progress to have been satisfactory in all three sets him free to follow his inclination by pursuing exclusively the subject which suits him best; happy since eminence in that one will not have been purchased by entire ignorance of all the others. Unfortunately, though most necessarily—for this Report concerns schools only—the curtain drops upon this interesting moment of transition, shutting out of view the influence which University Scholarships and Exhibitions exercise upon school work, and thus ignoring an obstacle to the realisation of the programme far greater than want of money, want of time, or want of appreciation, in the schools themselves.

What is the avowed object and purpose of the higher English school education? Is it the even and progressive development of young minds? the strengthening in equal proportion of the faculties of imagination, memory, reason, observation? the opening doors of knowledge in the plastic time of youth, which if not opened then will be fast closed in later years by the pressure of active work, or habitual exclusiveness, or energies paralysed through disuse? Nothing of the kind. It is constructed entirely with the aim of winning certain prizes; for scholarships with which a costly University bribes men to come to it for education; for class-lists leading up to College Fellowships; for the lucrative posts of military and civil service. In all these, but most of all where the Universities can determine the ordeal, one principle of success has been established, and that principle is one-sidedness. The candidate for India, for Woolwich, for Cooper's Hill, must at an early age select certain subjects and throw overboard all the rest. The childish aspirant to the entrance scholarships of a public school is placed in the hands

of a crammer at eight years old, that at thirteen he may turn out Latin verses as a Buddhist prayer-mill turns out prayers, and may manifest, as a distinguished head-master has lately said, to the eye of a teacher searching for intelligence, thoughtfulness, promise, intenseness, "a stupidity which is absolutely appalling." His scholarship won, he is pledged to pursue a course whose benefits are tangible and its evil consequences remote. The Universities have stamped upon all the schools one deep certainty, that for a boy to be "all round," as it is called, is the irremissible sin; that a schoolmaster who teaches with reference to intellectual growth and width of culture sacrifices thereby all hope of the distinctions which make a school famous and increase its numbers. If a classical scholarship is desired, science and mathematics are abandoned: nay, the palm of literary excellence is conceded even to men ignorant of the noblest literature in the world, their own birthright and inheritance, and knowing less of the history and structure of the English language than a fourth form boy knows of Greek. If mathematical success is aimed at, literature and science are ignored; if the few science scholarships existing tempt candidates from any of "the thirteen schools which possess a laboratory," mathematics in part and literature altogether must be given up. It would be waste of words to point out the fatal tendency of this separative process; to show how mere linguistic training needs the rationalising aid of scientific study, or how exclusive science hardens and materialises without the refining society of literature; yet such divorce is inevitably due not to the convictions of schoolmasters, not to the influence of parents, not to the prepossessions of the public, but to the irresistible force of the University system, which makes narrowness of intelligence and imperfect knowledge the only avenues to distinction or to profit.

It is true that an attempt to alter this involves little short of a revolution; but by all accounts a revolution is at hand. It is not for nothing that a parliamentary investigation into the expenditure of college endowments should have been supported by members of the colleges themselves, or that a proposal to distribute college scholarships and exhibitions by a central authority in accordance with the results of the leaving-examination should have emanated from eminent university teachers. For it cannot be too strongly urged that college scholarships stand on very different ground from university prizes or degrees. It is easy for Parliament to lay down rules which shall control the latter once for all; it is not easy to bind the actions of some forty different foundations, each electing its own scholars according to its own idiosyncrasies, or in obedience to the changing wills of bodies in a perpetual state of flux. It may still be audacious, but it is no longer novel, to suggest that, supposing future legislation to retain the college scholarships at all, they should be awarded by the authority of Government, in strict connection with leaving-examinations which Government shall conduct, and in reward not of special but of general proficiency. For this the scheme of the Commissioners virtually contends; into regions beyond this the Report before us necessarily does not enter.

It will be seen that we accept, and recommend all teachers to accept, the scheme of the Commissioners unreservedly as a working basis of educational improvement. It may not be ideally perfect; it may invite opposition on points of detail; but it is the resultant of all the intellectual forces which have hitherto been brought to bear upon the subject; and while agreeing with all its witnesses on the principle that wide general training should precede specialisation of study, it attains extreme simplicity of arrangement by allotting the first of these to the Schools and the last to the Universities. Do not let us forget that the cry which has arisen hitherto from all the head-masters on the point of scientific teaching has been a cry for guidance; for commanding and intelligent leadership; for authoritative enlightenment as to the relative value and the judicious sequence of scientific subjects; for information as to text-books, apparatus, teachers. For the first time this cry is met by an oracle whose authority no one will question, and whose completeness of delivery all who study its utterances will appreciate. Schoolmasters anxious to teach science, and doubtful how to set about it, will meet all the facts which can enlighten them in the Appendices to the Report. They will find lists of accredited text-books, specimens of examination papers, varieties of school time-tables, priced catalogues of apparatus, syllabi of lectures and experiments, botanical schedules and tables, plans and descriptions of laboratories, workshops, museums, botanic gardens; programmes and reports of school scientific and natural history societies. They will learn how costly a temple could be built to Science at Rugby, and how modestly it could be housed at Taunton. They will see how Mr. Foster teaches physics, how Mr. Hale teaches geography, how Mr. Wilson teaches *Erdkunde*. And they will accept all this as coming from men who have a right to speak, and who wield an experience such as has not been amassed before. On any legislative change which impends over the system and the endowments of the higher English education, the body of scientific opinion is strong enough, if united, to impress its own convictions; disunion alone can paralyse it. All who feel the discredit of past neglect, its injury to our national intellect, and its danger to our national prosperity, will do well to support by unqualified adhesion the first attempt that has been made to probe its causes, and the first consistent and well-considered scheme that has been put forth for its removal.

W. TUCKWELL

DREW'S "JUMMOO AND KASHMIR"

The Jummoo and Kashmir Territories. A Geographical Account. By Frederick Drew, F.R.G.S., F.G.S., Associate of the Royal School of Mines. (London: Stanford, 1875.)

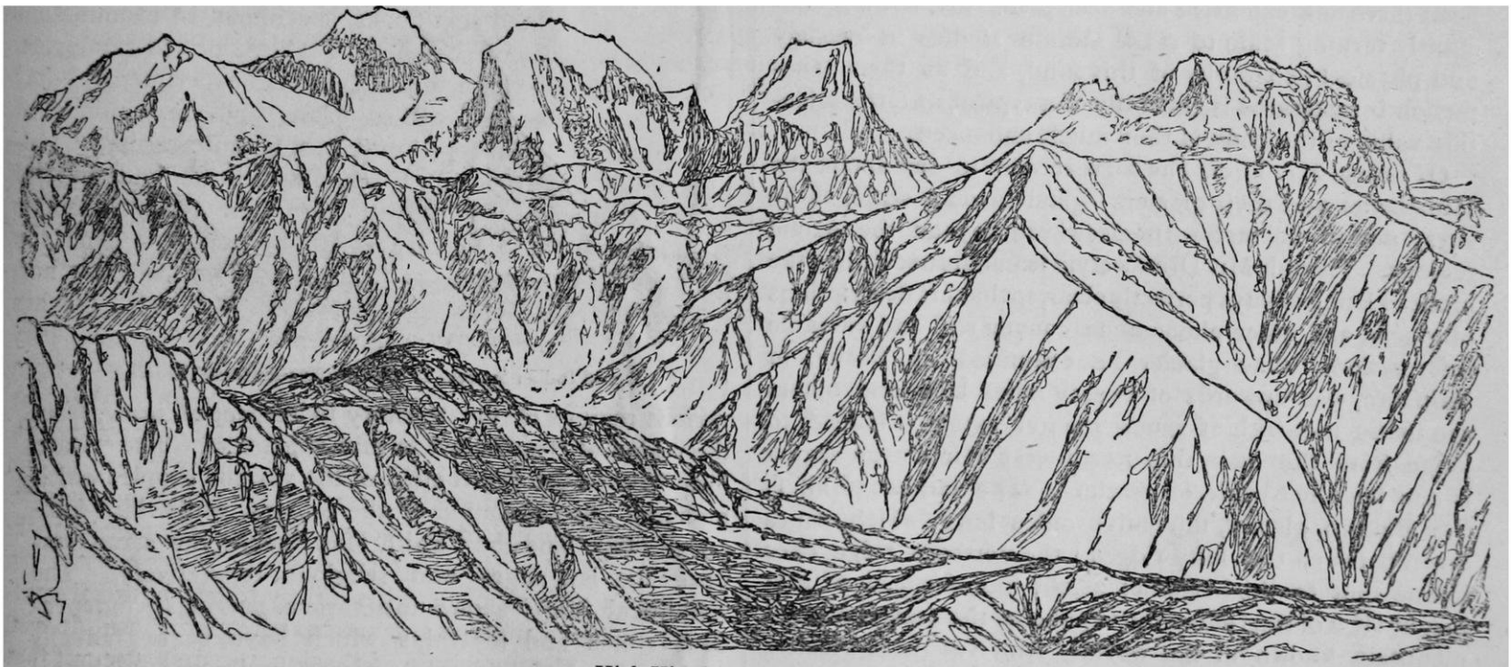
THE author of this work was for ten years, from 1862, in the service of the Maharaja of Kashmir, his primary duty apparently being the investigation of the mineral resources of the territory. During this period his duties led him to visit many parts of the Maharaja's dominions, and thus he had unusual opportunities of becoming well acquainted with the various districts and peoples under the sway of that ruler. Mr. Drew's previous training had qualified him to take intelligent advantage of his position and opportunities, and the result is the present bulky work, occupying 550 pages.

It is a perfect mine of information about the Kashmirian territories, more especially about their physical and political geography and their ethnology, while occasional details are introduced as to their zoology and botany. Mr. Drew delivers a "plain unvarnished tale," and has made no attempt to work his materials up into a merely popular book. Indeed, it might have been an advantage had he exercised a little more skill in arrangement; but with this defect we are not disposed to find serious fault, as every page of the work contains valuable information, which, by means of contents and index, is, after all, easily got at. Mr. Drew has made a substantial contribution to our knowledge of one of the most interesting regions of the globe.

Most Europeans, we suspect, have but a vague notion of how much is included under the name Kashmir. After all, Jummoo has a better title to give a name to the dominions of the Maharaja, as it is in the capital of this district that he resides. Jummoo is quite near the southern boundary of the Kashmirian territories, on a branch of the Chinab river, and hence must arise many inconveniences in the government of the country.

The territory included under the sway of the Maharaja is somewhat extensive, and of great variety in climate, physical characteristics, and races, extending from the broiling plains of the Panjab to the immense glaciers and eternal snows of the highest Himalayas, and including peoples both of Aryan and Turanian affinities, and of Mohammedan, Buddhist, and Brahman faiths. Looking down, however, upon the general map which accompanies Mr. Drew's volume, it is seen that the great mass of the territory is distinctly mountainous, and that to such an extent that one wonders where there can be any room for a population at all. Besides Jummoo and Kashmir, the countries of Ladakh, Baltistan, and Gilgit are included in the Maharaja's territories, whose entire area is estimated at 68,000 square miles.

Mr. Drew's plan is first in an introduction to present a general view of the Kashmirian territories, and then in succeeding chapters to treat of the various districts. The



High Himalayan peaks east of Nubra.

main characteristics of each district and its inhabitants are described in some detail, after which Mr. Drew takes the reader along a particular route which he himself has traversed, pointing out with great minuteness all that is worthy of note by the way. As Mr. Drew records mainly his own experiences, and as he is seldom tempted aside from the record of facts, it will be seen that the work is well adapted to afford the reader a clear and full idea of a region that is well worth becoming intimately acquainted with.

Mr. Drew divides the entire territory from a physical point of view into three regions, commencing at the plain of the Panjab and proceeding northwards. These are, first, the region of the Outer Hills, composed of mountains averaging from 2,000 to 4,000 feet above sea-level; second, the Middle Mountains, averaging between 8,000 and 10,000 feet; and lastly, the region of the lofty Himalayas, the mountains in which vary in height from 15,000 to 27,000 feet. There are many points in Mr. Drew's descriptions into which we wish we could enter in some detail, many observations concerning the country and the people we should like to lay before our readers, but this is impossible; a mere enumeration of the contents of the work would occupy most of the space at our command.

Of the inhabitants especially of this curious region, so near the supposed cradle of the Aryan race, and where the Aryans and Turanians meet, and sometimes intermingle, Mr. Drew has much to say that will no doubt command the attention of ethnologists. He observed carefully and records faithfully the characteristics and ways of the varied peoples, and although these have been observed by previous travellers, still it will be found, we are sure, that Mr. Drew has made an important contribution to the ethnology of the region. The Aryan people of Kashmir he divides into five principal races: the Dogra, Chibali, Pahari, Kashmiri, and Dard; and the Turanian, which belong to the Tibetan section of that group, into Balti, Ladakhi, and Champa. As might be expected, Mr. Drew gives much information concerning the castes of the Aryan races, and what he tells us is full

of interest. He throws some light also on the probable origin of castes, and especially of the distinction between the superior and inferior castes, and produces some very good reasons for believing that they are a result of the conquest of an inferior by a superior race. Mr. Drew was governor of Ladakh for a period, and thus had a splendid opportunity of becoming acquainted with an interesting region and curious people. He of course refers to the peculiar marital institution of the Turanians in the comparatively barren districts of the Himalayas. In Baltistan the people are of the same race as the Ladakhis, but having been converted to Mohammedanism, have eschewed polyandry for polygyny, with the result that the population has increased beyond the capacity of the country to support it, rendering emigration necessary.

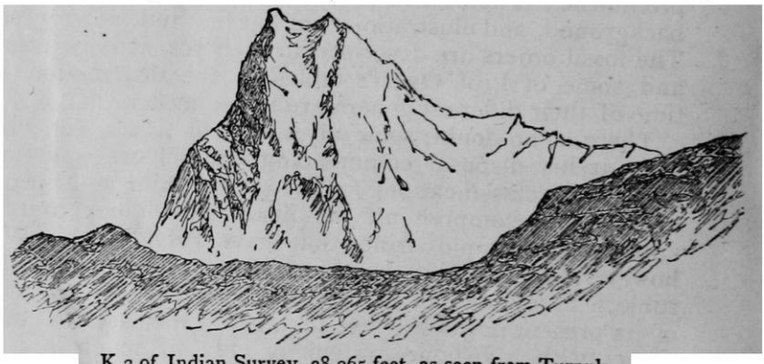
Mr. Drew presents minute studies of several places in Ladakh, especially of the salt lake district to the south of Leh. After carefully observing the geological characteristics of the district, he concludes that at one time, when glaciers were more universal than now, there must have been there one extensive and deep lake. Mr. Drew is constantly turning aside to make minute studies in geology and physical geography of this kind, and as the phenomenon investigated is generally of a typical sort, the scientific value of the book is thus much enhanced.

Of course Mr. Drew has a great deal to say about the Himalayas and their glaciers—glaciers on a scale, as he says, not to be met with elsewhere beyond the Arctic regions. Though Mr. Drew's style is unadorned, it has the merit of being always perfectly clear, so that his descriptions of glacial and other phenomena convey real and valuable information. One glacier he examined at Basha, in Baltistan, was upwards of twenty miles long, and others are to be met with of much greater extent; indeed, to judge from the map, this north-west Himalayan region is one huge net-work of glaciers. The largest of all is the Baltoro glacier, thirty-five miles long, which comes down between two lofty ridges; the northern ridge rises in one spot to the height of 28,265 feet, the peak of that height (K 2 of the Indian Survey) being the second highest mountain known in the world. And yet these glaciers are a mere remnant, the evidence seems to show, of the glacial covering which at one time spread over the Himalayan region.

