

THURSDAY, JULY 31, 1884

FORESTRY

Introduction to the Study of Modern Forest Economy, and Forestry in Norway, with Notices of the Physical Geography of the Country. By John Croumbie Brown, LL.D. (Edinburgh: Oliver and Boyd, 1884.)

EVERYTHING connected with forestry is especially attractive just now when so much attention is being drawn to the subject in its very varied aspects by the Exhibition at Edinburgh. Dr. J. C. Brown is one of the most voluminous writers we have on forest matters; his pen indeed is scarcely ever at rest, for he has told us about forests and forest management in various parts of the world, both in ancient and modern times, and now he publishes just at an opportune moment two little books the titles of which are given above. The first of these he tells us is issued in accordance with, and in discharge of, obligations imposed by a resolution passed on March 28 last year by a "scientific, practical, and professional" assemblage presided over by the Marquess of Lothian for the purpose of furthering "the establishment of a national School of Forestry in Scotland," and the promotion of "an International Forestry Exhibition in Edinburgh in 1884," the last of which is now being realised, but the former has yet to be accomplished, we hope, however, at no distant date.

Dr. Brown's first book commences by defining what a forest is, and he then goes on to point out that "in the conservation, culture, and exploitation, or profitable disposal, of forest products considerable differences of practice exists," as, for instance, the preservation of game in this country, while on the Continent the wood is the primary object. "In Britain," he says, "we hear much of arboriculture; on the Continent we hear much of sylviculture; the former refers to woods and plantations, the other term speaks of woods and forests; in the one case the unit is the tree, and the wood is considered as the collection of trees; in the other the wood is the unit, and the trees are considered only as the constituent parts. In the former attention is given primarily to the sowing and planting, and pruning it may be, and general culture of the tree; nowhere perhaps has this arboriculture been carried nearer to perfection than it has been in Britain, and the effects produced by the resulting woods are wonderful. In the latter, attention is given primarily to the wood or forest as a whole, capable of yielding products which can be profitably utilised; and the result generally is to produce a much greater proportion of fine trees than does even the arboriculture which has been referred to. And not less different is the exploitation of woods in Britain and on the Continent. In Britain the pecuniary return obtained from woods is considered a secondary matter in comparison with the amenity and shelter which they afford; but on the Continent the materials or pecuniary product, or other economic good, is made the object of primary importance."

This opens the subject of forestry in its widest aspect, and Dr. Brown naturally draws from it a moral on the necessity of forming the much talked of British School of Forestry. The book is divided into three parts, in the first of which the successive chapters treat of the following sub-

jects: Ancient Forests of Europe, the disappearance of European Forests, the evils which have followed their destruction, scarcity of timber and firewood, droughts, floods, landslips, and sand drifts. The second part is devoted to the consideration of "Elements of Modern Forest Economy," under which head we find chapters on Forest Conservation, Replanting or Reboisement, as Dr. Brown prefers to call it after the French usage; Exploitation or Management, Sartage and Jardinage, or Clearance and Selection, &c., concluding this part with a chapter on the study of Pathology. The third part is simply a short notice of modern forest conservancy in general. All these points are of extreme importance in a well-organised system of forest teaching, and under each head Dr. Brown brings together a quantity of matter which, besides being of a practical character, and consequently valuable, is also interesting reading. He possesses the power in an eminent degree of weaving into one uniform fabric what has been said by various writers on the subject that he has so much at heart, for Dr. Brown's books contain long and numerous quotations, through which it will not be necessary to follow him. On the study of pathology, however, as one of the branches in the curriculum of a forest officer's education, we entirely agree with him as to its great importance. It should indeed be equally imperative that a young forester should know something of the nature of the diseases with which the trees under his care are liable to be attacked, as that he should be acquainted with the structure, constitution, and habits of those trees, so that he may be enabled, if occasion requires, to cope with their diseases, and if possible save the victims from premature decay. For this reason a pathological museum should be attached to every forest school, and specimens might be continually added to it by preserving those that might be brought into the school for determination. Such a museum indeed is referred to by Dr. Brown in the following paragraph:—"In the Museum of the Prussian Forest Institute at Eberwalde the impression produced upon the mind of the visitor is that there are there specimens representative of every disease to which trees are heir; specimens exhibiting the progress of the disease from the attack to the consummation; and, hard by, the bark, the wood, the insect, or the parasitic herb or fungus by which it has been induced, the insect and the fungus being exhibited under all the transformations through which they pass; while specimens of the effects of lightning and other physical causes of the decay or destruction of trees are not lacking. And similar collections sufficient to afford facilities for the study of the diseases of trees and of means of preventing or of remedying the evils done are to be found in many other similar institutions." Dr. Brown concludes his first book with a sketch of the curriculum of the Spanish School of Forestry, which includes a wide range of subjects in mechanics, physics, acoustics, heat, optics, electricity, meteorology, chemistry, natural history, including botany and zoology. "The instruction is given (1) by oral lectures and lessons in drawing by the professors; (2) by written exercises, calculations, and analyses on the subjects embraced by these lectures; (3) by the detailed study of the animals, rocks, plants, and forest products which constitute the collections and adjuncts of the establishment; (4) by the practice of topography, land-surveying, the

study of natural history, and of mountains in the field; (5) by excursions to the plantations and mountains."