One interesting excursion made by Mr. Drew was to the district in the N.E. of Ladakh, which, in the form of a great mountain-surrounded plateau, extends to the Kuenlun Mountains. This plain is divided into two by a low range of mountains running east and west, the southern half being known as the Lingzhithang Plain, and the northern half is named by Mr. Drew the Kuenlun Plain. This extensive and almost lifeless plateau has been crossed before Mr. Drew's journey, by various travellers—the unfortunate A. Schlagentweit, Mr. W. H. Johnson of the G. T. Survey, Mr. Haywood, Mr. Shaw, Dr. Cayley, and the two Yarkand Mission parties. Mr. Drew discusses the observations of some of these observers, and from observations made by himself, comes to the conclusion that the entire plateau must at one time have been under water, the mountains in the centre appearing above the surface as islands. His account of his observations on this journey are of considerable value as supplementary to those of previous observers—of the mirage, of the capricious lakelets which are still sometimes seen, of the composition of the surface of the plateau, of the remains of shingly beaches, salt deposits, and other features. This great plateau has by no means been yet fully explored, though it would be likely to yield to a competent observer important data in physical geography.

One special chapter is devoted to the various languages spoken in the territories, and their relationships well pointed out. In the appendices, also, material is provided for the comparative philologist in a Dogra grammar, various vocabularies and phrases.

A characteristic and valuable feature of the work is the series of maps which enable the reader to follow satisfactorily all the author's routes and descriptions. First of all there is a general map on the scale of sixteen miles to an inch, sufficiently minute to enable one to recognise the chief physical features, and in which the various glaciers are indicated. Then come five maps, constructed each from a different and special point of view. The "Snow Map" is coloured, to show the characteristics of



K 2 of Indian Survey, 28,265 feet, as seen from Turnuk.

various regions of the territory in respect of snow, from the region of "no snow" to that of glaciers. The "Race Map" shows the distribution of the various peoples which make up the population of the country, while the "Language Map" and the "Faith Map" serve the same purpose for languages and religions respectively. The "Political Map" shows the various previously independent states and rajaships which have been gradually agglomerated into one dominion under the Maharaja of Jummoo. Besides the maps there are isometric views and sections of the principal mountain regions, and a number of illustrations of places and people. We think the illustrations, especially in the way of typical photographic portraits, ought to have been more abundant in a work otherwise so elaborate and minute; but this may be remedied in a second edition.

We have given but a faint idea of the contents of this thick volume, but perhaps we have said enough to show that henceforth it must be considered as one of the principal authorities on a country of great interest in itself, and of special interest to English people on account of its relation to our Indian dominions and government. Much has already been written on the country and on the regions which border upon it, and special studies have been made of particular parts and aspects of it—Mr. Drew refers with deserved praise to Dr. Leitner's great work on Dardistan;—but on the country as a whole, in all its aspects, political, historical, ethnological, and physical, Mr. Drew's work must be considered as a permanent and trustworthy authority.

OUR BOOK SHELF

Zoology for Students. By C. Carter Blake, D.Sc. (Daldy, Isbister, and Co., 1875.)

In this work Dr. C. C. Blake has published, as he tells us in the preface, the substance of his annual course of lectures on zoology at Westminster Hospital. Beginning with the highest form, man, he descends the whole scale of animal life, ending with the Protozoa, or Acrita. A general description of each class is followed by a more detailed account of each of the different orders which compose it. As a preface, "notes" taken from some of Prof. Owen's Hunterian Lectures on the principles of zoological classification, are, with the lecturer's permission, introduced.

The arrangement adopted is not the most modern. The Batrachina and the other Amphibia are retained as orders of the class Reptilia; the importance of the different sections of the Teleostei is considered to be as great as that of the Ganoidei or Plagiostomi; the Cirripedia are separated from the Crustacea; the "Bryozoa" are associated with the "Radiata," and the Entozoa are retained among the Articulata. More stress is laid on external peculiarities than is the custom now-a-days, among biologists, and the importance of embryology is not made prominent. Theoretical considerations are placed in the background, and illustrations are but few and far between. The fossil orders are described in their respective classes, and some of Prof. Owen's tables of the distribution in time of their different genera are introduced.

There is, no doubt, some advantage to a student with time at his disposal commencing the science upon an antiquated classification, for it enables him afterwards to more fully comprehend the history of biology, and to appreciate the rapid strides that have been made. We, however, fear that it is the object of most who take up the subject to obtain, as quickly as possible, a clear idea of its present position; and such being the case, to commence with a bygone system is only so much loss of time. The view taken by Dr. Blake will therefore detract from the value of his otherwise useful work. Another thing that will diminish its value is a certain want of accuracy which pervades it. Drawings of the feet of three birds are given, and they are all wrongly named. A scansorial foot is adjudged to a passerine bird; that of a kingfisher is said to be gallinaceous, whilst that of a steganopod is termed "foot of duck." More than once the peculiarities of two closely allied animals are reversed, as when we are told that among the Proboscidia "in one form, entirely extinct (Dinotherium), the incisors project in the form of long tusks from the upper jaw; in the existing elephants, from the lower jaw," and when "the articulated group (of the Brachiopoda are said to) possess an anal aperture, the non-articulated possess none whatever."

The chapter on the Pisces is much confused. "The living Ganoids have completely bony skeletons, but the fossil ones may have had skeletons soft and cartilaginous like those of the Sturgeons. They have several holes in the arterial trunks. Their optic nerves do not decussate, but merely cohere laterally." The external nares are said to be "simple" in the Rays and Sharks, or "double, as in most osseous fishes." The Ammocete is called the Sandlaunce, and it is described as a separate genus.

The same character is more than once repeated on the same or the following page, whilst others equally important are omitted. On the first page of the section describing the Reptilia, the two following sentences occur as parts of the definition of the class: "a heart with two auricles, and with the ventricle more or less completely divided;" "the heart has two auricles; the ventricle is imperfectly divided." Pentastoma is retained among the "Entozoa," instead of being placed among the Arachnida; we can find no reference to Ceratodus, a most important fish theoretically; and the brain of the Marsupials is said not to possess a corpus callosum.

Notwithstanding the imperfections above pointed out, there is much to be learnt from Dr. Blake's work; many of the descriptions are excellent; nevertheless there are so many essential facts omitted, that it will be found more valuable as an adjunct to a work like Prof. Huxley's "Introduction to the Classification of Animals," than as an independent source of information.

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.*]

"Instinct and Acquisition"

In NATURE (vol. xii. p. 507) there appears, under the above heading, a very interesting article, being an epitome of a paper read by Mr. Spalding at the Bristol meeting of the British Association. Now that the doctrine which is maintained in this article—a doctrine with which Mr. Spalding's name is associated as almost its only experimental verifier—has proved itself so completely victorious in overcoming the counter-doctrine of "the individual-experience psychology"—and this along the whole line both of fact and theory—it seems unnecessary for anyone to adduce additional facts in confirmation of the views which Mr. Spalding advocates. I shall therefore confine myself to detailing a few results yielded by experiments which were designed to illustrate the subordinate doctrine thus alluded to in Mr. Spalding's article:—

"Though the instincts of animals appear and disappear in such seasonable correspondence with their own wants and the wants of their offspring as to be a standing subject of wonder, they have by no means the fixed and unalterable character by which some would distinguish them from the higher faculties of the human race. They vary in the individuals as does their physical structure. Animals can learn what they did not know by instinct and forget the instinctive knowledge which they never learned, while their instincts will often accommodate themselves to considerable changes in the order of external events. Everybody knows it to be a common practice to hatch ducks' eggs under a common hen, though in such cases the hen has to sit a week longer than on her own eggs. I tried an experiment to ascertain how far the time of sitting could be interfered with in the opposite direction. Two hens became broody on the same day, and I set them on dummies. On the third day I put two chicks a day old to one of the hens. She pecked at them once or twice, seemed rather fidgety, then took to them, called them to her, and entered on all the cares of a mother. The other hen was similarly tried, but with a very different result. She pecked at the chickens viciously, and both that day and the next stubbornly refused to have anything to do with them," &c.

It would have been well if Mr. Spalding had stated whether these two hens belonged to the same breed; for, as is of course well known, different breeds exhibit great variations in the character of the incubatory instinct. Here, for instance, is a curious case. Spanish hens, as is notorious, scarcely ever sit at all; but I have one purely-bred one just now that sat on dummies for three days, after which time her patience became exhausted. However, she seemed to think that the self-sacrifice she had undergone during these three days merited some reward, for, on leaving the nest, she turned foster-mother to all the Spanish chickens in the yard. These were sixteen in number, and of all ages, from that at which their own mothers had just left them up to full-grown chickens. It is remarkable, too, that although there were Brahma and Hamburg chickens in the same yard, the Spanish hen only adopted those that were of her own breed. It is now four weeks since this adoption took place, but the mother as yet shows no signs of wishing to cast off her heterogeneous brood, notwithstanding some of her adopted chickens have grown nearly as large as herself.

The following, however, is a better example of what may be called plasticity of instinct. Three years ago I gave a pea-fowl's egg to a Brahma hen to hatch. The hen was an old one, and had previously reared many broods of ordinary chickens with unusual success even for one of her breed. In order to hatch the

pea-chick she had to sit one week longer than is requisite to hatch an ordinary chick, but in this there is nothing very unusual, for, as Mr. Spalding observes, the same thing happens with every hen that hatches out a brood of ducklings.* The object with which I made this experiment, however, was that of ascertaining whether the period of maternal care subsequent to incubation admits, under peculiar conditions, of being prolonged; for a pea-chick requires such care for a very much longer time than does an ordinary chick. As the separation between a hen and her chickens always appears to be due to the former driving away the latter when they are old enough to shift for themselves, I scarcely expected the hen in this case to prolong her period of maternal care, and indeed only tried the experiment because I thought that if she did so the fact would be the best one imaginable to show in what a high degree hereditary instinct may be modified by peculiar individual experiences. The result was very surprising. For the enormous period of eighteen months this old Brahma hen remained with her ever-growing chicken, and throughout the whole of that time she continued to pay it unremitting attention. She never laid any eggs during this lengthened period of maternal supervision, and if at any time she became accidentally separated from her charge, the distress of both mother and chicken was very great. Eventually the separation seemed to take place on the side of the pea-cock; but it is remarkable that although the mother and chicken eventually separated, they never afterwards forgot each other, as usually appears to be the case with hens and their chickens. So long as they remained together the abnormal degree of pride which the mother showed in her wonderful chicken was most ludicrous; but I have no space to enter into details. It may be stated, however, that both before and after the separation the mother was in the habit of frequently combing out the top-knot of her son—she standing on a seat, or other eminence of suitable height, and he bending his head forwards with evident satisfaction. This fact is particularly noteworthy, because the practice of combing out the top-knot of their chickens is customary among pea-hens. In conclusion I may observe, that the pea-cock reared by this Brahma hen turned out a finer bird in every way than did any of his brothers of the same brood which were reared by their own mother, but that on repeating the experiment next year with another Brahma hen and several pea-chickens, the result was different, for the hen deserted her family at the time when it is natural for ordinary hens to do so, and in consequence all the pea-chickens miserably perished.

I have just concluded another experiment which is well worth recording. A bitch ferret strangled herself by trying to squeeze through too narrow an opening. She left a very young family of three orphans. These I gave, in the middle of the day, to a Brahma hen which had been sitting on dummies for about a month. She took to them almost immediately, and remained with them for rather more than a fortnight, at the end of which time I had to cause a separation, in consequence of the hen having suffocated one of the ferrets by standing on its neck. *During the whole of the time that the ferrets were left with the hen the latter had to sit upon the nest;* for the young ferrets, of course, were not able to follow the hen about as chickens would have done. The hen, as might be expected, was very much puzzled at the lethargy of her offspring. Two or three times a day she used to fly off the nest, calling upon her brood to follow; but upon hearing their cries of distress from cold, she always returned immediately and sat with patience for six or seven hours more. I should have said that it only took the hen one day to learn the meaning of these cries of distress; for after the first day she would always run in an agitated manner to any place where I concealed the ferrets, provided that this place was not too far away from the nest to prevent her from hearing the cries of distress. Yet I do not think it would be possible to conceive of a greater contrast than that between the shrill peeping note of a young chicken and the hoarse growling noise of a young ferret. On the other hand, I cannot say that the young ferrets ever seemed to learn the meanings of the hen's clucking. During the whole of the time that the hen was allowed to sit upon the ferrets she used to comb out their hair with her bill, in the same way as hens in general comb out the feathers of their chickens. While engaged in this process, however, she used frequently to stop and look with one eye at the wriggling nest-full with an inquiring gaze expressive of astonishment. At other times, also, her family gave her good reason to be surprised; for she used often to fly off the nest suddenly with a loud scream—an action which was doubtless due to the unaccustomed sensation of being nipped by the young ferrets in their search for the teats. It is further worth while to remark that the hen showed so much uneasiness of mind when the ferrets were taken from her to be fed, that at one time I thought she was going to desert them altogether. After this, therefore, the ferrets were always fed in the nest, and with this arrangement the hen was perfectly satisfied—apparently because she thought that she then had some share in the feeding process. At any rate she used to cluck when she saw the milk coming, and surveyed the feeding with evident satisfaction.

Altogether I consider this a very remarkable instance of the plasticity of instinct. The hen, it should be said, was a young one, and had never reared a brood of chickens. A few months before she reared the young ferrets she had been attacked and nearly killed by an old ferret which had escaped from his hutch. The young ferrets were taken from her several days before their eyes were open.

In conclusion I may add, that a few weeks before trying this experiment with the hen I tried a similar one with a rabbit. In this case the ferret was newly born, and I gave it to a white doe rabbit which had littered six days before. Unlike the hen, however, she perceived the imposture at once, and attacked the young ferret so savagely that she broke two of its legs before I could remove it. To have made this experiment parallel with the other, however, the two mothers ought to have littered on the same day. In this case the result would probably have been different; for I have heard that under such circumstances even such an intelligent animal as a bitch may be deceived into rearing a cat, and *vice versâ*.* GEORGE J. ROMANES

Dunskaith, Ross-shire, Oct. 10

* The greatest prolongation of the incubatory period I have ever known to occur was in the case of a pea hen which sat very steadily on addled eggs for a period of four months, and had then to be forced off in order to save her life.

* *Apropos* to what Mr. Spalding says about the early age at which the instinctive antipathy of the cat to the dog becomes apparent, I may state that some months ago I tried an experiment with rabbits and ferrets somewhat similar to that which he describes with cats and dogs. Into an outhouse which contained a doe rabbit with a very young family I turned a ferret loose. The doe rabbit left her young ones, and the latter, as soon as they smelled the ferret, began to crawl about in so energetic a manner as to leave no doubt that the cause of the commotion was fear, and not merely the discomfort arising from the temporary absence of the mother.

Curious Australian and N. American Implement

A VERY interesting illustration of the occurrence of the same specialised implement in widely separated regions is found in the resemblance between the vermin hooks of the Australians and the same kind of weapon found among the Ute Indians. Several of the former were brought home by Wilkes' Expedition, and are found in the National Museum (Fig. 1). They

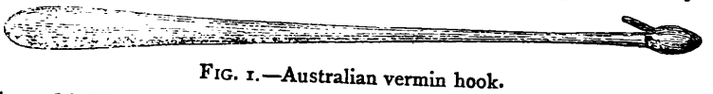


FIG. 1.—Australian vermin hook.

have highly finished handles, and the bone hook is fastened on with wrapping and gum. Of the latter, Major Powell, in his Colorado Report (1875), says, "These Indians all carry canes with a crooked handle, they say to kill rattlesnakes, and to pull rabbits from their holes" (Fig. 2).

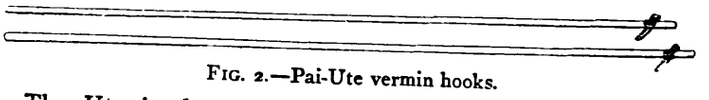


FIG. 2.—Pai-Ute vermin hooks.

The Ute implement is very rude, consisting of a switch merely, with the bark stripped off, and a nail passed through the thick end at an acute angle, and firmly lashed with sinew. Major Powell's Fig. 45, entitled "The Human Pickle," has two of these hooks (or canes) in his hand. O. T. MASON.

Washington, D.C., Oct. 13

OUR ASTRONOMICAL COLUMN

DOUBLE STARS. (1) ϕ ERIDANI.—In the year 1850 the late Capt. Jacob calculated two orbits for this binary system, the second of which represents very fairly his subsequent measures to the end of 1857, a rather severe test for elements founded upon the data available in 1850. We look in vain for measures later than Capt. Jacob's, though it may be hoped this and other interesting objects

of the southern heavens have not been entirely neglected of late years. The public observatories are perhaps too closely occupied with other work to allow of much being expected from them in a class of observation peculiarly suited to the amateur astronomer, but there must be a grand field of operations for private observers, in southern double and variable-star astronomy.

Capt. Jacob's last orbit of p Eridani may be written thus :—

Peri-astron passage	1819·83
Node	110° 40′
Node to peri-astron in direction of motion ...	285° 50′
Inclination	46° 36′
Excentricity	0·323
Semi-axis	4″·25

Mean annual motion, −3°·3645, or period of revolution 107 years.

The components are of equal brightness, and hence it is to be expected some measures may be registered 180° different from others; accordingly, to work the whole series into any supposable orbit it is necessary to add 180° to Sir J. Herschel's micrometrical measures (Cape Obs., p. 276), and indeed it will be seen that he has so recorded the angles of the 20-feet sweeps, p. 174.

The errors of the above orbit are, for

1835·00	Pos. ($c-o$)	+ 2°·5	Dist. ($c-o$)	0″·00
1857·96	,,	− 1°·6	,,	+ 0″·03

The following are deduced from the same orbit :—

1875·0	Pos.	218°·9	Dist.	3″·92
76·0	,, ...	216°·3	,, ...	3″·89
77·0	,, ...	213°·7	,, ...	3″·86

As the measures of this star are, so far, scattered in several volumes, they are collected here for convenience of reference. Dunlop's angle was evidently registered in the wrong quadrant, as is pointed out both by Sir J. Herschel and Capt. Jacob; the correct reading appears to be 343° 6′.

			°		″
Dunlop	1825·96	Pos.	343·1	Dist.	2·5
Herschel	35·00	,,	302·3	,,	3·65
Jacob	45·88	,,	276·0	,,	4·16
,,	46·83	,,	277·0	,,	4·32
,,	49·82	,,	270·0	,,	—
,,	50·80	,,	268·73	,,	4·32
,,	51·79	,,	266·38	,,	4·30
,,	52·76	,,	264·84	,,	4·14
,,	53·99	,,	263·24	,,	4·36
,,	56·09	,,	261·12	,,	4·70
,,	57·96	,,	258·18	,,	4·49

The place of p Eridani for the commencement of 1876 is in R.A. 1h. 35m. 5s., and N.P.D. 146° 49′·5.

(2) O. Σ 387.—Between the epoch of Mr. Otto Struve's measures in 1844 and Baron Dembowski's in 1868, the angle in this binary has retrograded 77°, and no doubt if measures are obtained this year a very considerable further change will be manifested: yet the distance, if we except Secchi's estimate in 1856, has been found about half a second, as long as the star has been under observation. A first approximation to the elements may soon be practicable. The place of this object for beginning of 1876 is R.A. 19h. 44m. 6s., and N.P.D. 55° 0′·1. The number applies to the Pulkova Catalogue of 1850.

THE MINOR PLANETS.—No. 150 of the group of small planets has been reached, Prof. Watson, director of the Observatory of Ann Arbor, Michigan, having detected another member, apparently on the night of October 18; the place as yet doubtful, the telegrams through the French and English cables being discordant. It is stated to be of the 10th magnitude, and is therefore brighter than the great majority of planets discovered during the last few years. Considering the close scrutiny which the ecliptical region of the sky is receiving at the present day, we must surely soon be in a position to pronounce with some degree of confidence whether any trans-Neptunian planet as bright as stars of the 13th magnitude exists within 2½° or 3° from the ecliptic, and in the event of greater inclination, the scheme of Prof. Peters, on its completion, may afford an equally definitive conclusion. There have been some curious alarms in this direction, as in the autumn of 1850, during observations of the minor planet Hygeia at Washington, when an apparently slow moving object was compared with the planet on more than one evening; but although sought for diligently on the supposition of its being a distant body, was not recovered, nor, we believe, has since been seen in the observed place. The change of position was larger than could well be attributed to casual errors in micrometric observations; but there seems to be no other explanation of this case, except admitting error of observation and the existence of a variable star of long period in that spot.

NOTES FROM THE "CHALLENGER"

PROF. WYVILLE THOMSON has just sent me from the *Challenger* an account of certain results of Deep Sea dredgings in the North Pacific. In these dredgings was obtained a Gymnoblastic Hydroid of such colossal dimensions that the largest form hitherto known sinks in comparison with it into utter insignificance. Prof. Thomson has determined the Hydroid as a MONOCAULUS or nearly allied form, and a beautiful drawing which accompanies his letter confirms this view.

The animal itself has not yet arrived, but the letter which gives an account of its capture contains so many points of general interest, that the following extract will, I feel sure, be acceptable to the readers of NATURE :—

"H.M.S. *Challenger*, N. Pacific, July 24, 1875.

"On the 17th of June, in the North Pacific, lat. 34° 37′ N., long. 140° 32′ E., depth 1,875 fathoms, temperature at bottom 1° 7 C., bottom grey mud, the trawl brought up three or four examples of what seems to be a species of MONOCAULUS, or something allied to it. The point which naturally struck us most was that the hydranth in a specimen measured fresh by Moseley and myself, was nine inches across from tip to tip of the expanded (non-retractile) tentacles, and the hydrocaulus was seven feet four inches high! On the 5th of July, lat. 37° 41′ N., long. 177° 4′ W., depth 2,900 fathoms, with bottom temperature the same as before, and a bottom of red clay with manganese nodules, the trawl, which was torn to pieces by having taken in too great a weight of nodules of manganese, brought up entangled in its outer netting another fine specimen of this same form. It was put in weak picric acid, and then into weak alcohol, and you have it in the short piece of test-tube among the horsehair. This specimen was not measured, but the hydranth was carefully sketched by Mr. Wild, and I enclose you the sketch.

"These delicate things, drawn up rapidly through the water from a depth of nearly four statute miles, and transported into such totally different conditions of temperature, pressure, &c., suffer greatly from the violent change: they are in fact almost knocked to pieces, and their finer tissues are in a nearly deliquescent state, so that our great anxiety is to get them at once into some reagent which will harden them somewhat. It is wretched to see them melting away absolutely under one's eyes: when put into any of our fluids they at once contract out of all form, but that cannot be helped. I thought it best you should have them as well preserved as we could manage, so I only gave them a cursory glance and sent them on.

"The hydrocaulus is enormously extensile—it is of a pale pink colour, and our specimens, when distended in the water, were about four feet or so long: one, as I mentioned before, which Moseley and I measured, was seven feet four inches high, but that one was stretched over the surface of the trawl net, and although it must of course have been capable in life of extending to that degree, it might not have been a normal attitude. When at what

seems to be its normal state of distension, the diameter of the hydrocaulus is about half an inch. Its structure you can make out for yourself. The proximal ends of several of them were coated with mud when they came up; the longitudinal striæ were very evident in the soft tissue; fluid gravitated down the centre of the hydrocaulus, and collected in a bladder-like expansion at the base. The base of this stem was of a darker colour than the rest—a dull rose—in most of them (not in the one figured by Wild). As I did not mean to describe the creature I did not look out for processes or fibrillæ at the proximal extremity; you may find them in the spirit specimens. The total length of the hydranth when moderately extended was 1½ inches.

"The proximal range of tentacles number about a hundred, and these are about four inches long—they are almost transparent in life—of a pale pink colour in most specimens. The sporosacs are in close tufts of a maroon colour just at the base of the proximal tentacles. The specimen I looked at was a male, but the tissues were so soft—almost slimy—that I did not like to tease it too much. The walls of the body-cavity were yellowish, and seemed to contain some vertical rolls of glandular matter, and the hypostome terminates in a fringe of about forty-eight or fifty extensile tentacles round the mouth. So much for our gigantic Corymorphoid! These are the only two occasions on which we got it, or anything like it. I should have liked to get a haul or two in Behring's Sea, for there doubtless we should have had it in shallow water. I can only tell you one thing more about it—its associates. On the 17th of June, 1875, in 1,875 fathoms, it was associated with many fishes (Ophidoids, Macrurids, Scopellids—all the usual deep-sea lot), several Gasteropods, many Crustaceans (Dorippe, Galatea, Caridids, &c., and a fine Scalpellum), a few Annelids, many Echinoderms (Brisinga, Phormosoma, Ophiurids, two very fine Holothurids of a new group), species of Isis, Primnoa, Polythoa, and Actinia. On the 5th of July, in 2,900 fathoms, there were some worms (Aphroditacean), an Urchin allied to Diadema, two Holothuriæ, and one or two sponges; but the trawl-net was torn by the weight of the manganese nodules, so we had scarcely a fair sample of the fauna. In the bottle with the tube you will find among the horse-hair one or two pieces of *Heliopora cerulea* from Moseley. He sends at the same time a paper on it to the Royal."

That the enormous depths from which this colossal Hydroid has been brought up should favour the development of gigantic representatives of the diminutive forms of shallower zones, and that in the tenants of these sunless regions of the sea we should find colour not less vivid than that of their light-loving relatives, are facts full of significance.

It is also worth noticing that the sexual zooids of the great Hydroid are to all appearance simple sporosacs, instead of the medusiform zooids which are so frequent in the Gymnoblastic Hydroids of our littoral regions. Indeed, among the many Hydroids which I have examined from deep water, I have never found one which could be referred with probability to a form characterised by the production of medusiform zooids. It would seem that these zooids—delicate and active organisms which are among the most abundant captives of the towing-net in the surface-zone of the sea—are unable to endure, either before liberation from their parent Hydroid, or for a period however short in their free state, the darkness and pressure and other conditions to which the dwellers in the deep sea are exposed. GEORGE J. ALLMAN

NORDENSKJÖLD'S ARCTIC EXPEDITION

A LETTER from Prof. Nordenskjöld to Mr. Oscar Dickson, of Gothenburg, appears in the *Göteborgs Handels Tidning* of the 14th inst. It is dated "On board the *Pröven*, at anchor at the mouth of the Jenesej, 16th August, 1875." The following extracts may be of interest to our readers:—

"We are now employed as busily as possible in equipping the boat in which I, accompanied by Dr. Stuxberg, docent Lundström and three men, intend to sail up the Jenesej, with the view of returning to Europe across Siberia, while the other part of the expedition returns to Norway by sea, on board the *Pröven*.

"After the *Pröven*, on the 8th of June, was towed free of cost out of Tromsö by a little steamer of the same name, we were compelled to lie at anchor in the sound between Carlsö and Renö for five days, on account of a head wind. Finally, on the 14th, we could again weigh anchor and get to sea through Fuglö Sound. We thereupon set our course past North Cape, which we passed on the 17th, to the southern part of Novaya Zemlya.

"During spring and the early part of summer the west coast of this double island is, for some distance from the land, surrounded by a compact ice girdle, impassable at most places, which disappears later in the season, and in which, according to the experience of the fishermen, there are formed, generally at an early period, two sounds which are covered only with thin passable drift-ice, and by which the ice-free belt of water along the coast is connected with the ice-free ocean westwards. One of these open channels is usually situated off Matotschkin Scharr, and its formation is caused by the strong currents which prevail in that sound; the other is to be found about the latitude of Severo Gusinnoi Mys, or North Goose Cape. The latter was chosen by me for the *Pröven*, and was passed without any special difficulty on the 22nd of June. The expedition thus, in seven days from its departure from Carlsö, cast anchor for the first time at Novaya Zemlya, in a little ill-protected bay immediately north of North Goose Cape.

"During the voyage there were set on foot, when the state of the weather permitted, frequent soundings and dredgings, examinations of animal and diatom life in the surface of the sea, determinations of the temperature at different depths, &c. Our operations were generally very successful, and showed that in this sea we may reckon on reaping rich harvests in natural history. We also made repeated trials at different depths of a new instrument for bringing up specimens of the bottom, constructed for the expedition by Dr. Wiberg, which showed itself very well adapted for the purpose, and easily managed."

After visiting and examining various parts of the coast for many days, the *Pröven* was directed to the Sea of Kara, and on the 26th July the anchor was let go off Cape Grebeni, on Waigats Island. So violent a storm was raging, however, that a boat could not be sent out till the 30th July to land on Waigats Island. "A rich collection was here made of Upper Silurian fossils, strongly resembling those from Gotland, and therefore of special interest for Swedish geologists. Here we for the first time encountered Samoyedes, who when they sighted the vessel drove down to the shore in peculiar high sledges adapted for travelling in both summer and winter, and drawn by three or four reindeer. They immediately gave us to understand that they wished to come on board, whither they also accompanied us in our boat, and where they were soon afterwards well entertained by us.

"During our stay on the west coast of Novaya Zemlya we of course instituted numerous investigations regarding the geology, animal and vegetable life, &c., of the regions visited by us, and the number of the places on the coast where we landed rendered it possible for the scientific staff of the expedition to collect materials for ascertaining the natural relations of these regions, which are certainly far more extensive than have been brought home by any of our predecessors." At last on August 2 the sound was successfully passed, and on the *Pröven* reaching the Sea

of Kara it was found completely free of ice! "Our course was set towards the middle of the peninsula which separates the Sea of Kara from the Bay of Obi, and is named Jalmal by the Samoyedes. The wind was very moderate, so that we only advanced slowly—a circumstance by which our patience was in truth sorely tried, but which had this good result, that during our sailing forward in these waters visited for the first time by a scientific expedition, we were able daily to undertake dredgings, hydrographic work, &c. The dredgings gave an unexpectedly rich and various harvest of marine animals, among which I will specially mention here several colossal species of Isopoda, masses of Amphipoda and Copepoda, a large and beautiful Alecto, uncommonly large Ophiurids, beautifully marked Asterids, innumerable mollusca, &c. The peculiar circumstance here occurs that the water at the surface of the sea, which in consequence of the great rivers which debouch in these regions is nearly free of salt, forms a deadly poison for the animals which live in the salt water at the bottom. Most of the animals brought up from the bottom accordingly die if they are placed in water from the surface of the sea.

"Here, as on the west coast of Novaya Zemlya, were instituted, when opportunity offered, with the thermometers by Negretti and Zambra and Casella procured by you during your stay in London last spring, determinations of the temperature of the sea, not only at the surface, but also at different depths under it. These investigations yielded a specially interesting result, and perhaps may be regarded as conclusive of a number of questions regarding which there has of late been much discussion concerning the ocean currents in these regions, the direction of which, in the absence of other data, it has been attempted to determine chiefly by the temperature of the surface water. By means of numerous observations along the west coast of Novaya Zemlya from Matotschkin Scharr to Jugor Sound, and thence past Cape Grebeni to 75½° N. lat. and 82° E. long., and on to the mouth of Jenisej, I have obtained indisputable proof that in this sea the temperature of the sea-water at the surface is exceedingly variable and dependent upon the temperature of the air, upon the neighbourhood of ice, and upon the influx of warm fresh water from Obi and Jenesej, but that the temperature of the water at a depth of only ten fathoms is nearly quite constant, between − 1° and 2° C. If, in the northern part of the Sea of Kara, where the water on the surface is almost completely *free of salt*, and at this time of the year very warm, a flask filled with water from the surface is sunk to a depth of ten fathoms, the water freezes to ice. There are thus no warm ocean currents here at any considerable depth below the surface. A large number of deep-water samples have been taken by the apparatus constructed by Prof. Ekman, which is exceedingly well adapted for the purpose, and I am convinced that at the bottom the content of salt is also constant, which can be ascertained with certainty after the return of the expedition by analyses of the samples of water which have been taken.