With regard to the status of forest officers in different parts of Europe they are described as taking rank with military men and other Government officers of recognised social position, and having in many instances an official uniform and a higher salary than is accorded to military officers, by way of compensation for the monotonous life they are called upon to lead in the forests, which often has a depressing influence—"day after day, month after month—trees, trees, trees everywhere, trees and shade, trees and shade—shade that reminds one of the expression '*the valley of the shadow of death.*'"

"Forestry in Norway" is a book of a different character from the preceding. It treats of the general features of the country in its various aspects, with especial regard of course to its arboreal vegetation, and the effects of temperature, rainfall, rivers, lakes, mountains, valleys, &c. The book is for the most part very pleasant reading.

In Chapter IV., under the head of Geographical Distribution of Trees in Norway, Dr. Brown shows that he has made himself acquainted with the modern literature of the subject, especially with the well-known report and maps prepared by Dr. F. C. Schubeler, Professor of Botany in the University of Christiania. From this and from the numerous other works cited the conclusion is drawn that the true forests of Norway are composed almost entirely of the Norway spruce fir (*Picea excelsa*, Link.) and the Scotch fir (*Pinus sylvestris*, L.), though some other trees, as the elder, beech, and oak, are found forming little woods. We must here point out that nearly the whole of this chapter requires careful editing. There is no excuse for the retention of old and exploded names, still less perhaps for absolute mistakes. On p. 39, for instance, it is stated that the Norway spruce is generally known as *Abies communis*, a name under which very few indeed would know it except those well versed in the synonymy of the plant. On the same page *Millaw* is printed for Miller, *Lank* for Link; and a page or two further on, the Norwegian birch is referred to *Betula odorata*, Bechet, when it should be *B. alba*, L. Again on p. 45 we are told that two species of oak "are found growing wild in Norway, the sessile-fruited oak, *Quercus robur*, W., and the common oak, *Q. pedunculata*, W." The fact is that the sessile-fruited oak is *Q. sessiliflora*, Sm., and the pedunculated oak, *Q. pedunculata*, Ehr., both of which are now placed by most modern authorities under the one name of *Quercus robur*, L. Similar instances occur further on, as well as misspellings, all of which could be easily rectified, and the book made more trustworthy.

The general readable nature of the bulk of the book will no doubt cause it to be read by those into whose hands it may fall, whether they are specially interested in forestry or not, and will thus form one means of promoting the extended use of the volume.

LENSES

Lenses and Systems of Lenses. By Chas. Pendlebury, M.A., F.R.A.S., Senior Mathematical Master of St. Paul's. (Cambridge: Deighton, Bell, and Co., 1884.)

WE are glad to welcome at last an English book on this subject, on which up to the present but little has been written in our language. An abstract of

Gauss's paper in Taylor's *Scientific Memoirs*, and a paper by Maxwell in the second volume of the *Quarterly Journal of Mathematics* form, so far as we are aware, the main English literature of the subject. Of course since the time of Gauss foreign writers have used it freely: Listing, Helmholtz, and Carl Neumann in Germany; Verdet and others in France, have introduced it with more or less modification into their works. We would suggest that a list of books and memoirs on the subject would form a valuable addition to Mr. Pendlebury's book. The author gives frequent references in footnotes to books or papers from which he has drawn information, but a complete list would be a great help to others studying the subject. The method itself is very elegant and attractive, though somewhat barren of results; perhaps this is the reason why it has been neglected in England. It enables us to obtain a beautiful solution of the problem to a first approximation when all the rays make but small angles with the axis, but refuses to help us further.

The book before us is clear and well written, though perhaps unnecessarily long. Mr. Pendlebury has three chapters successively on refraction at a single surface, at two surfaces, and at any number of surfaces. This would be very well for a student who was supposed to begin the study of optics with this book, but such a student is hardly likely to exist; and one who has read the ordinary text-books on the subject could easily follow at once the reasoning of the most complicated case, and might be left to deduce the others so far as they differ from it as corollaries.

Referring, however, to some points in the book, we think that in Fig. 4 it would have been better to take as the standard case one in which the points X and X' both lie to the same side of A, the case usually considered in text-books on optics. This would have obviated the necessity of having to put a negative sign to the symbol u in the algebraical work. Attention also might with advantage be called to the point that one of the two focal distances is negative.

Again, a difficulty occurs when we compare the results of Sections 67 and 74; in the one we have

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f},$$

while, using the same notation, the results of the other may be written

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}.$$

The explanation, of course, is that Fig. 18, from which the last result is deduced, is not drawn for the standard case of a lens forming a virtual image of an object. There is another small point of arrangement which it seems to us might be slightly modified with advantage; we would draw a rather more definite line between the analytical and geometrical methods of treating the subject.

If we assume that a pencil of rays diverging from a point will, after refraction, pass through a point, we can prove geometrically the existence of the principal points, the focal points, and the nodal points. We cannot, however, without analysis, find the position of these points in terms of the curvatures and distances between the various refracting surfaces.

Again, if we assume the position of the focal and

principal points, we can find geometrically the position of the image of any point after refraction through the surface. This we may describe as the geometrical treatment of the subject.

By the aid of analysis we can show that there is, to the degree of approximation to which we go, a point image of any point, and we can find in terms of known quantities the positions of the cardinal points of the system and the relation between a point and its conjugate focus. Mr. Pendlebury adopts both methods indiscriminately; it seems to us that it would have been better to have kept the two somewhat more distinct.