"On the 8th August we landed for a few hours on the north-western side of Jalmal, where an astronomical determination of the position of the place was made. A great many astronomical determinations had previously been made during the expedition along the west coast of Novaya Zemlya and Jugor Sound. Traces of men, some of whom had gone barefoot, and of Samoyede sledges, were visible on the beach. Close to the shore was found a sacrificial altar, consisting of about fifty skulls of the Ice Bear, Walrus, and Reindeer bones, &c., laid in a heap. In the middle of the heap of bones there stood, raised up, two idols, roughly hewn from drift-wood roots, newly besmeared in the eyes and mouth with blood, also two poles provided with hooks, from which hung bones of the Reindeer and Bear. Close by was a fireplace and a heap of Reindeer bones, the latter clearly a remnant of a sacrificial meal. After a stay here of several hours, I sailed further north, until further advance in this direction was prevented by impassable masses of great even icefields at 75° 30′ N. lat., and 79° 30′ E. long. Afterwards I followed the edge of the ice eastwards, and finally steered our course towards the north side of the mouth of Jenisej, where the Swedish flag was hoisted and the anchor was let go on the 15th in the afternoon. We had now attained the goal which great seafaring nations had in vain striven for centuries to reach.

"The expedition will now, in accordance with the plan agreed upon, separate, inasmuch as I, accompanied by Lundström and Stuxberg, and three men, intend, in a Nordland boat brought with us for the special purpose, to sail or row up the Jenisej, in order to return by Turuchansk and Jeneseisk to Europe, while the *Pröven* returns hence to Norway, if possible going north of the north point of Novaya Zemlya."

SCIENCE IN GERMANY

(*From a German Correspondent.*)

SINCE we possess in the kinetic molecular theory, as founded by Clausius, a mechanical theory based on the atomic conception of gases, it is possible to employ the results of the chemical investigation of these bodies for physical deductions. It is only necessary to suppose for this purpose that *the same* molecules, which are the bearers of the thermal and mechanical properties of gases, act reciprocally in chemical reactions. We must point out as one of the most important confirmations of this view, that Avogardo's hypothesis, based on general physical deductions, and adopted in chemistry as the foundation-stone of its whole recent development, has lately found its mechanical confirmation in the gaseous theory of Maxwell and of Boltzmann.

Recently, however, difficulties have arisen in the further investigation of this theory, with regard to the specific heat of gases. The quantity of heat contained in a gas is defined as the total energy of its molecules, and this energy consists solely in progressive motion, if the molecule is looked upon as a mere material point. On the other hand, the pressure of the gas upon the surface-unit equals two-thirds of the kinetic energy of progressive motion contained in the volume-unit. If, therefore, we raise the temperature of the gas by one degree, the volume remaining the same, we can find by calculation the adduced quantity of heat according to the gaseous theory, from the increase of pressure determined by Mariotte-Gay Lussac's law. This quantity of heat in its relation to the mass-unit, is, as is known, called the specific heat of the gas at the constant volume (c), and calculation now shows this value to be 0·60 of the observed one. In close connection with this it was found that the proportion of specific heat at constant pressure (c') to the specific heat at constant volume (c), viz. $\frac{c'}{c} = k$ is = 1·67 according to the theory mentioned, but = 1·405 according to observation.

Clausius has shown that the theoretical value of c is certainly increased, if we take into account that according to the results of chemical researches the molecules of the gases hydrogen, oxygen, and nitrogen are *not* material points, but polyatomic, and that they are thus capable of storing, as it were, a certain quantity of energy in the shape of motion relative to a centre of gravity. But when Boltzmann lately investigated the behaviour of polyatomic gas molecules according to mechanical principles, he found c for a diatomic gas (like hydrogen, oxygen, nitrogen) to be 1·22 times more than observation shows. He found by calculation $k = 1·33$, and this value is *smaller* than the actual one (1·405). We must remark here that the supposition of a number of atoms larger than

2 would decrease k still further, and here exists for the present an unsolved contradiction between experience and the theory in its present form.

Looking at this state of things, Herren Kundt and Warburg at Strasburg thought it advisable to investigate experimentally the simplest case which nature offers to us, viz. the case of a gas which, according to its chemical behaviour, is a monatomic one. Herr Baeyer pointed out to them that mercury gas was such a gas; they therefore undertook to determine the specific heat of mercury gas. Here a contradiction to the theory did *not* become apparent; the experiment has yielded exactly the value demanded by theory for a monatomic gas, viz., $K = 1{\cdot}67$. Thus it is proved that the molecule of mercury gas, with regard to its thermal and mechanical properties, behaves exactly like a material point. It is hardly necessary to remark that, with regard to other properties, it is not at all necessary that the same molecule should behave like a material point. Thus, for instance, one glance at the spectrum emitted by incandescent mercury gas, which is crossed by many bright lines, shows us at once that the molecule of the same, with regard to the light it emits, does certainly not behave like a material point.

With regard to the way in which the experiment was conducted, we confine ourselves to the following remarks.

The k for mercury gas was determined from the velocity of sound in this gas, and this was found by means of the method of dust figures, formerly described by Herr Kundt.* A glass tube A, closed at both ends, well dried and pumped perfectly free from air, contained a certain quantity of mercury, which had been carefully weighed, and a little silicic acid. Sealed to this tube was another one, B (this a little narrower), in such a manner as to form the prolongation of A. A was placed in a four-fold box made of iron plates, which was heated by a series of Bunsen burners. This box also contained the great reservoir of an air thermometer, and, if observations were made at a temperature under 354°, several mercury thermometers besides. The end of B, projecting from the box, was sealed up, and over this end a long wide glass tube D was placed, which was closed at one end and contained a little lycopodium.

If now, after the necessary regulation in the heating arrangements, the thermometers in the box showed equal and sufficiently elevated temperatures, the tube composed of A and B was sounded by friction to its third longitudinal tone; at the same time a reading of the air thermometer was taken, and the temperature of the air in D was noted down. The powders introduced then showed in tubes A and D the sound-waves in mercury gas and in air respectively, so that afterwards the lengths of these waves could be measured with the greatest accuracy.

Let us suppose

l to be the length of the sound-wave in air,
l' " " " in mercury-gas,
t the absolute temperature of air in D,
t' " " of mercury gas in A,
$d = 6{\cdot}9783$ the density of mercury gas (air = 1),
k = the proportion $\frac{c}{c}$ of the two specific heats for air.
k' " " " " for mercury gas.

Then we have

$$k' = k \left(\frac{l'}{l}\right)^2 \frac{t'}{t} d.$$

If k for air was taken at = 1·405 according to Röntgen, then by seven definite experiments, at different degrees of saturation of the mercury vapour, and three different sets of apparatus being employed, it was found on the average that

$$k' = 1{\cdot}67.$$

The results of the different experiments never deviated more than one per cent. from this value.

If the specific heat c at constant volume for air is taken as = 1, then it follows that c for mercury

$$c = 0{\cdot}60.$$

W.

* See NATURE, vol. xii, p. 88.

AMONG THE CYCLOMETERS AND SOME OTHER PARADOXERS

NO notes have been handed down of the conversation between Erskine and Boswell, whilst strolling in Leicester Fields, on squaring the circle. There is on record, however, Boswell's small joke, "Come, come, let us circle the square, and that will do us good."

The subject is one that has occupied the thoughts of some few from the earliest times of geometrical history, and there are some now fascinated by it at this date, when we have—

"on the lecture slate
The circle rounded under female hands
With flawless demonstration."

Old Burton advises him that is melancholy to calculate spherical triangles, square the circle, or cast a nativity. A popular novelist ("Aurora Floyd," chap. iv.), describing one of her characters "who was an inscrutable personage to his comrades of the 11th Hussars," says he was, "according to the popular belief of those harebrained young men, employed in squaring the circle in the solitude of his chamber."

To say of a man that he is a circle-squarer will make an ordinary mathematician shrug up his shoulders and indicate expressively that there is, in his opinion, a screw loose somewhere. Having had some slight acquaintance with the writings of a few of the race forced upon us, we propose here to pass them under review, generally contenting ourselves with letting them speak for themselves, for thus shall we possibly most effectually confute their absurdities, at least in the judgment of our mathematical readers.

De Morgan, the great exposer of circle-squarers, trisectors, *et id genus omne*, has, after Montucla, stated ("Budget of Paradoxes," p. 96) that there still exist three ideas in the heads of this race—(1) That there is a large reward offered for success; (2) that the longitude problem depends on that success; and (3) that the solution is the great end and object of Geometry. Some eight years ago we saw a letter from a Spanish Don of La Mancha, who offered to send an infallible method of squaring the circle; and within the last four months an application came to us from Sweden, in which the author stated that he had heard that the London Mathematical Society had offered a prize for the trisection of angles, and as he had after long working at the problem obtained a solution, he was ready to transmit the same, but his organ of caution led him to fear lest his communication might get into improper hands, and so he wished to know to whom to send the aforesaid solution. We need hardly say that the Society, in this matter imitating the example of the French Academy of Sciences and of our own Royal Society, has declined to receive any communication upon either of the above-named subjects or upon that of the allied problem, the Duplication of the Cube. This decision was arrived at in consequence of a bulky mass of papers on the circle problem having been laid before the President in the end of 1871. The author had previously submitted his papers to our own examination, and after some little perplexing we were able to indicate the point at which the author had tripped. We have heard nothing further of the solution, nor seen any of the elaborate figures since. We think it fair to state that we believe this cyclometer to have been an honest man and a good geometer. He had worked at the problem, off and on, some twenty years, and attacked it by the lunes of Hippocrates of Chios.

We have consulted the "Introductorium Geometricum" of Charles de Bovelles (Bovillus) in the 1503,

1507 (?), and 1510-1517 editions; and also his "Géométrie Practique" in the 1549 and 1555 editions; and we are disposed to think that De Morgan (B. of P., pp. 31, 32) is in error, possibly in this case following Montucla (for he says he has not seen the former work, and he makes no mention of the second), though all the copies of the "Introductorium" cited above contain the *De Quadratura* which De Morgan states that he has seen. Any how, all the constructions we have seen of Bovillus give $\sqrt{10}$, and not $3\frac{1}{8}$. This will readily be seen from the following:—Bovillus inscribes a square in a circle, and then *states* that the quadrantal arc is equal to the line drawn from an angle of the square to the middle point of one of the opposite sides. In his "Géométrie" he says of Cusa (whose views De Morgan states him to have adopted): "Il ha usé de dimensions infinies, lesquelles un géométrien ne cognoist, et ne confesseroit jamais estre possibles. Nonobstant, son invention est bonne et approuvee, tant par raison que par expérience." Nor do we find any account of his quadrature agreeing with that of a peasant labourer, but he states that he too had attempted the problem by another method (than that of Cusa), and not without success. Whilst standing on a bridge at Paris he noticed the carriage-wheels passing over the road; the fact that when the wheel has performed a revolution we have a straight line whose length equals the circumference of the wheel, suggested his solution to him, and on his return home he easily got his construction, which is this: Divide a radius of the circle into four equal parts, produce this radius through a fourth of its length; join the extremity of this line with an extremity of the diameter at right angles to the radius, and with the point as centre and this distance as radius describe a circle; the portion of the tangent at the extremity of the selected radius cut off by this circle, he says, equals the semi-circumference. It will be seen that this is the same value as that given above. Bovillus, also, in a *libellus de mathematicis supplementis* (1509), gives a third construction, which leads to the same value.

Before leaving this writer we ought to state that he attributes the first construction we have given to his friend M. Achaire Barbel, a man "ingenious at new inventions of use in geometry." It is with considerable diffidence that we have ventured to go thus into detail, but it seems to us that De Morgan had fallen into error in the case of this early writer.

We propose now to take up the subject at the point where it is left in the "Budget," constantly regretting that the hand which so vigorously lashed the offenders in this line now lies cold. Here we must give place to that arch circle-squarer, Mr. James Smith. We shall deal tenderly, however, with his book, as we learn that he too has gone over to the majority and joined his former opponent. The book we have now before us is "Why is Euclid unsuitable as a Text-book of Geometry? This question answered and the Propositions of Euclid 8 and 13, Book VI., proved to be erroneous by Heterodox Geometry." (Motto—"Magna est veritas et prævalebit." London: Simpkin, Marshall, and Co., 1871.) The editor, whose name does not appear, in an address to the reader, states that Geometricus, a principal correspondent in the pamphlet, is "an intimate acquaintance and almost in daily communication with Mr. James Smith, the well-known author," &c. Geometricus became a convert to Mr. Smith's views. He has no niche in the "Budget:" were we not informed to the contrary, we should have been disposed to say that Geometricus and Mr. James Smith were one and the same person. The first fifteen pages are mainly devoted to a correspondence between Geometricus and the Rev. Dr. Jones, if that can be called a correspondence in which the writing on one side is copious and on the other confined to simple acknowledgments of receipts of letters.

The doctor was singled out for this honour in consequence of his having written an able pamphlet "On the unsuitableness of Euclid as a Text-book of Geometry." Geometricus was delighted at the appearance of this work, thinking now at last "here is a recognised mathematician, who has got out of the groove and who can see a geometrical truth by whomsoever propounded;" but alas! he is soon disappointed, and finds that, as in Mr. Smith's experience, directly a mathematician is driven into a corner, he invariably gets out of it by pleading pressing engagements, want of time, &c., "and so a great and important scientific truth—it may be—is born to blush unseen," &c. He then sends James Smith's works (which we said above had converted himself), and now the redoubtable champion of "$\pi = 3\frac{1}{8}$" himself descends into the arena, and must have given the doctor a pretty lively time of it, from the 13th of April to the 10th of June, 1871, as he assails him in six long letters, with diagrams, occupying nearly thirty-three octavo pages of print. Much of what had been written in the "Athenæum Budget of Paradoxes" is brought up and the Smithian value maintained, for though this incontrovertible solution "may not be admitted by you or Clifford (alluding to Prof. Clifford's paper 'On an unexplained contradiction in Geometry,' read before the British Association), or any such like mathematicians of the present age, I can afford *to bide my time* and trust to posterity doing me justice."

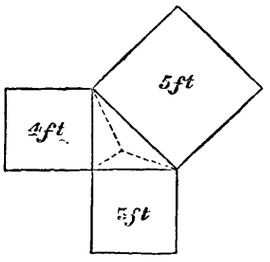
This is the main portion of the pamphlet; there is, however, occasional sparring, both on the part of Geometricus and of Mr. Smith, with the editor of (and some writers in) the *Mechanics' Magazine*. In an appendix a correspondent recommends J. S., "now poor De Morgan (who made you look so rediculous [*sic*]), has departed from this life, there are still some great men left—Prof. Sylvester. Try him, Smith; if you convert that gentleman to your $3\frac{1}{8}$, I will give in *humbly*." Similar advice is given by the same writer in a second letter. The whole book is provocative of much amusement, and is quite of a piece with J. Smith's previous writings.

At the time of writing the previous remarks, we were under the impression that the "Budget" had exposed "Cyclometry and Circle Squaring in a Nutshell, by a member of the British Association for the Advancement of Science." This we at once found was not the case when the pamphlet was lent us by a friend. As we have devoted sufficient attention to Mr. Smith, we may shortly say that it is in octavo form, forty-four pages, and contains letters written between 24th October 1870 and January 1871; that is, immediately preceding the earliest date in the work we have noticed above. The correspondents are A. E. M. (is this the E. M. of the "Budget"?) and S. B. J. This last is another signature, we find, for the pertinacious Smith, who has figured elsewhere as "Nauticus," and wherefore not as "Geometricus"? The "Budget," though it does not discuss this *brochure* individually, has well demolished it by anticipation.