A short account of the paper of Maxwell to which reference has been made, "On the General Laws of Optical Instruments," would form a valuable addition to the book, and may, perhaps, be included when the author extends it, as he hopes to do, so as to cover a wider area in the field of geometrical optics. At present the field is open to him, and a book on the whole subject as good and interesting as "Lenses and Systems of Lenses" is greatly needed.

R. T. G.

OUR BOOK SHELF

Fuel and Water. Translated from the German of Franz Schwachhöfer, by Walter R. Browne, M.A. (London: Charles Griffin and Co., 1884.)

MR. WALTER R. BROWNE has made a very good translation of a book written for the German students of agriculture in Vienna. He has added a clever sketch of the mechanical theory of heat as an introduction. The English of the translation is remarkably good and clear, and the original treatise has been written by a competent man. The translator in his preface appeals to manufacturers and users of steam on a large scale; but the work is much too scientific for them, dealing not with the various forms of boiler now in the market, but rather with the general principles on which boilers should be constructed. On the other hand I fear that the information given is in many parts not full enough for the engineer, and we frequently find data given such as will be of more value to the German than to the English reader. The chief physical formulæ relating to heat and applicable to practical questions connected with engineering are clearly stated, but the comparison of results deduced from these formulæ with the results derived from actual experience is rather sparingly made. The third chapter, which is headed "Heating Apparatus," treats of the furnace and its management. The author gives the results of some actual experiments as to the loss of heat in the chimney, in the ash-pits, in priming water, and by conduction and radiation. He also gives an experiment with what is called an economiser. This chapter seems to me one of the best in the book. Altogether, I think the work is one which may in many parts be profitably consulted by those engineers who desire to compare theory with practice.

FLEEMING JENKIN

The Elements of Euclid. Books I. to VI. With Deductions, Appendices, and Historical Notes. By J. S. Mackay, M.A. (London: W. and R. Chambers, 1884.)

THIS text-book has been compiled at the request of the publishers, and the event shows that it was by a "happy thought" their choice of an editor fell upon Mr. Mackay, the Mathematical Master of the Edinburgh Academy. Of it we have nothing to say but what is good. This praise is not so much for the text, for others have done well in this direction. Still even here Mr. Mackay has shown great judgment and skill in his selection of proofs. The text is in the main that of R. Simson's well-known

editions, and no change has been made in Euclid's sequence of propositions, and no violent change in his modes of proof.

But what we particularly like are the carefully prepared historical notes, which take the form of footnotes or of fuller paragraphs in the six appendices. Mr. Mackay remarks, "It would perhaps be well if such notes were more frequently to be found in mathematical text-books: the names of those who have extended the boundaries, or successfully cultivated any part of the domain, of science, should not be unknown to those who inherit the results of their labour."

We regret that though authors have before expressed themselves to similar effect, yet few have had the inclination or leisure to act as our present author. He has had to curtail his material, but what he gives us shows that he is well qualified by the extent of his reading to satisfy this want.

We note here that recent French mathematicians are in the habit of attributing the first use of the word "orthocentre" (which Mr. Mackay ascribes to Dr. W. H. Besant) to Dr. Booth; in so doing they are certainly in error, as Dr. Booth himself, in the second volume of his "New Geometrical Methods" (p. 261), says "the point has been called by some geometers the *orthocentre*." What he may lay claim to is his calling what is now often called the *pedal* triangle the *orthocentric* triangle.

The figures are admirably drawn and are quite a feature of the book; they deserve the editor's commendation when he thanks Mr. Pairman for the "excellence of the diagrams."

This edition is well suited for the geometrical student, and, at the same time, its cheapness puts it within the reach of all who wish to study "Euclid."

Traité Pratique d'Analyses chimiques et d'Essais industriels. Par Raoul Jagnaux. (Paris: Octave Doin, 1884.)

THE purpose and character of this little book is best indicated by the saying of Berzelius which heads the author's preface: "Le meilleur mode d'analyse est celui qui exige le moins d'habitude chez l'opérateur." The book is mainly intended for the use of the chemical engineer and the metallurgist, and the methods of analysis described are essentially "works-methods," in which rapidity of execution is a very important consideration. Many of these methods are new, and have been devised partly by M. Hautefeuille, and partly by the author. We would especially note those depending upon the precipitation of such metals as zinc, copper, nickel, and bismuth as oxalates, whereby the formation of gelatinous precipitates, difficult to wash, is avoided. The book contains a large number of analytical results as evidence of the validity of the methods employed; many of these analyses, such as those of aventurine glass, garnierite, sylverine, are valuable as illustrating the composition of substances which are not frequently examined.

T.

LETTERS TO THE EDITOR

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

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

The Relation between the B.A. Unit and the Legal Ohm of the Paris Congress

AT a meeting of the Electrical Standards Committee of the British Association held on Saturday, June 28, the following resolution was carried:—

"That for the purpose of issuing practical standards of elec-

trical resistance, the number of B.A. units adopted as representing the resistance of a column of mercury 100 centimetres in length, one square millimetre in section, at a temperature of 0° C. be '9540."

It follows from this that the legal ohm of the Paris Congress, which is defined as the resistance of such a column 106 cm. in length, contains 1'0112 B.A.U., while the B.A.U. contains '9889 legal ohm. Thus resistances which are expressed in terms of B.A. units may be reduced to legal ohms by multiplying by '9889, while makers and others who have a standard B.A. unit can construct a legal ohm by making a coil equal to 1'0112 times that unit.