The close of the work is of a prophetical cast. "It is more than sixty years ago since an astronomer of recognised authority—who repudiated the idea that I could solve the problem of 'squaring the circle'—said to me: '*A bright day will have dawned on the astronomical world if ever the* EXACT *ratio of diameter to circumference in a circle shall be discovered.* The day will arrive when it will be said: 'In the nineteenth century of the Christian era—that remarkable century of invention and discovery—darkness still overshadowed the mathematical world. Scientific truth is, and ever has been, a plant of slow growth, but *Magna est veritas*, &c.'" It is to be hoped that the good man has not left his mantle behind, and that "Geometricus" and he were really one and the same.

Mr. John Davey Hailes has a place in the "Budget" (pp. 339, 340). He has not, so far as we know, touched upon the squaring of the circle, but possibly he is approaching that as the termination of his labours. We

have before us five slips. The first addressed "To the Scientific of University College, London, 1871. The Curve a Progressing Wheel Curve. A *wheel* four feet diameter with a *nail in its rim*: when *traversing forward*, the *nail will form a curve, and much longer than the circumference of the wheel. Query: How much longer?* and what must be the DIAMETER of a circle—*for a part of the said circle to* SHOW THE SAID CURVE?" And then there follow two other geometrical questions, the one to divide a trapezium into two equal parts. On the back is pasted (all in writing): "A Problem within a Problem. History record (*sic*) Pythagoras discovered the demonstration of the three squares to surround a Right Angle Triangle; the Two smallest when added together to equal the largest of twenty-five square Feet. I *ask* to find the *Dimentions* to demonstrate the Three Triangles *dotted out* into proportionally *un*equal parts, that when added to each square they produce the same result; viz. Two to equal the largest Figure.



"N.B.—From the Figures 3, 4, and 5,
They can be wrought perfective."

Dated Oct. 2, 1871.

So far there is not much harm in J. D. H.

Another slip addressed, in ink, "To University College, London," is a bit of Hailesian Astronomy, and is, "Astronomy is Paradoxical." The N.B. is of interest in the light of the recent Transit Expeditions. "Those Transit of Venus measurers *that try for the distance* of the sun by Paradox, are in error. Let them try to find *the distance by demonstration. I say it can be done.*" The back of this page is devoted to "Astronomy and Longitude," and opens with the following doggrel:—

Science the Lock of Bible Truth, all the Works Divine,
Magnetic Key, unlock the Truth, and give *true Mean Time.*
In the Time of Joshua the *Sun* stood over Gibeon, the Moon over Azalon;
It was at the *Summer Solstice*, 2548 *from Adam*, DISPROVE WHO CAN?
The Sun began to go back on the Dial of Ahaz at 40′ past Noon.

This last line is in ink. We have then a rule to find true longitude at sea by time, sun, and moon. The spelling is a caution, and the calculation a fitting companion. This is dated Oct. 16th, 1870; the former page Oct. 6th, 1871. Our last document from Mr. Hailes was sent to the British Association, 1868, and is entitled "My Calculated Time of Christ's Crucifixion, A.D. 30," with a number of dates: "And now I challenge all the astronomers in the world *justly* to dispute my above-given times for the above-given events." Verily, Mr. J. D. H. believes wisdom will die with him. Stand down! you will not do much harm, Mr. Hailes.

Mr. W. Upton, B.A. (B. of P., pp. 256-258) brought out in 1872 (E. and F Spon), "The Circle Squared: Three famous Problems of Antiquity geometrically solved—1. The Quadrature or Circle Squared. 2. Diameter definitely expressed in terms of the circumference. 3. The circumference equalised by a right line. The whole rendered intelligible for arithmeticians as well as for geometers, and adapted for the higher classes in schools of both sexes, private students, collegians, &c." We think the day is not very near at hand when this subject will occupy the minds of schoolboys; the present generation have enough to do to secure time for the study of the elements in the "Conflict of Studies" which is being now waged. Mr. Upton, if now living, must be in his 83rd year, and can hardly be expected to write much more on this subject. In his preface he acknowledges to previous failure with respect to the trisection, "but has it now complete." (De Morgan demolished his former essays; one we have seen appears to depend upon a construction familiar to practical geometers. The neatest of practical methods we believe to be that hit upon by J. J. Sylvester, F.R.S., recently referred to in the columns of NATURE.) His aim (in the quadrature) has been at *practical* utility, not rigidly subject to all the extreme niceties of mathematical strictness. The more general treatment he has not gone into on account of the expense (he has not apparently the purse of a James Smith or a "Kuklos") He pledges himself to the satisfactory fulfilment of all that the following advertisement sets forth:—"1. The *full* development of the Quadrature, analytically and synthetically, in its threefold aspect—arithmetical, geometrical, and trigonometrical; containing—2. The so greatly coveted and despaired of desideratum of equalising a circular segment by a rectilineal figure, which determines at once the complete solution of the Quadrature. 3. An appendix, with diagrams, &c." All this to be published on or before Jan. 1, 1873, or much sooner if a sufficiency of *early* subscription warrants it. This work we have not seen; we infer, then, that there were not found eighty subscribers of sufficient faith in Mr. Upton's word and sufficiently interested in the question to come down with the requisite 3*s.* 6*d.* each. What an opportunity for a liberal-minded man! A trifle of 14*l.* in the one scale, and in the other a vexed question set at rest. Nor is this all; he could, too, satisfactorily account for the real origin and inspired nature of mythology, but for the present he confines himself to the more immediate subject. "Certain Hebrew letters and Greek mythology, nay, even Scripture itself, seem to bear distinct allusions to matters touching upon the origin of the square and circle." He winds up with a singular excursus upon the Hebrew ל "distinctly representing the square and circle; the *level* line answering for *base* of the one and *diameter* of the other; the perpendicular for the adjoining side of the square; and the curve for a quadrant of the circle: each with an appearance of *string* at the extremity to intimate its being carried on to *completion.*" There is a "Supplement" (diagram and five pages, *free of charge*), from which an estimate of the value of the work may be got on the author's own showing: "The *precise* difference is therefore *not* equivalent to the impression of a pin's point; so that the author considers himself fully justified in looking upon the two areas as *arithmetically* equal. Moreover, in a *geometrical* solution, which is the *real* object of the problem, it is evident that so *invisible* a difference can have no possible effect."

Again, if he should be enabled to publish his proposed treatise, he can "show by three or four *distinct* but *concurrent proofs* that the circle itself not only admits of, but—more surprising still—actually suggests the formation of a right-lined figure equal in area to the circular segment belonging to each quadrant! This is what may indeed be esteemed as the ***true secret***, the ***virtual key*** of the Quadrature; which the author will give to his readers and apply for them in the annexed diagram. He would have reserved the *fact* till he could have given it with the several proofs *complete*. But, as the fact itself, and its application to the diagram, ought to prove sufficient to produce conviction as to the truth of his assertion, he will proceed to apply it without further preface." We gather from his remarks that they turn upon the lengthening of a line by a *point* from a pencil which can make no *perceptible* difference in the geometrical construction. It seems only necessary to make this statement, and leave our mathematical readers to draw their own conclusions therefrom. (*To be continued.*)

*INTERNATIONAL METEOROLOGY**

IT may be truly said that all the large questions which fall within the province of meteorology can only be adequately discussed by data collected in accordance

* Report of the Permanent Committee of the First International Congress at Vienna, for the year 1874. Printed by authority of the Meteorological Committee. (London: Stanford, 1875.)

with some well-devised scheme of international observation. What is required is the means of giving an accurate general representation of atmospheric pressure, temperature, humidity and aqueous precipitation, together with the movements of the air as indicated by the direction and force of the wind, and of the phenomena more immediately connected with these movements. Of these last, the more important are clouds, their species and motions, and electrical and auroral manifestations.

These large inquiries naturally fall into two groups. The first group is concerned almost exclusively with the great movements of the atmosphere, and it is the adequate investigation of these inquiries which is aimed at by the United States Government in their great scheme of observations made at the same *physical instant* over the whole globe. This scheme may be called *cosmopolitan*.

The second scheme may, in contradistinction to the above, be called *international*. It includes those inquiries which deal with the large and vitally important subject of comparative climatology, or a comparison of the climates of different countries and regions, and of their meteorology generally, inclusive of the great movements of the atmosphere over a restricted portion of the globe, such as the United States, the North Atlantic, or Europe. It is altogether essential to the discussion of those inquiries which fall under this head that the observations be made at the same *local time* and with instruments so constructed and placed as to give results strictly comparable with each other. It is evident that the exposure of the thermometers, including their immediate surroundings and height above the ground, must be uniform in all countries; otherwise the observations, being incomparable, cannot be used in questions of international meteorology.

Of the recurring meteorological phenomena which first and most imperatively require to be dealt with internationally, both from their importance in atmospheric physics and from their intimate bearings on animal and vegetable life, are the daily changes which take place in the temperature, humidity, pressure, and movements of the atmosphere from 9 A.M. to 3 P.M. With observations at these hours, together with the daily maxima and minima of temperatures from a network of stations well spread over Europe, we should be put in a position of being able to inquire, with some hope of success, into the influence exerted on meteorological phenomena by different latitudes and elevations; by the Baltic, Caspian, Black, Mediterranean, and Adriatic Seas, the English Channel, and the Atlantic; and by the Swiss Alps, the mountain ranges of Great Britain and Norway, the scattered hills of Ireland, the elevated plateaux of Spain, and the extensive flats of Germany and Russia. We entirely concur with Prof. Plantamour in thinking that during recent years the study of the movements of the atmosphere has been too exclusively directed with a view to the application of the results to the prediction of storms on the coasts and to the system of storm-warnings, and that other points of view have been completely abandoned (Report, p. 58). It is right, however, to add that this neglect may be excused on the ground that, as there is an entire want of uniformity in the hours and modes of observing in the systems of meteorology as pursued in the different countries of Europe, the data for the investigations of nearly all the important questions of international meteorology do not exist.

It was a widespread feeling of a requirement of uniformity of procedure in the prosecution of meteorological researches in different countries which led many to look to the Congresses of Leipsig and Vienna as likely to secure this result; and it is a matter of regret that at these meetings nothing was done to bring about uniformity in the hours and modes of observing. Doubtless the question of international observations was under discussion at Vienna, but the feeling of the delegates regarding it, as indicated by the state of the vote and the large number who abstained altogether from voting, was such that the only resolution arrived at was this, viz.: "That the best form of publication for the stations selected for international objects should be determined by the Permanent Committee, after consultation [*nach Anfrage*] with the directors of the central institutes."*

The matter accordingly came before the Permanent Committee at their meeting at Utrecht in September 1874, and after numerous explanations and a long discussion they unanimously resolved on a form for the publication of observations made for international objects (p. 7). This resolution is now being carried out by several of the countries represented at the Vienna Congress.

With reference to this resolution, however, it is to be remarked that (1) no provision was made by it for the observations being made at the same hours of the day; and as a matter of fact, the observations in the British Isles in connection with the scheme are 9 A.M. and 9 P.M.; in Russia, 7 A.M., 1 P.M., and 9 P.M.; in Norway, 8 A.M., 2 P.M., and 8 P.M.; in Italy, 9 A.M., 3 P.M., and 9 P.M.; in Austria, variously, and so on.

(2) No provision was made for securing uniformity as regards the vital question of the exposure and position of the thermometers, without which comparability is impossible.

(3) The forms adopted, both for the daily observations (p. 10) and for the monthly results (pp. 47-50) are in several respects defective, inasmuch as they do not include some of the more important data required in international inquiries.

The result will only be the printing of various sets of observations styled international, but which are not international—being, in truth, taken at their very best, merely national. By observations so made, no international question of meteorology can be satisfactorily discussed, and many international questions of the first importance, both practical and scientific, cannot even be attempted to be discussed.

When the subject was before the Vienna Congress, Plantamour urged the necessity of drawing a distinction between observations referring to the special study of the climate of each country, and those which are intended to indicate the simultaneous condition of the atmosphere over the whole surface of the earth (Report of Vienna Congress, p. 35). Until this be done, or until some such scheme as we have here indicated has been considered and agreed upon, it would be a mistake in meteorologists co-operating in carrying out a scheme which, while called international, completely fails to furnish the data required for international inquiries.

The only wise course the Permanent Committee can take at their next meeting is to rescind this resolution, as they have already virtually rescinded (p. 8) the resolution regarding rain-gauges all but unanimously passed at Vienna; and after consideration of the whole question to make provision that the instructions given them by the Vienna Congress with regard to this matter be carried out, viz., that no resolution be come to till after they have consulted the directors of the central institutes of the different countries; by which means they will furthermore be put in a position to propose a scheme which has been well matured, and therefore of such a character as will enlist in its behalf the general co-operation of meteorologists.

NOTES

WE can only this week join in the universal expression of regret at the death of Sir Charles Wheatstone, which took place at Paris on the 19th inst., at the age of seventy-three years. Inflammation of the chest was, we believe, the immediate cause of the sad result. The Paris Academy showed the greates

* Protocol of the Ninth Meeting of the Congress.

interest in Sir Charles during his illness, and previous to the removal of his body to London a religious service was held at the Anglican chapel in the Rue d'Agueneau, at which a deputation from the Academy was present. MM. Dumas and Tresca delivered addresses, which will be published in the *Comptes Rendus*. Sir Charles was buried yesterday in his family burial-place at Kensal Green. We shall give a memoir in an early number.

THE following changes are proposed to be made for the ensuing session in the Council of the London Mathematical Society :—Profs. Cayley and Sylvester, having served their term of office, become ordinary members, and the Council recommend that their places be filled up by Lord Rayleigh, F.R.S., and Mr. W. Spottiswoode, F.R.S. Dr. Henrici, F.R.S., and Mr. H. Martyn Taylor are put in nomination to fill up the vacancies caused by the withdrawal of Mr. R. B. Hayward and Mr. W. D. Niven.

THE anniversary meeting of the foundation of the French Institute by the executive directors of the first French Republic was celebrated as usual on the 25th of October. The president was M. Lefuel, a member of the Academy of Fine Arts: he was assisted by delegates of the other academies. M. Lefuel had to perform the duty of awarding the great biennial prize (see vol. xii. p. 526) for 1875 to M. Paul Bert, member of the Versailles Assembly and a Professor of Physiology at the Sorbonne, for his discoveries relating to the part played by oxygen in the act of respiration. Although the report was presented to the Academy of Sciences at a secret sitting, it is expected that it will be published shortly, as the noblest part of the award is not the gift of a handsome sum of money, but the reasons why the prize had been adjudged to the candidate. After this the report for the prize established by the celebrated Volney was read at full length, and three lectures were delivered. The last one was by M. Mouchez, the new member of the Academy of Sciences, on the Venus Transit Expedition to St. Paul. The brave captain read it in plain sailor-like fashion and with much humour, and met with a most favourable reception.

THE Congress of Meteorologists, which was to have been held at Poitiers at the end of October, has been postponed for a month, and will be held on the 19th, 20th, and 21st Nov. next. It is to be styled the "Meteorological Congress of Western Oceanic France." All the departments situated within the space bounded by the Dordogne, the Atlantic, the Loire, and the central mountains of France, together with the Council of the Observatory of Paris, will be represented on the occasion. Among the representatives who will be present are MM. Belgrand, Renou, de Touchimbert, de Tastes, de la Gournerie, Lespiault, Raulin, and Leverrier, who will preside. Delegates from the departments of the regions adjoining are invited to be present to assist in laying the basis of a common understanding among the different regions in matters referring to meteorology.

A REUTER'S telegram, dated Rome, October 23, states that Mr. J. Norman Lockyer and Major Festing had arrived there, deputed by the British Government to propose to the Italian Government to send to the Exhibition at South Kensington in 1876 a collection of the instruments used by Italian professors in recent important astronomical observations.

PROF. BOYD DAWKINS, F.R.S., who left early in June for Australia, has returned to England *viâ* the Rocky Mountains Railroad and New York. The duties of the Geological chair at Owens College have been taken during his absence by Mr. C. E. De Rance, F.G.S., of the Geological Survey of England and Wales.

THE Commission on Vivisection have been meeting constantly during the past and present weeks, and have examined a considerable number of witnesses.

IT is announced that the preliminary works for the Channel Tunnel are to be commenced this week near Calais. A shaft will be sunk to a depth of 100 metres.

AS zoologists are not likely to look in the Transactions of the Society of Biblical Archæology for anything concerning their own studies, especially in a paper entitled "The Tablet of Antefaa II.," it may be as well to mention that this paper, by the learned president of the society, Dr. S. Birch, of the British Museum, in the last issued number of the Transactions (vol. iv. part i.), contains an interesting account, with numerous illustrations, of the different breeds of domestic dogs kept by the ancient Egyptians. It would appear from the drawings preserved on the walls of the tombs, that the variations of this animal in those early days were quite as well marked as those that may be seen at a modern dog-show.

THE Geographical Society of Paris held its first semi-monthly meeting of session 1875–1876 on the 20th of October; more than 190 members were present. The chair was filled by M. Delesse, the president of the central section. The correspondence was unusually long and interesting, and it is evident that geographical studies are advancing in France.

AN expedition under M. Largeau has been fitted out by the French Chambers of Commerce and private subscriptions to proceed to Rhadames from Algiers, and open communications with Soudan and Timbuctoo. The expedition is already on its way. A French paper, the *Rappel*, has sent a special correspondent with M. Largeau; this is perhaps the first time that any French journal has taken such a step.

NEWS has been received from the French Gaboon expedition under MM. Marche and Brazzi. These two gentlemen had arrived at St. Louis and selected a number of Laptots to accompany them in their excursions. The expedition is to last several years. A Government steamer was to conduct them from St. Louis to Gaboon.

A FRENCH expedition is being fitted out to make a "Tour du Monde" in ten months. The excursionists are to visit India, Japan, the interior sea of Japan, Chinese ports, Australia, &c. A special library, with instruments, will be placed on board. The members of this expedition will be exclusively of the male sex. The fare is to be 800*l.*, everything included. The Geographical Society will superintend the management of the enterprise, although it will be supported by private funds and is altogether a private speculation.

THE Marquis de Compiègne, the African explorer, has ftle for Cairo, where he has been appointed by the Khedive the acting secretary of the newly-established Khedival Geographical Society.

THE *Times* special correspondent at Suez, under date Oct. 26, telegraphs as follows with regard to African exploring expeditions :—"Despatches of the 14th and 20th of August, received yesterday, report that Lieut. Gordon was in Appudo with the steamer. The Kabba Regga people were intriguing. Linant saw Stanley, who had traversed Lake Victoria from south to north alone, at M'tesas. Cameron was at Tanganyika for eight months, trying to go the western route between Uganda and Zanzibar, which was interrupted by the Karaque tribe two degrees south. Subsequent despatches report the death of Linant in a fight with the Kabba Regga people. Lake Victoria is very large, and full of isles."

WE announced some time ago that the Italian Geographical Society was organising an expedition for African exploration. The Society has already raised 70,000 lire, which it expects its honorary president, Prince Humbert, to raise to 100,000 lire (4,000*l.*) The *Times* Milan correspondent sends additional

details. The Italian expedition is to be divided into two sections; one is to set out from the Gulf of Aden for Tajurra, or Berbera, or some other port on the eastern coast of Africa, proceed to Shoa, and thence to Kaffa; and from this great slave market it would make its way through an unexplored region to the central lakes, studying the hydrographic course of the eastern Nile. The other party would take its start from Khartoum, and, exploring the region lying between Monboottoo and the Victoria Nyanza, push on, if it be practicable, as far as the great valley of Lualaba, discovered by Livingstone. The first-mentioned section of the expedition will be commanded by the Marquis Antinori, one of the vice-presidents of the Geographical Society, a distinguished ornithologist, who has spent several years in Central Africa, and whose travels in that region have won him a widespread reputation. He is now about seventy years old. The other section will be under the guidance of Ademoli, also familiar with the districts he proposes to explore, a young, brave, and strong man, known for his enthusiasm in the work of discovery, to which he has devoted himself.

FURTHER correspondence from members of the English Arctic Expedition confirms the news brought home by the *Pandora* that an unusually easy passage had been made to within 100 miles of the entrance to Smith Sound, and it is even expected that if circumstances continue equally favourable the pole may be reached this year. The expedition is not expected home, however, till the end of 1877. On July 23, the *Alert* met with the first accident; she went on shore on a small island off Kingitok, but was floated off without injury as the tide rose.

LAST week we gave an abstract of Lieut. Weyprecht's paper on the principles which ought to guide Arctic exploration. Now it is stated that the Scientific Commission appointed by the German Government has reported, we believe in consequence of this paper, against the expediency of a fresh Polar Expedition, but has recommended the establishment of stations of observation in both hemispheres.

A PAPER of considerable interest, by Dr. Daniel Wilson, has been reprinted from the *Canadian Journal*. Its title is "Hybridity and Absorption" in relation to the Red Indian Race." Dr. Wilson, while of course admitting the patent fact that the American Indians, like most other barbarous races, have largely melted away before the white races, thinks that in accounting for this too much stress has been laid on mere extermination. He adduces data to prove that a very considerable proportion of red blood has been absorbed into the whites of North America, and that especially in the Canadian Dominion this shows itself in the physiognomy of all classes. It would be difficult, he believes, to find either in the United States or in Canada many Indians of pure breed. In Canada half-breeds are the almost universal representatives of the former Indian tribes, and many of them are settling down to a steady civilised life. In short, Dr. Wilson has what appears to us a well-founded belief that the aborigines of North America are being gradually absorbed into the dominant race, and that in course of time they will have become as integral a part of the population as any one of the elements which may be traced in the population of Europe, and that their physical and mental characteristics will tell upon the American character—just as Melanochroic attributes have left marked traces on the intrusive Xanthochroic European peoples. Fortunately the evidence gives good ground for believing that this influence is decidedly good, physically and intellectually. The characteristic "Brother Jonathan" face, which is generally attributed to influences of climate, soil, food, &c., Dr. Wilson is inclined to attribute to a decided admixture of Indian blood; probably both causes have had to do with it. Dr. Wilson rightly advocates the most judicious and humane treatment of the Indians both by the U.S. and Canadian Governments.

THE opening lecture of this session's Manchester Science Lectures for the People, the charge for admission to which is only one penny, was given on Tuesday last by Capt. Davis on "Arctic Discoveries." The other lectures are as follows:—Prof. Rucker on "Soap Bubbles;" R. Bowdler Sharpe, F.L.S., on "The Birds of the Globe;" Prof. J. Martin Duncan, F.R.S., on "The Great Extinct Quadrupeds;" Prof. Thorpe, F.R.S.E., on "Cavendish and his Discoveries;" Prof. Ferrier, F.R.S., on "The Functions of the Brains;" Prof. Henry E. Armstrong, on "Food;" William Pengelly, F.R.S., on "The Age of the Men of Kent's Cave." Part II.

A CIRCULAR, signed by Mr. W. Melton, who is judicial assessor on the Gold Coast, was issued last month by order of the Governor, "To the native kings, chiefs, captains, headmen, and principal men of the Gold Coast Colony," pointing out that "it is most desirable that the Gold Coast Colony should be well represented at the forthcoming International Exhibition at Philadelphia," and asking them to give all assistance in their power in sending contributions and collecting articles illustrative of the countries and districts over which they preside. Mr. Melton has issued a classified schedule of articles suitable for exhibition. Department I. Materials in their unwrought condition, mineral, vegetable, and animal. II. Materials and manufactures, the result of extractive or combining processes. III. Textile and felted fabrics, apparel, costumes, and ornaments for the person. IV. Furniture and manufactures of general use in construction and dwellings. V. Tools, implements, machines, and processes. VI. Boats and sailing vessels. VII. Apparatus and methods for the increase and diffusion of knowledge. VIII. (Not represented). IX. Plaster and graphic arts. As the arrangements are, we are told, in vigorous hands, and it is announced to the "native kings, chiefs," &c., that they may be reimbursed for any outlay they make, it is expected the collection from this colony will be extensive and interesting. In connection with this, Schweinfurth's "Artes Africanæ," just published, is of interest: we shall give an early notice of this work.

IN reference to a recent note, p. 461, we are glad to see that at the Brighton meeting of the Social Science Association a resolution was passed requesting the Council to communicate with the authorities of the Science and Art Department of the Privy Council, suggesting the desirableness of making "Foods, their uses and preparation," the subject of examination.

IT seems that a good deal of the tobacco used in the manufacture of the so-called Havana cigars in Germany comes from Colombia, principally from Jiron, Ambalema, and Palmira, and that its quality is not of the first mark. Tobacco is also cultivated in the State of Bolivar, and is exported for a similar use.

MR. AMOS SAWYER contributes a short though interesting article to the *Transactions of the Academy of Science of St. Louis* on the cause of climatic change in Illinois. During the last twenty years, he says, the climate has been slowly, but surely, changing from wet to dry; and although this change has been beneficial from a sanitary point of view, agriculturally considered it has been, and will hereafter prove to be, a great obstacle to the successful cultivation of the soil. The most important agent, in Mr. Sawyer's opinion, is what he calls the aqueous agent. The chemical and mechanical effects of this agency are constantly at work, and the result is plainly visible in the deepening of the channel of all the small streams. At the present time all the prairie land is in cultivation, or used as pasture; the ponds and small lakes have become so filled up that they contain less than

half the former amount of water; the stock now consumes the reeds and marsh-grass, exposing the water to the direct rays of the sun, thereby promoting evaporation, so that by midsummer even the mud in their basins has dried to a hard crust, and a change in the temperature during the heated term brings, as a rule, a cool, dry atmosphere instead of rain, as in former years. Mr. Sawyer goes on to describe the large increase in the consumption of water by domestic animals. In this State at the present time there are at least "three million horses, cattle, and mules, and five million hogs and sheep, and they will consume not less than *seventy million gallons* of water every twenty-four hours—quite a lake of itself." This, surely, must be a misprint, or American animals are very thirsty beings!

A CORRESPONDENT of the *Aberystwith Observer*, the Rev. James Lewis, of Llanilar Vicarage, writes as follows to that journal:—"Whilst returning from service at the parish church of Rhostie, about 8.15 P.M. on Friday, the 24th ult., in company with two members of the congregation, my attention was called to a remarkably strange phenomenon. In walking across a field on the farm of Cwmclyd, it was noticed that our footsteps were marked by a peculiar light, which could be traced back for several yards, each footprint being as distinctly marked on the ground as when one walks in snow. When we got into the adjoining field the light disappeared until we came near to the end of it, when it was observed that our footsteps were again marked by the same luminous appearance. In colour the light was similar to that of phosphorus rubbed on a wall in a dark room, or a mass of glow-worms, of which insect, however, there was no trace on the surrounding ground."

IN the *Bulletin International* of the Paris Observatory for the 21st inst. appears an interesting note by M. de Lagrenè on the thunderstorms which have occurred in the department of Haute-Marne during the seven years ending 1874. In this department the average annual number of thunderstorms is 87, of which 25 occur in July, 20 in May, and 14 in June. During the six months from October to March inclusive the mean annual aggregate is only six. The geographical position of Haute-Marne is an important one as regards these electrical phenomena, about which so very little is yet known, and this Departmental Meteorological Commission is doing good service in contributing its share in the work of collecting data on the origination, intensity, and rate of propagation of thunderstorms, and the manner in which they are influenced by the winds prevailing at the time, by the contour of the ground, and by forests.

WE have received the first number of the *Iowa Weather Review*, September 1875 (pp. 20), which has just been started by Dr. Gustavus Hinrichs, from which we learn that the system of rain observations set on foot by him, as explained in a recent notice in NATURE, is only the beginning of a more complete system by which it is hoped that the whole meteorology of this important State will be adequately and systematically observed and turned to practical account in the interests of the people. There is an idea shadowed out in the prospectus by which, if gone into and developed, the United States will be divided into meteorological districts or regions similar to what is now being done in France, and which is really the only means by which many highly important questions can be properly investigated. Dr. Hinrichs gives the monthly rainfall for the months of past years' observations, as well as the monthly means, at six places in the State, and sends a carefully compiled monthly report of his own observations made at the laboratory of the Iowa State University at Iowa City, the amounts and averages of each month being compared with the results of previous years' observations.

THE additions to the Zoological Society's Gardens during the past week include a Binturong (*Arctictis binturong*) from Malacca, presented by Captain A. R. Ord; a Wood Owl (*Syrnium aluco*), European, presented by Mr. F. Brannd; a Missel Thrush (*Turdus viscivorus*), European, presented by Mrs. Watson; a Grey Wagtail (*Motacilla boarula*), seven Picked Dog Fish (*Acanthias vulgaris*), European, purchased; a Cape Buffalo (*Bubalus caffer*) born in the Gardens.

ON THE VARIATIONS OF THE ELECTROMOTIVE FORCE OF A NEW FORM OF LECLANCHÉ'S CELL

A NEW form of Leclanché's cell has been constructed by Dr. Muirhead, and is supplied by Messrs. Warden, Muirhead, and Clark.

In this form the carbon and black oxide of manganese are packed in the outer case around a glazed porcelain jar perforated with holes about one-eighth of an inch in diameter, the jar containing a zinc plate bent into the form of a cylinder.

The advantages gained are that a much larger surface of zinc is exposed and the perforations of the jar are in no danger of being choked up by deposition of chloride of zinc.

The following results may be of some interest as showing how the electromotive force of this cell varies when it works for a considerable time through circuits of various resistances.

A circuit of known resistance was formed, through which the battery worked, and two points in this circuit were attached to the poles of a sawdust Daniell's cell, so as to form a branch circuit in which a galvanometer was included; one of these two points was then moved along the circuit until the galvanometer showed that there was no current through the Daniell; when this is the case the E.M.F. of the battery is to that of the Daniell in the same ratio as the resistance of the whole circuit to that of the part between the points of attachment of the Daniell.

A set of coils was used by which the resistance could be adjusted to ·05 ohm, and by adding one of these coils to the common part of the circuit (so that the resistance of the whole circuit did not remain quite constant) a very small change in E.M.F. could be measured.

The current through the Daniell was always very small, and as it passed sometimes in one direction and sometimes in the other, the difference between the potentials of its poles must have remained very nearly constant.

In the circuits of small resistance it became necessary to take account of the internal resistance of the cell. This was found (for these circuits) to be generally between ·45 and ·46, it was subject to slight variations between these limits, but rarely exceeded them when the battery was worked for only two or three hours, although on leaving the battery circuited through 30 ohms for 20 hours it rose as high as ·525. The lowest resistance observed was ·420 when working through 10 ohms.

The following tables give the E.M.F. of the battery in terms of the Daniell:—

When the cell had been circuited through 10 ohms for 2 min., the E.M.F. was 1·320; for 3⅔ min., 1·314; for 5½ min., 1·304; for 13 min., 1·292; for 23 min., 1·283; for 34 min., 1·277. For 1h. 1m., 1·266; for 1h. 31m., 1·256; for 1h. 56m., 1·254; for 2h. 11m., 1·253.

When circuited through 20 ohms for 2½ min. the E.M.F. was 1·3465; for 4 min., 1·3420; for 5½ min., 1·3385; for 13 min., 1·3315; for 18 min., 1·3270; for 30 min., 1·3215; for 46 min., 1·3155. For 1h. 1m., 1·3095; for 1h. 22m., 1·3045; for 1h. 31m., 1·3035.