A resolution of the nature of the above was rendered necessary by the fact that the legal ohm is defined in terms of the resistance of a column of mercury, while the resistances in use in England are B.A. units. The relation between the two has been determined by different observers with slightly different results. The Committee hope to secure uniformity in the resistances sold to the public as legal ohms, by stating the number they intend to adopt for the purpose of issuing standards.

R. T. GLAZEBROOK,
Secretary Electrical Standards Committee
of the British Association

The Yard, the Metre, and the Old French Foot

THE ratio of the metre to the yard can scarcely be said to be known with certainty at the present day. The latest and most exhaustive investigation of this question is due to Prof. W. A. Rogers of Cambridge, Mass. The value which he assigns to it (pending a final and authoritative comparison of the "Mètre des Archives" with its chief representative, by the International Commission of Weights and Measures) is—

39'37027 : 36.

This ratio is very nearly identical with the much simpler one—

35 : 32,

the error of which is less than 1 in 8000. If we disregard this error, the conversion of yards into metres can be effected with the greatest ease by the following arithmetical process. Thus—

Given 35 yards or 39'37027 yards
Subtract 1/10th - 3'5 - 3'937027
Add 1/7th + '5 + '5624324

Results 32'0 metres 35'9956754 metres
Error - '0043246

By a singular piece of good luck, this error, small as it is, may be entirely removed by one more easy approximation: for dividing the last quotient by 130 gives + '0043263—where the outstanding disagreement is less than a unit in the last given figure. Hence, if we wish for a closer conversion than will be given by the terms 1, - 1/10, + 1/7 (of the last), we have only to add further, + 1/130 (of the last) to obtain the utmost accuracy at present possible.

The converse operation—to convert metres into yards—is not quite so short and easy in the closer approximation. The following shows the approximate and the more exact conversion:—

Given Ex. 1 Ex. 2
Add 1/10th + 3'2 + 3'6
Subtract 1/16th - 0'2 - 0'225
,, 2/100ths - '0045
,, 1/20th - '000225

Results 35'0 yards 39'370275 yards

The fact is, almost any conversion may be performed in some such way, in three or four operations; and it was not for the sake of the rigorous ones that this note was written, so much as to bring into notice the very close and useful approximation represented by the ratio 32 : 35.

By way of applying the rules usefully, we may take as examples:—To find the equivalent of a kilometre in yards, and of a mile in metres. Thus—

1000 metres 1760 yards
+ 100 - 176
- 6'25 + 25'14286
- '125 + '19341
- 00625 -

Answers 1093'61875 yards ... 1609'3363 metres

Here we see that the approximate ratio 32 : 35 entails an error of only 0'131 yard (or less than 5 inches) in one kilometre; or of 0'193 (or less than 2) decim. in one mile, so converted.

The old French foot, the sixth part of the toise—the famous "Toise of Peru"—survives now practically only in the Prussian toise, so far as that is not superseded by the metre. Whatever may be its present range, the ratio of the old French foot to the present English foot is curious. I believe it may be expressed, within the limits of error of the relation so far as can now be known, by the fraction 389/365. That is to say, the excess of the former is 24/365 x the latter, the two components of which fraction are such as may easily be remembered when once the coincidence has been noted.

J. HERSCHEL

Collingwood, July 25

Fireballs

IN reference to the phenomena of fireballs the following notes may be of interest. Last year, in July, I was residing on Naphill Common, Buckinghamshire. About midday, during my absence at Oxford, a violent thunderstorm broke over the district, and appeared to extend from Oxford to London. On returning I found that the house had been struck by lightning, apparently in two places. One chimney was knocked in through the roof, the debris partly filling up my room. The kitchen chimney had also been visited, the lightning breaking some of the brickwork of the hearth, and passing a person cooking at the fire; two or three others were in the house at the time, but no one was hurt. On carefully examining the marks left, I found that a door in a room adjoining the one above-mentioned had been split, and some iron knobs knocked off and broken, the screw nails being removed out of the wood, and a large hole several feet square made in the side of the house. From examination of the outside of the wall at the foot of the kitchen chimney, the bricks showed displacement opposite the marks inside at the hearth. I believe a tree was struck, and a water-trap or cess-pool shifted out of position. Some men using a reaping machine in a neighbouring field stated that they knew the storm was coming by the fire playing about the blades of the machine. A boy who had been near at the time said that he saw a large ball of fire fall on the house, which it seemed to enter; it then reappeared, and passed into the meadow. I therefore think it likely that the damage done to the rooms and side of house was due to the electric development called a fireball.

Glasgow

W. J. MILLAR

The Swallowing of one Snake by another

AS the author of the article "A Cannibal Snake" (NATURE, July 3, p. 216) wishes to know whether an instance similar to that recorded by him has ever before been brought to notice, I feel bound to publish an occurrence which I witnessed many years ago, and of which I have often told, without ever putting it into writing. During the summer of 1857 I lived in the environs of Washington; as an amusement, snakes were kept in cages. Sometimes, in the evening twilight, when toads and frogs appeared on the garden paths we used to feed the snakes with them. The usual habit of the snakes was to seize the toad wherever the jaws happened to strike, and to move them afterwards along the body of the victim, so as to begin the process of swallowing from the head. Once I threw a toad into a cage containing two of the common water-snakes of that region (Nerodia sipedon, if I recollect right, is the scientific name of the species). Both seized the toad at the same time; the one near the head began at once to swallow; the other put its jaws in motion as usual, in order to get at the head, but in doing this it reached the head of its comrade, and began to swallow that, as well as the toad. This went on for some time, until about three-quarters of the one snake were ingulfed within the other. Then the snakes separated again, the swallowed one coming out covered with slime, but apparently unharmed and as lively as ever. It lived a long time afterwards. The snakes were of about equal size, and, as far as I remember, from 2 1/2 to 3 feet long. I suppose that it was the swallowing snake, and not the swallowed one, that kept the frog, but I do not think I ascertained the fact at the time. The whole performance lasted a few minutes only.

Heidelberg, Germany, July 27

C. R. OSTEN SACKEN

The Red Sunsets

I NOTE in NATURE of July 3 (p. 229) an abstract of a communication of M. Gay to the Paris Academy of Sciences, made

on June 23, in which he suggests a connection between the red sunsets and the frequent rains. During the latter half of the past winter the rains were incessant in the Atlantic States of America, and the writer suggested that they were due to the volcanic dust in the atmosphere, in a letter published in the *Philadelphia Public Ledger* of February 23. In a subsequent issue, March 8, he called attention to Dr. Aitken's researches. Subsequently Prof. Heilprin, of the Philadelphia Academy of Natural Sciences, offered a similar suggestion.

Philadelphia, July 16

CHAS. MORRIS

THE SALTNESS AND THE TEMPERATURE OF THE SEA¹

PROFESSOR DITTMAR'S researches, an account of which forms Part I. of this volume, have finally proved that, so far as the most refined analysis can go, the mixture of salts dissolved in ocean water has attained a state of chemical equilibrium. But, although there is constancy of proportion between the various salts, the ratio of the total salts to the water varies considerably in different parts of the ocean.

The great evaporation in the dry tropical areas and the removal of water by freezing in the Polar seas tends to increase the salinity in these places, while in the tropical zones of continual rain and in the Polar fringes where the icebergs melt, there is constant dilution going on. The determination of the salinity at different places and depths is of great oceanographic importance, and the problem of finding the salinity has been attacked in various ways. The most simple and straightforward is to evaporate a weighed portion of the water to dryness and weigh the residue, but this cannot be done without chemical change taking place. The magnesium chloride present decomposes with the water into magnesia and hydrochloric acid, and all the carbonic acid of the carbonates is driven off. Gay-Lussac showed long ago how to avoid the error due to the dissociation of magnesium chloride, but no means have yet been suggested for taking account of the carbonates in a total salt determination. Direct weighing being thus found inexpedient, the next best method would appear to be to find the exact amount of any one element present, and by means of a table of complete analysis, taking advantage of the constancy of composition of ocean salts, to convert that into the salinity by multiplication with a constant factor. This is the method which Prof. Dittmar prefers, and for the purpose he estimates the chlorine or rather the total halogen by means of his refinement of Volhard's process. When the salinity of water has to be determined at sea, this delicate method cannot be conveniently employed, and it has been customary hitherto to measure the specific gravity of the water very carefully and afterwards to reduce the results to salinities. An attempt has been made with considerable success in the United States to substitute the determination of the refractive index of water for that of the density, and thence to deduce the salinity by a formula. This method is pre-eminently adapted for use at sea, but it appears not to possess the necessary delicacy.

The only method by which the specific gravity of a fluid can be ascertained on board ship is by means of hydrometers, and as the extreme values for sea-water are, according to Mr. Buchanan, 1.02780 and 1.02400, apparatus of great delicacy must be employed. A very delicate glass hydrometer was used on the *Challenger*, yet in spite of its fragility and the thousands of observations that Mr. Buchanan made with it in all weathers, he succeeded in carrying the one instrument which he had used during the entire voyage back to this country unbroken. His description of the hydrometer is as follows:—

¹ "The Physics and Chemistry of the Voyage of H.M.S. *Challenger*." Vol. i. Part ii. "Report on the Specific Gravity of Ocean Water." By J. V. Buchanan, M.A., F.R.S.E. Part iii. "Report on the Deep-Sea Temperature Observations obtained by the Officers of H.M.S. *Challenger* during the Years 1873-76." (London: Longmans and Co., 1884.) See NATURE, July 24, p. 292.

"Preliminary calculations showed that convenient dimensions would be about 3 mm. for the diameter of the stem and about 150 c.c. for the volume of the body, and from 10 to 12 cm. for the length of the stem. The tube for the stem was selected with great care from a large assortment, and no want of uniformity in its outward shape could be detected with the callipers. The tube for the body of the instrument was also selected from a number, in order to secure such a diameter as would give the instrument a suitable length. In order to provide against accidents, I had four instruments made from the two lengths of tubing. The glass work of the instrument being finished—except that the top of the stem, instead of being sealed up, was slightly widened out into a funnel—the instrument was loaded with mercury, until the lower end of the stem was just immersed in distilled water of 16° C. A millimetre scale on paper was then fixed in the stem, and the calibration carried on by placing decigramme weights on the funnel-shaped top, and noting the consequent depression on the scale. The whole length of the scale was 10 cm., and this portion of the stem proved to be of perfectly uniform calibre. Several series of observations were made in order to determine accurately the volume of any length of the stem. . . . When this operation of calibration was finished, the end of the stem was carefully closed before the blowpipe."