When circuited through 30 ohms for ½ min. the E.M.F. was 1·3702; for 2 min., 1·3608; for 3 min., 1·3585; for 4 min., 1·3562; for 10 min., 1·3500; for 20 min., 1·3446; for 26 min., 1·3404; for 28 min., 1·3391. For the next four minutes the E.M.F. was very unsteady. For 32 min., 1·3411; for 33 min., 1·3398; for 39 min., 1·3364. For 1h. 3m., 1·3318; for 1h. 14m., 1·3292; for 1h. 28m., 1·3211; for 23h. 30m., 1·2810.

When circuited through 100 ohms for 7 min. the E.M.F. was 1·4415; for 10 min., 1·4417; for 20 min., 1·4423.

No further change was observed at the expiration of one hour.

When the cell (after being insulated for 21 hours) was circuited through 3,200 ohms, after 1 min. the E.M.F. was 1·448; after 3 min., 1·450; after 18 min., 1·454; after 38 min., 1·459.

When the cell was short circuited through itself for two minutes the E.M.F. fell from 1·407 to 1·235. (These measurements were taken with the cell working through 3,500 ohms.)

On being circuited through 3,500 ohms for 23 min., the E.M.F. rose to 1·383.

More observations were made than those here recorded, readings being taken in some cases every minute, but the only irregularity observed was that noticed when working through 30 ohms.

In these experiments we may notice that when the battery was short circuited through 10 ohms, the E.M.F. after the first two minutes fell 4¼ per cent. in 1½ hours; through 20 ohms it fell 3 per cent.; and through 30 ohms, 2¾ per cent., in the same time. But when circuited through 100 ohms and upwards, the E.M.F. increased with the time,* the percentage increment increasing with the resistance. Hence it appears not unlikely that there may be some resistance through which the E.M.F. will remain absolutely constant; should this be found to be the case, and should this resistance always remain the same, the battery will be very valuable when required to work through such a circuit.

It may be remarked that, in accordance with the usual rule, the E.M.F. of the battery increases with the external resistance.

The cell was insulated for a considerable time previously to commencing each set of experiments. S. A. SAUNDER

Cavendish Laboratory, Cambridge

OUR BOTANICAL COLUMN

EXOTIC TIMBER-TREES IN MAURITIUS.—Amongst useful plants that have been introduced into countries distant from their native habitats, the timber-trees are of some interest, inasmuch as beyond the proof of their establishment in foreign climates and soils, some time is needed to prove what effects the change may have on the quality of the timber itself, for on this alone depends the value of the experiment in a commercial point of view. It is, however, satisfactory to learn that some well-known timber-trees that have been introduced into Mauritius through the instrumentality of the Royal Gardens, Kew, are in a flourishing state. Thus, the mahogany (*Swietenia mahagoni*), one of the oldest and most valued of furniture woods, has made a very rapid growth, forming, in three or four years after the sowing of the seeds, trees about twenty feet in height, with stems from three to six inches in diameter. In India, likewise, the mahogany thrives well, and as a proof that the wood is valuable, it may be stated that a tree blown down in the Calcutta Botanic Gardens during the great cyclone realised over 1,000 rupees. Logwood (*Hæmatoxylon campcachianum*) is reported also to grow well in Mauritius, and it moreover makes excellent hedges, far superior, it is said, to hawthorn. It has been quite naturalised on the hills and waste lands in the vicinity of Port Louis, and annually produces large quantities of seeds.

BAMBOO AS A PAPER MATERIAL.—A good deal of attention has of late years been directed to new materials for paper making. Esparto has been one of the most successful of modern discoveries, and now we are told that the supplies of that useful substance are decreasing and must in course of time fail altogether. Where then shall we look for our future supplies is a question that has agitated many minds, and which has been answered frequently by references to the numerous fibre-producing plants of both the East and West Indies, Australia, &c. We know that in India the fibrous barks of many trees, and notably that of *Daphne papyracea*, are used for paper making; while in China and Japan, where paper is used for a much greater variety of purposes than it is in England, the barks of *Broussonetia papyrifera* and *B. Kæmpferi* are made into paper of every conceivable and indeed inconceivable form; for some specimens are so much like leather that it takes a critical eye to detect it, and others are such good imitations of crape and muslin that the same care is needed to determine their true nature. That the Chinese and Japanese excel in paper-making cannot be doubted, when we consider all their manufactures, and more especially that fine quality of paper known as India proof paper, which they make from young bamboos. The bamboo as a paper material in this country is a comparatively modern introduction; indeed, we can hardly say that it has actually become a commercial article, but there seems no reason why the stems of the bamboo, which in tropical countries is one of the commonest and fastest growing plants, should not be converted into *half stuff* and sent to England in almost any quantity. To make this material better known has been the aim of Mr. Thos. Routledge, in a little pamphlet of forty pages, which he has just issued. Mr. Routledge is no doubt able to speak with authority on the details of manipulation of paper stock in a practical, if not in a scientific sense; but it is not our intention to follow him through the subject, but simply to refer to some facts quoted by him as an illustration of the suitability of bamboo as a paper-making material, and to endorse to a certain extent some of those facts and suggestions. Thus, with regard to supply, it is well known that in most tropical countries bamboos of various species flourish to a considerable extent and are to the people of immense value, furnishing them with numerous articles of daily necessity; then again their growth is so rapid as to form a constant supply. With regard to the rate of growth, we read that at Gehzireh, the gardens of the Khedive of Egypt at Cairo, it has been known to grow nine inches in one night. At Sion House, the Duke of Northumberland's, stems of *Bambusa gigantea* have attained the height of 60 feet in twelve weeks; while at Kew, *Bambusa vulgaris* is recorded as growing in favourable seasons at the rate of eighteen inches per day; and at Chatsworth the same species has attained the height of 40 feet in forty days. For the purpose of paper-making the stems should be cut down in a comparatively young state, before they become too woody, and reduced to pulp or half stuff before being sent to this country.

SCIENTIFIC SERIALS

American Journal of Science and Arts, October.—This number contains the following two papers read at the Detroit meeting of the American Association for the Advancement of Science.—Address of Dr. John Le Conte, the retiring president.—A comparison between the Ohio and West Virginia sides of the Alleghany coal-field, by E. B. Andrews.—There is also a reprint from the *Philosophical Magazine* of Mr. Mallet's paper on the temperature attainable by rock-crushing.—In an obituary notice of Sir Charles Lyell, there is introduced an extract of a letter from Dr. Mantell to Prof. Silliman, in 1841, describing how Mantell and Lyell first met.—The original articles in this number are: On the arithmetical relations between the atomic weights, by M. D. C. Hodges.—A note by L. F. Pourtales recording the corals found at the Galapagos Islands.—On instinct (?) in hermit crabs, by Alexander Agassiz. This records how young crabs reared without shells during their growth, "made a rush" for them as soon as they were placed in the tank where they were living.—On Southern New England during the melting of the great glacier, Part ii. We reserve our notice of this till the paper is completed.

Geological Magazine, October.—The original articles are: The Geology of Central Sumatra, by R. D. M. Verbeek (superintendent of the Geological Survey of Sumatra). This is stated to be the commencement of a series of articles on the subject, published with the authority and assistance of the Dutch-Indian Government. The oldest rocks in this part of Sumatra are granites, granite-syenites, and syenites. Then follow sedimentary rocks classed as of Carboniferous or Permian age. "This oldest sedimentary formation of Sumatra can be divided into two parts. The lower portion consists of clay-slates with auriferous quartz-veins, marl-slates and siliceous schists; the upper part consists only of limestone, with some small beds of schists." There are quartz porphyries and greenstones, the age of which is not known, but they are probably older than the tertiaries. The tertiaries themselves are divisible into five groups. The trachytic rocks are younger than the tertiaries. Three clearly drawn sections illustrate the paper, and a list of principal papers on the geology of Sumatra is given.—On the origin of Coums, by J. G. Goodchild. That many of these cauldron-like hollows are due to the eddying of ice is the argument of Mr. Goodchild.—Dr. Walter Flight continues his "History of Meteorites."—Dr. Thomas Wright records the occurrence of the genus *Cotylederma* in the middle lias of Dorsetshire.

Poggendorff's Annalen, No. 8.—This number commences with an investigation by Karl Müller as to the pitch of the transversal vibrations of bars of gypsum, when these are saturated with different droppable liquids. It appears that the liquid does not act as a weighting of the bar, but enters into union with the molecules of the substance, diminishing the co-efficient of elasticity; and this is manifested in a fall of pitch, the fall having

* As the coils were arranged in boxes, and so could not be kept at a uniform temperature, it was thought that this might be due to unequal heating. It was found, however, that the alteration in the ratio of the resistances due to this cause was such as to cause the E.M.F. to appear to increase less than it really did by about ·005 per cent. in one hour, which would not affect the results in the tables.

been greatest (in the cases studied) on imbibition with water, less with oil, and least with alcohol. It is greater the higher the specific gravity of the liquid. The change of pitch with alcohol and with oil was more regular than with water, and the regularity was almost perfect, if the changes of tone of the saturated bars were compared with one another, and not with the dry state.—Herren Kundt and Warburg continue the account of their researches on friction and conduction of heat in rarefied gases. Having experimented with air, hydrogen, and carbonic acid, they here show that the coefficients of friction are independent of pressure within the limits 750 mm. and 1 mm. mercury. With rarefaction under 1 mm. they could not sufficiently remove the vapour.—Dr. Oberbeck describes a method of determining the conductivity of liquids for electricity. The principle is briefly this:—Connect the ends of an induction spiral with a spark micrometer. Then, with a certain strength of inducing current, a separation of the balls may be found, at which sparks continuously pass; but on slightly increasing the interval they cease to pass. Next, connect the two ends of the spiral also with an uninterrupted branch line; it will depend on the resistance of this and the intensity of the inducing current, whether sparks will pass between the balls. If the line is short and of metallic wire, the spark current disappears, however near together the balls may be brought; but if it consist of thin tubes of badly conducting liquids,, a small approximation of the balls will reproduce the sparks. Thus the conductivity of liquids may be compared.—An improved construction of lightning conductors for telegraph-wires is described by M. Schaack. The line-wire and that of the telegraph-apparatus are connected respectively with two binding screws on pieces of wood which form opposite rims of a rectangular tin case containing water, and a loose coil of German silver wire, covered with caoutchouc, connects the binding screws through the water. The wire of the telegraph-apparatus, after passing through the apparatus, returns to the case, which is connected to earth.—There is also an account of M. Le Cour's valuable proposal for employment of tuning-forks in electric telegraphy.—M. Schneebeli continues his researches on the attraction and separation-time of electro-magnets, and takes occasion to describe Hipp's chronograph as recently improved.—Among the remaining papers may be noted one by M. Sauer, describing some interesting experiments on the visibility of ultra-violet rays, and another by M. Holz, on transformation of electric currents of low tension into disruptive discharges of higher tension.

Der Naturforscher, September.—This number contains some interesting observations made at hot springs in Italy, by M. Hoppe Seyler, on the upper temperature-limit of life. At Ischia, on Monte Tabor, he found green algæ on the widening sides of a fissure through which rose hot steam, and the thermometer showed 64°·7 C. This was higher than in the case of algæ growing in water; at Lipari, the limit of temperature for such seemed to be about 53°.—In a lecture by M. Brefeld (given in outline), on the biology of yeast cells, the author describes the process of fructification, which is asexual, and tells how all his attempts to produce it with cultivated yeast were in vain; with the natural yeast used in fermenting wine he always succeeded.—The peculiar condition of vegetation on the sides of lakes, and banks of rivers, owing to reflection of light and heat from the water, and constancy of temperature of the latter, is illustrated by Dr. Hoffmann from a number of phænological phenomena on Lake Maggiore, the lakes of Geneva, Zurich, and other localities.—M. Felix Plateau investigates the process of digestion in insects; and M. Böhm records the gases resulting from fermentation of dead marsh and water plants; finding that these gases sometimes consist of carbonic acid, nitrogen, and hydrogen, sometimes of marsh gas with the first two. There is, he thinks, a sort of conflict between the two fermenting processes.—From accounts of the aurora of Feb. 4, 1872, Donati is led to the striking result that it was observed in different regions of the earth not in the same physical moment, but everywhere at the same local hour; as is the case with celestial phenomena which do not share in the earth's rotation. The aurora appeared first in the extreme east of the southern hemisphere, in Eden and Melbourne, and shortly after in China, whence it travelled over Asia, Europe, and America. Donati attributes the phenomenon to electro-magnetic currents from the sun.—There is also a paper on the movements of Encke's comet, by Dr. von Asten; and among other subjects treated are: insular giant reptiles, diathermancy of moist air, beats of musical tones, and the formation of meteorites and vulcanism.

Zeitschrift der Oesterreichische Gesellschaft für Meteorologie, Sept. 15.—The first paper in this number, by Herr Luedicke, of Gotha, gives an account of observations made by him on the tidal action of the moon in its several phases on the atmosphere, during a period of 100 revolutions, from Jan. 1867 to Feb. 1875. The differences between the mean heights of the barometer in the four quarters are small; the greatest difference, viz., that between the second and last quarter, amounting only to ·57 mm. The various tables given by Herr Luedicke agree, however, in pointing to the following conclusion:—That pressure diminishes with the waxing and increases with the waning moon. Comparing the means of readings nearest perigee with those nearest apogee, he finds (1) that pressure is less at perigee than at apogee; and (2) that pressure in apogee is less about the time of the equinoxes, greater about the time of the solstices, than in perigee. Lastly, taking the mean variations from the monthly mean of all observations taken in apogee and in perigee, that in perigee the excesses happen at the quadratures, the deficiencies at the syzygies; and inversely, in apogee the excesses happen at the syzygies and the deficiencies at the quadratures. These variations are rather large: for instance, in apogee at the first quarter the deficiency is 3·83, at the last 5·16 mm. It appears from all his results that the effect of the moon upon the atmosphere is exactly contrary to that produced upon the ocean, pressure being lower when the moon is near than when it is far from the earth. Tables of the varieties of weather in the four quarters are given at the end of the paper.—In the "Kleinere Mittheilungen" two articles appear on Mr. Blanford's observations in India.

Bulletin de l'Académie Royale des Sciences de Belgique, tom. xl. No. 7.—In the "Classe des Science" are the following articles:—A brief note by M. Emm. Liais, on the parallax of the sun.—A note on *Drosera rotundifolia*, by M. Ed. Morren, to which is a plate showing the structure of the different kinds of glands and hairs. M. Morren describes the capture of two insects, and especially draws attention to the way in which the glands curve in "prehension," like an animal's tongue.—M. G. Dewalque contributes a short article on lightning strokes.—M. E. Quetelet records the dip of the needle at Brussels in 1875, determined on two dates—

April 14, between 10.30 A.M. and 12.30 = 66° 56′·6
May 22 ,, 11 ,, 12 = 66° 58′·8

The diminution is at the rate of 2¼ min. per annum. The declination has been determined on three days as follows:—

June 9, between 11 A.M. and 12.30 = 17° 24′·4
,, 23 ,, 10.30 ,, 11.30 = 17° 25′·1
,, ,, ,, 2 ,, 3 = 17° 26′·3

The decrease is 8¼ min. per annum. This last observation was by M. Hooreman.—M. L. Saltel contributes two mathematical papers.