The constants necessary for making a specific gravity observation were all determined with the utmost care. They included the exact weight *in vacuo* of the instrument, the volume of the body, the volume of each division of the stem, and the expansion of the whole instrument for a degree Centigrade. These data were fully tabulated, and in addition tables were made of the total weight when each of a set of brass weights was placed on a small table that could be slipped over the top of the stem. These weights were necessary, as, without them, the stem would require to be of great length in order to serve for waters of different density.

In making an observation Mr. Buchanan always kept the water sample in the laboratory for a night in order that it might have time to attain the temperature of the surrounding air. He then placed about 800 c.c. in a glass jar supported on a swinging table, and immersed the hydrometer in it after ascertaining its temperature exactly. To insure the greatest possible accuracy two readings were frequently made with different weights on the table, the results separately reduced, and the mean taken as the density. The density was calculated in every case by ascertaining the weight of the loaded hydrometer and dividing it by the immersed volume, which is calculated from the temperature and stem-reading.

Prof. Dittmar examined very particularly into the probable error in reading Buchanan's hydrometer, and after a long series of experiments, described in the chapter on Salinity in Part I., he came to the conclusion that the difference between the salinity as calculated by it and by his direct chlorine determinations (*i.e.* $\chi_1 - \chi$ where χ stands for the permillage of chlorine) amounted to $-.042 \pm \delta$, δ being a variable the chances of which being greater or less than .06 are equal, and are 4 to 1 in favour of its being less than .12. The value of χ is usually between 19 and 20.

At first Mr. Buchanan reduced his specific gravities to the temperature of 15°.56 C. by Hubbard's tables, but Prof. Dittmar, in the course of his investigation of "The specific gravity of water as a function of salinity, temperature, and pressure," succeeded in constructing a much better table in which the variation of the coefficient of expansion with the salinity of the water is taken account of, and all Mr. Buchanan's results published in this volume have been calculated by it. A very ingenious graphic method of comparing Hubbard's results with Dittmar's and converting one into the other is given in Plate I. of Part II.

In the course of his work Prof. Dittmar hit upon an elegant method of determining densities, which was found to be very satisfactory. He filled a water-bath with a particular sea-water that had been selected as a standard, and kept it at a constant temperature. A specific-gravity bottle was filled with the same water, stoppered, hung in the bath to the balance-pan, and weighed accurately. To compare any number of samples of water it was sufficient to fill up the bottle with the water in question, and again weigh it immersed in the standard. Prof. Dittmar confined himself to making out the relation between salinity, specific gravity, and temperature, leaving the relation of specific gravity and pressure for subsequent treatment by Prof. Tait, whose great chain of experiments on the compressibility of sea-water is now drawing to a close, and the results of which will shortly be published in the *Challenger* Reports. The conclusion Prof. Dittmar comes to is summed up in the formula—

$$\chi = \frac{{}_4S_t - {}_4W_t}{a + bt + ct^2}$$

where χ is the "salinity" or permillage of halogen; ${}_4S_t$ the specific gravity of sea-water at t° relatively to pure water at 4° C.; ${}_4W_t$ is the specific gravity of pure water in the same way; a , b , and c are constants which have been determined once for all.

In the chapter on Salinity in Part I. Prof. Dittmar gives a table dealing with 300 samples, collected in all parts of the ocean and from all depths. These tables show the position, the depth of the ocean at the station, the depth from which the sample was drawn, the permillage of chlorine (χ), the mean deviation of the mean χ from the individual results, and the difference between the amount of chlorine as calculated from Buchanan's observations of specific gravity, and as found directly by Dittmar.

Mr. Buchanan gives in his report all his observations classified according to geographical position and depth, and arranged in eighteen large tables. These record the specific gravity of water from all depths in the North and South Atlantic, the Southern Indian Ocean, the North and South Pacific, and the interesting inclosed seas of the Malayan Archipelago. The numbers are simply given as they were observed, only corrected for temperature by Dittmar's table, and all discussion of their oceanographic significance has been deferred until a subsequent occasion.

A series of coloured charts illustrating the bathymetrical and geographical distribution of specific gravity over the whole world and in the individual oceans accompanies the memoir. These are extremely interesting, and in many cases they tell their own story without explanation, though when the full descriptions are published, the value and interest of the plates will be greatly increased. The track-chart of the *Challenger* coloured to show the surface salinity of the ocean, is especially worthy of notice; its details have been filled in, and the whole rendered more complete, by the incorporation of the results of other exploring expeditions.

The great importance of Mr. Buchanan's specific gravity observations will be more readily recognised by the general reader when they are elucidated by the work of Prof. Tait and Mr. Buchan, and treated more generally than is possible in a mere statement of observed figures.

The third part of the volume is devoted to the temperature observations made during the cruise. The nature of the information contained in the curves which make up this part of the work is very concisely put in the editor's introduction:—

"It has been deemed advisable to publish, for the convenience of scientific men, the whole of the deep-sea observations of temperature made during the voyage of the *Challenger*. These are given in detail in the accompanying series of 263 plates, which show the latitude and

longitude of the station; the depth in fathoms of the bottom; the depth at which each temperature was taken; the number of the thermometer; the temperature actually observed read to quarter degrees; the error of the thermometer; and the temperature corrected for instrumental error only."

The temperatures have been plotted by Staff-Commander Tizard, and a free-hand curve drawn through the points. From this the "temperature by curve" which is employed in drawing the diagrammatic sections of the ocean showing the bathymetrical arrangement of the isothermals is taken. These sections will be published in vol. i. of the *Challenger* narrative, and to the general reader they will present a much more intelligible idea of the distribution of oceanic temperature than can be given by the study of tables of figures or curves for separate stations. The separate station curves are, however, of the utmost value to any one who wishes to make a detailed study of ocean temperatures. With a direct view to such a purpose the curves have been drawn with rigid adherence to the numbers in the observation books, even the most obvious cases of observational error being left uncorrected; for the specialist can easily discover and correct them himself, and no one else will notice them.

The temperature observations, like the specific gravity observations, form a rich mine of material with which good work may be done. It is shown by a glance at the charts that there are areas in the ocean of great salinity and areas of great dilution; it is shown that the pressure increases uniformly with the depth; it is known that the surface temperature of the water varies greatly in different latitudes, and that, as the depth increases, the temperature decreases, at first very rapidly, but after the first few hundred fathoms with increasing slowness, until at the bottom the temperature of the open ocean is everywhere the same, between 34° and 35° F.; it is known also that in inclosed seas, or in those where there are submarine barriers cutting them off from the rest of the ocean, the temperature assumes a constant value in its descent, and sometimes the bottom is nearly 20° F. warmer than that of the ocean at the same depth a few miles distant; but this is all that is known. It is evident that there must be an ocean circulation on a magnificent scale going on, a gradual onward sweep of the whole mass of the water, but the direction of this mass motion can only as yet be guessed at, and its rate is utterly unknown. The material for solving this, the great oceanographic problem, is rapidly accumulating, and when the physical and chemical reports of the *Challenger* Expedition have all been made public, it will be strange indeed if a large generalisation cannot be based upon them, and the discovery of the secret of ocean circulation be added to the many discoveries which have been made by the scientific men of the cruise.

The nature of this volume, both on account of the subjects with which it deals and the number of formulæ and long tables of numbers it contains, must have made the task of editing it no light one; and the accuracy of every part, the almost entire absence of typographical errors, and the beauty of the lithographed charts show that authors, editor, engravers, and printers have alike exerted themselves to produce a volume worthy of being the first to record the physical and chemical work of the *Challenger* Expedition.

HUGH ROBERT MILL

SPECIALISATION IN SCIENTIFIC STUDY¹

THERE once was a science called "natural philosophy," which, like some old synthetic types of animals, held in itself all the learning that applied to physical facts. By the beginning of this century this science of natural things had become divided into physics and natural history. These divisions have since spread,

¹ From *Science*.

like the divisions of a polyp community, until now natural history has more than a dozen named branches; and in physics the divisions are almost as numerous. There are now at least thirty named and bounded sciences; each name designating a particularly limited field, in which there are able men who work their days out in labour that does not consider the rest of nature as having any relation to their work.

This progressive division of labour follows a natural law; and it is perhaps fit that science should itself give a capital illustration of the application of this law to forms of thought, as well as to the more concrete things of the world; but it is an open question whether or no it is advantageous to the best interests of learning. There can be no question that the search for truth of a certain quality is very greatly helped by this principle of divided labour. If a man wish to get the most measurable yield out of the earth in any way, the best thing for him is to stake off a very small claim, tie himself down to it, fertilise it highly, till it incessantly, and forget that there are blossoms or fruit beyond his particular patch; for any moment of consciousness of such impracticable things as grow beyond his field is sure to find expression when he comes to dig his crop, whether his crop in the intellectual field be elements or animals, stars or animalculæ. The harvest of things unknown is most easily won in this kitchen-gardening way of work.

The world needs, or fancies that it needs, this kind of work; and it is now of a mind to pay more of its various rewards for the least bit of special and peculiar knowledge than for the widest command of varied learning. In a thousand ways it says to its students, not only as of old, "Study what you most affect," but, "*Effect that study altogether*, know the least thing that can be known as no one else knows it, and leave the universe to look after itself."

This is the prescription of our time. We are now proceeding on the unexpressed theory that, because no man can command the details of all science, therefore he shall know only that which he can know in the utmost detail. We seem to be assuming, that, if many separate men each know some bit of the knowable, man in general will in a way know it all; that when, in another hundred years of this specialisation, we have science divided into a thousand little hermit-cells, each tenanted by an intellectual recluse, we shall have completed our system of scientific culture. No one can be so blind to the true purposes of learning as to accept this condition of things as the ideal of scientific labour. It may be the order of conquest, the shape in which the battle against the unknown has to be fought; but beyond it must lie some broader disposition of scientific life,—some order in which the treasures of science, won by grim struggle in the wilderness of things unknown, may yield their profit to man.

The questions may fairly be asked, whether we have not already won enough knowledge from nature for us to return, in part, to the older and broader ideal of learning; whether we may not profitably turn away a part of the talent and genius which go to the work of discovery to the wider task of comprehension; whether we may not again set the life of a Humboldt along with the life of a Pasteur, as equally fit goals for the student of nature.

Until we set about the system of general culture in science, it will be nearly impossible to have any proper use of its resources in education. A sound theory of general culture in science must be preceded by a careful discussion of the mind-widening power of its several lines of thought. This determination cannot be made by men versed only in their own specialties; it must be made by many efforts to determine by comparison what part of the sciences have the most important power of mind-developing. At present there are few men whose opinion on such a subject is worth anything, and the number constantly grows less.