THE *Journal de Physique* for September commences with a paper by M. Marey on the movements of liquid waves in elastic tubes, a phenomenon exemplified in the circulation of the blood. He applies his graphic method: passing an indiarubber tube through a series of boxes in such a way that when it expands at successive points, through passage of a wave, it presses upwards the membrane of one of the well-known monometric capsules. These successive movements are indicated, as usual, on a rotating blackened cylinder. He explains the various phenomena of positive, negative, secondary, and reflected waves, harmonic vibrations, &c.—M. Govi follows with an account of some experiments meant to prove that induced electricity of the first kind has tension. A new instrument for determining, more especially, the density of solids of which only small fragments are had, is described by M. Paquet. It is like a Baumé areometer, consisting of a pear-shaped air-vessel, weighted at the lower, narrow end with a bulb of mercury, while a thin tube rises from the upper part, surmounted by a short wider tube closed below, into which the solid fragment is put, with water. Both tubes are graduated. The density is ascertained after immersion of the instrument in water.—A valuable paper by M. de Romilly treats of the conveyance of air by a jet of air or steam, issuing from one ajutage, and entering another; several varieties of ajutage having been experimented with, and in different positions. He finds, *inter alia*, there is an integral conservation of the quantity of motion, with a conical receiver of 5 to 7 degrees, small section towards the jet-ajutage, which is placed at an exterior distance, given by the form of the jet, making a cone of about 15 degrees, the jet-orifice occupying the summit, and the receiver-orifice the base.

—M. Righi contributes a paper on an electroscope with very sensitive dry piles; its use in some experiments on electricity of contact, and on the electromotive force of heat. The journal concludes with a number of abstracts from other serials.

Bulletin de la Société d'Anthropologie de Paris, 1875.—In fascicule 4ème, tome ix. IIe série, M. G. de Rialle, in considering the present state of our knowledge in regard to the races inhabiting Central Asia, invites travellers to turn their attention to the study of the Herazehs, who occupy the most easterly spurs of the chain of the Paropamisus, and who still preserve many traces of the habits and traditions of the northern steppes, from which they have probably been driven by Mongol invaders. Little is known of these people, who are dreaded by the Afghans for their bravery and ferocity, and who regard themselves as allied to the Calmuks of Cabul. In the course of the discussion on M. de Rialle's paper, Madame C. Royer drew attention to the important service which travellers might render to the sciences of Comparative Ethnology and Anthropology, if they would make young children, in whom distinctions of race are most prominently exhibited, the special objects of their observations. M. Topinard, in conclusion, called upon the members of the Central Asiatic Expedition to discover whether any survivors could still be traced of the fair-skinned people described by the Chinese as inhabiting the western portion of the central plain of Asia two or three centuries before our era, and as having green eyes and red hair. Tchihatcheff asserts that he has met with red-haired individuals among the nomad Turkomans of Asia Minor, and Desmoulins believes that they are typical representatives of the primitive Turks.—In the same number of the *Bulletin* we have a summary of the views entertained by M. A. de Bertrand and others in regard to the definition and classification of prehistoric eras. M. de Bertrand, in considering the age of the Reindeer of Thurigen, suggests that we may refer the period of the introduction of polished stone into Gaul to about 3,400 years before the Christian era, and that we may possibly assume 2,000 years as the maximum of the duration of this age. His attempted determination of these periods was strongly opposed by MM. Leguay, Roujon, and others.—Several interesting reports have been laid before the Paris Society, of the numerous caves and grottoes which have been examined in the course of 1874, by M. Louis Lartet, Lagarde, and other members. The finds at Cumières, near Verdun, have been especially rich, while the explorations made at the cemetery of Curanda (Aisne) are valuable from the great variety of objects intermingled with the human remains, but owing to the successive occupation of the ground by Gallic, Romano-Gallic, and later populations, the results yield no certain evidence of the antiquity of the earlier races, whose remains are interspersed among those of definite and determinable historical character. An examination of the remains *in situ* has, however, led M. Millescamps to the important conclusion that flint instruments were cut and used as recently as the Merovingian age in France. —M. P. Broca has proposed to adopt the word "Stéréométrie" for that branch of craniometric science which treats of the determination of cranial capacities. In his paper M. Broca explains the various methods which he has found best adapted for the purpose. He considers that, of all the substances tried, bullet-lead, although not perfectly free from sources of error, is the most reliable, the results yielded by repeated experiments varying not more than five cubic centimetres for the same skull. No absolutely correct method has as yet been devised, and hence we must content ourselves for the present with approximate results.

Sitzungsberichte der Kgl. böhm. Ges. der Wissenschaften in Prag.—The publication of this Society comprises the whole of 1874, during which period some thirty important papers were read in the Natural Science Department of the Society. We notice the following:—On the independent representation of the *n*th derivative of broken functions of a variable, by Prof. Dr. Studnicka.—On the chemical composition of microsommite, by Prof. Safarik.—On harmonic systems of points on rational curves of the third and fourth order, by K. Zahradnik.—On the discovery of diluvial animal remains in the Elbe Loess, near Aussig, by Dr. Laube.—On some minerals from Kuchelbad, near Prague, by Dr. Safarik.—On the different forms and the signification of the changes in generation of plants, by Dr. L. Celakovsky.—Researches on the hyëtography of Bohemia, by Dr. Studnicka.—On the inflorescences of Borragineæ, by Dr. L. Celakovsky.—The solution of the problem of seat and essence of attraction, by Dr. Studnicka.—On the laws regulating incandescence of wires by electric currents, by Prof. A. von Waltenhofen.—Contradiction of Stieda's criticism on the author's work "On Hair," by Dr. J. Schöbl.—On a hyæna skull, by Dr. A. Fric.—On the Myriopoda hitherto observed in Bohemia, by Prof. F. V. Rosicky.—On a new universal microscope, by Prof. Zenger.—On a new photographic process to enlarge photographs correctly and to any size, by the same.—On curves of the fourth order, by Prof. E. Weyr.—On the travels of M. Emil Holub in Southern Africa, by Prof. C. Koristka.—On a new mineral mixture, named Parankerite, by Dr. Boricky.—On the theory of Cardioids, by Dr. K. Zahradnik.—On the discovery of an Ichthyomorphous *Ceratodus Barrandei* in the gas coal of the Rakonitz deposit, by Dr. A. Fric.—On the elements of a mechanical theory of ocean currents, by Prof. G. Blazek.—On the Cladocera-fauna of Bohemia, by B. Hellich. Preliminary researches on the Annelida of Bohemia hitherto observed, by F. Vejdovsky.—On the integration of differential equations of the first order, by Dr. E. Weyr.—On the pseudoscorpiones-fauna of Bohemia, by Prof. A. Stecker.—On the coal deposit of Pilsen, by Prof. J. Krejci.—Report on the chalk deposits of Perutz, in Bohemia, and their fossil remains, by the same.—On a new simple method of determining tautozonal planes of crystals, by the same.

THE August number of the *Bulletin de la Société d'Acclimatation de Paris* contains a very instructive paper, by Dr. Vidal, on the fauna and flora of Japan. The useful indigenous animals of that country are not so numerous as the geographical position of the islands would seem to indicate; the principal are a small species of ox, goats, rabbits, and wild boars. Imported animals, such as sheep and pigs, are rare, the former, indeed, not appearing to thrive in the climate, although they exist in considerable quantities on the opposite coasts of Northern China. A species of small black bear, and monkeys, are prized by the natives as articles of diet. Horses are abundant, though the ass and the mule are unknown in the country. Birds, both useful and ornamental, are very numerous, the principal being several varieties of duck and common "barndoor fowls," pheasants, and quails; wild geese are abundant, but the domestic variety and the turkey are almost unknown. Of fish there is a plentiful supply, and the fisheries form one of the most important industries of the country. Salmon are very common and highly prized.—M. L. Faton gives a summary of experiments with several kinds of vegetables and useful and ornamental plants, which is valuable as indicating the species which best repay the trouble of scientific cultivation.—At the July meeting of the Society a letter was read from M. C. Naudin, enclosing seeds of *Cytisus proliferus* from the Canary Islands, a plant which is cultivated there for the sake of its leaves, which are used as food for cattle. M. Naudin suggests that it might be usefully cultivated in France, or at any rate at the Cape of Good Hope, and in Australia.—Another plant (*Reana luxurians*), called in Guatemala Téosinté, and cultivated there for the same purposes as the one above named, is recommended by M. J. Rossignon.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. viii. fasc. xvi. The first portion of this number contains the following among other papers:—On the hydrological map of the department of Senna e Marna, by M. Curioni.—On two benzol-bisulphuric acids and their relations to other compounds, by MM. Koerner and Monselise.—The second portion of these *Rendiconti* contains reports by M. Carcano and M. Hajech, on the work of the Institute during the year; accounts of prize awards, with reports of committees on the competitive memoirs; and an announcement of prizes to be competed for within the next three years. Among the subjects of the latter we note the following:—Actual mean longevity of man in Italy, compared with other peoples; What are the best antifermentatives and antiseptics, disinfectants and deodorizers? Indicate a good method of cremation; Respective merits of animal and human vaccination; Embryogeny of silkworm; History of the progress of the anatomy and physiology of the brain, in the present century.

SOCIETIES AND ACADEMIES

MANCHESTER

Scientific Students' Association, Oct. 20.—Mr. John Plant, F.G.S., in the chair.—Mr. Wm. Gee lectured on *Polytrichum commune* (the common Hair-moss), as a type of moss-structure, commenting on the points of differentiation between true mosses and cryptogams erroneously associated with them, tracing the life-cycle, the minute anatomy of the organs, and the

function of mosses in nature and art.—The Chairman exhibited a collection of Ammonites from the Kimmeridge Clay and from the Tertiary Sand near Alexandria.—Mr. C. Robinson showed local drift-shells; and Mr. Gee a miner's lamp-glass, tempered by the new process to withstand change of temperature, although of the usual thickness (¼ inch).

California

Academy of Sciences, Aug. 2.—Mr. H. Edwards, vice-president, in the chair.—Mr. Lackington presented a paper on some new Crustaceans of the Pacific coast.—Dr. Blake made some remarks on a mineral which he had presented to the Academy a few months ago under the name of Colomite. He stated that a superficial analysis of the mineral had then led him to believe that it was a potash mica, containing a very large quantity of chromium. Since that time the mineral had been analysed by Prof. Genth, of Philadelphia, who had discovered that it contained a large quantity of vanadium, more than 20 per cent. Under these circumstances he proposed to name the mineral Roscoelite, as Prof. Roscoe, of Manchester, had so successfully investigated the properties of vanadium. The mineral occurs in a gold mine in the lower hills of the western slope of the Sierra. It is associated with a small vein of quartz, but it is principally in the mica that the gold is found, a few pounds of the mineral (a miner's panful) often yielding as much as $240 in gold. The occurrence of so large a quantity of a pentivalent metalloid in a mica offers another and perhaps the most striking anomaly presented by this class of minerals as regards their chemical composition. Dr. Blake then alluded to some physiological experiments he had performed to determine the molecular relations of beryllium. Neither the specific heat of the metal nor the vapour density of its chloride had been determined, and chemists were undecided as to whether it was a bivalent or quadrivalent element. Its physiological reactions, when introduced directly into the blood of living animals, so closely resembled those of alumina that there can be no doubt but that it belongs to the same isomorphous group, and that it is a quadrivalent element. There is also a close relation between the intensity of physiological action of this substance and its atomic weight. When compared with aluminum, as in a series of experiments conducted expressly to determine this point, the quantities of Be_2O_3, under the form of sulphate, required to kill 2,270 grammes of rabbit, when injected into the veins in divided doses (three injections), were ·059, ·061, ·050; the quantities of Al_2O_3, introduced into the veins under the same conditions were ·021, ·023, ·022; and the smallest quantity required to kill, when introduced in one injection, was, of Al_2O_3, ·016, and of Be_2O_3, ·038, showing a marked increase in the physiological action of these substances, with an increase in the atomic weights, the atomic weight of Al being 27·4 and of Be, 14. This, the author believes, is the first occasion on which physiological reactions have been used to determine the chemical properties of a substance. Should, however, the carbon compounds follow the same laws in their physiological reactions as the inorganic elements, living matter must offer a valuable reagent in investigating their molecular properties. The interesting experiments of Messrs. McKendrick and Dewar, published in the 23rd vol. of the Proceedings of the Royal Society, would indicate that such may be the case, as these gentlemen found in experimenting with the compounds of the Chinolin and Pyridin groups, that the physiological actions became stronger in going from the lower to the higher members of the series. They also observed that in the Pyridin group, when the base became doubled by condensation, not only was the physiological action more intense, but its character was completely altered, agreeing in these respects with the salts of iron with which analogous changes take place, both in the character and intensity of their physiological action, when the molecule is doubled in the change from ferrous to ferric salts, as the author has shown in the *Journal of Anatomy and Physiology*, vol. iii. p. 24.

Paris

Academy of Sciences, Oct. 18.—M. Frémy in the chair.—Admiral Paris presented the volume of the "Connaissance des Temps" for 1877. This publication, prepared by M. Loery, is now double in size what it was twenty years ago, and much improved. The following papers were read:—New problems relative to the conditions of equality of size of rectilinear segments on the tangents of geometrical curves of any order and class, by M. Chasles.—Third note on the electric conductivity of bodies moderately conducting, by M. Du Moncel. In the polarisation currents obtained with silex of Herouville, he found that the electrodes do not simply play the part of conductor, but acquire a peculiar electric state, which they may retain for days, and even under intense heat; this state cannot alone produce a current of polarisation; the dielectric must have undergone electrification under influence of the electrodes. But once this has occurred, they may be separated for some time without losing the power of giving a current when brought together again. The phenomena are analogous to those of phosphorescence.—On the trepanation and evacuation of long bones in cases of osteitis of neuralgic form, by M. Gosselin.—Fall of a meteorite on 12th May, 1874, at Sersukow, in Russia, by M. Daubrée. It weighs ninety-eight kilogrammes, and is of the oligosidere type.—On the carpellary theory according to the Irideæ (second part), by M. Trecul.—On the rotatory power of quartz in the ultra violet spectrum, by M. Croullebois.—On the laws which govern reactions with direct addition, by M. V Markovnikoff.—On a case of oxidation in the cold state, of acetic acid in neutral or weakly alkaline liquids, in presence of nitrates and phosphates of soda and potash, by M. Mehay.—Process for artificial cooling of considerable masses of air by contact with a cold liquid, by MM. Mignon and Rouart. In a candle manufactory at Amsterdam, they use a cooled solution of chloride of calcium, which descends on the uppermost of a series of plates rotated with the axis of a cylinder between discs projected from the cylinder-wall, thus giving a continuous finely-divided cascade. Through this passes 26,000 kilogrammes of air in an hour, and a building of 3,051 cubic metres' capacity has thus been kept, in September, at 12° or 13° C.—On the sexual generation of the Vorticellians, by M. Balbiani.—M. Petit and M. Godet presented notes on treatment of Phylloxera.—M. Hugo, one on a transformation of the law of Bode, regarding the distances of the planets.—M. Brachet, on an improvement of Gramme's machine, a modification in the microscope, and a process for rendering ordinary glass fluorescent.—M. Varssin-Chardanne submitted several memoirs on aërial navigation.—M. Marchand described his process of aërial navigation.—The Secretary quoted from a work of M. Mouchot's in 1869, where he refers to the ancient Roman method of utilising solar heat.—The Secretary also noticed a second edition of "Preliminary notions for a treatise on the construction of ports in the Mediterranean," by M. Cialdi.—Magnetic map of France for 1875, by M. Marié Davy. This note gives tables of declination and annual variation for different districts.—Observations of the Perseides, made on Aug. 10, 1875, at Spoix (Côte d'Or), by M. Gruey.—On a chloride of silver pile composed of 3,240 elements, by MM. Warren de la Rue and H. W. Müller.—On a successful case of trepanation for an osteitis of neuralgic form, in a flat bone—the frontal—by M. Pingaud.—On the frequency of earthquakes relatively to the age of the moon, by M. Perrez. He finds evidence that during the last century and a quarter, earthquakes have been more frequent at syzygies than at quadratures.—M. Rivet transmitted a note from Martinique on earthquake shocks there and the electric phenomena which preceded them in telegraph wires.—M. Montucci presented a note on the hypothesis of a terrestrial central fire, and M. Noirit one on an automatic dredger.

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