The greatest difficulty partly expresses itself in, and partly rises from, the multiplication of societies which include specialists as members, and specialties as the subjects of their discussions. We no longer have much life in the old academies, where men of diverse learning once sought to give and receive the most varied teaching. The geologists herd apart from the zoologists: and in zoology the entomologists have a kingdom to themselves; so have the ornithologists, the ichthyologists, and other students. "That is not my department," is an excuse for almost entire ignorance of any but one narrow field. If naturalists would recognise this "pigeon-holing," not only of their work, but of their interests, as an evil, we might hope to see a betterment. Until they come to see how much is denied them in this shutting-out of the broad view of nature, there is no hope of any change. Special societies will multiply; men of this sort of learning will understand their problems less and less well; until all science will be "*caviare to the general*," even when the general includes nearly all others beyond the dozen experts in the particular line of research.

The best remedy for this narrowing of the scientific motive would be for each man of science deliberately to devote himself, not to one, but to two ideals, *i.e.* thorough individual work in some one field, and sound comprehension of the work of his fellows in the wide domain of learning—not all learning, of course, for life and labour have limits, but of selected fields. In such a system there will be one society-life meant for the promotion of special research, and another meant for the broader and equally commendable work of general comprehension.

It is in a certain way unfortunate that investigation is to a great extent passing out of the hands of teachers. This, too, is a part of the subdivision work; but it is in its general effects the most unhappy part of it. As long as the investigator is a teacher, he is sure to be kept on a wider field than when he becomes a solitary special worker in one department.

The efforts now being made for the endowment of research will, if successful, lead to a still further tendency to limit the fields of scientific labour. A better project would be to keep that connection between inquiry and exposition from which science has had so much profit in bygone times.

TWO GREEK GEOMETERS

DR. ALLMAN in his article "On Greek Geometry from Thales to Euclid," in the current volume of *Hermathena* (vol. v. No. 10), discusses in Chapter IV. the discoveries of Archytas of Tarentum, and in Chapter V. those of the Greek geometer Eudoxus of Cnidus.

Archytas was a contemporary of Plato (428-347 B.C.), probably senior to him, and saved his life when Plato was in danger of being put to death by the younger Dionysius. These particulars and others of interest are skilfully arrayed by the author; one only of these we recall, *viz.* Horace's reference to the death of Archytas by shipwreck in an ode (Book I. 28), in which he recognises his eminence as an arithmetician, geometer, and astronomer. Unfortunately no undoubted works of his have come down to us; the authenticity of some that have been attributed to him is here discussed, but these do not treat of geometry. In former chapters his contributions to the doctrine of proportion and his demonstrations of theorems as well as solutions of problems have been noticed. Here the question of his identity with the Architas of Boethius' *Ars Geometrica* is discussed, and a strong case made out for the same. The connection of Archytas with the Delian Problem (already touched upon in *Hermathena*, vol. iv.) next comes under consideration, and the passage in Eutocius is translated at length and accompanied by a figure. An enumeration of the theorems which occur in this passage is made,

whence we see that this geometer "was familiar with the generation of cylinders and cones, and had also clear ideas on the interpretation of surfaces; he had, moreover, a correct conception of geometrical loci and of their application to the determination of a point by means of their intersection." Dr. Allman further maintains that in this solution "the same conceptions are made use of, and the same course of reasoning is pursued, which, in the hands of his successor and contemporary Menœchmus, led to the discovery of the three conic sections. Such knowledge and inventive power surely outweigh in importance many special theorems." In arriving at these views he has to combat (which he does in some detail and apparently with success) the reasoning of Cantor, which is "based on a misconception of the passage in which the word *τόπος* occurs." Dr. Allman insists that *τόπος* means *place* and not *locus* (as used by mathematicians). The whole discussion is well worthy of the careful attention of all interested in the history of geometry: we must forbear to enter into the matter further.

Eudoxus (born about 407 B.C.), a pupil of Archytas, was an astronomer, geometer, physician, and lawgiver, and hence a noteworthy man in more ways than one. Here again Dr. Allman, one of whose great merits is his independence and his thorough examination of the original authorities, differs from Boeckh and Grote, but we cannot give details. A full discussion of the additions to geometry made by Eudoxus follows, and from it we learn how great he was as a geometer; his contributions to astronomy must be sought for elsewhere, though they too come under notice. "This eminent thinker—one of the most illustrious men of his age, an age so fruitful in great men, the precursor, too, of Archimedes and of Hipparchus—after having been highly estimated in antiquity, was for centuries unduly depreciated; and it is only within recent years that, owing to the labours of some conscientious and learned men, justice has been done to his memory, and his reputation restored to its original lustre." The article under notice will considerably conduce to this right placing of Eudoxus, amongst whose merits the least is not that he was a true man of science. "Of all the ancients, no one was more imbued with the true scientific and positive spirit than was Eudoxus." Five reasons for this statement follow, and the article closes. The whole paper is a most interesting as well as valuable one; indeed the interest grows as the author approaches his goal, and we venture to predict for Dr. Allman, when his articles appear in a volume, a most cordial welcome from all mathematicians.

THE ROYAL GARDENS AT KEW

THE Report of the Director on the Progress and Condition of the Royal Gardens at Kew for the year 1882 was unavoidably delayed. It bears date only from November 1, 1883, and was not published until well on in 1884. The date of the Report has, however, nothing to say to its interest and merit, and there is always plenty of both in these too short accounts of the great work carried on at Kew. Passing over some details, noting that the amount of damage which the collections have suffered has been, notwithstanding the unprecedented number of visitors, practically *nil*, and that the lecture-classes for young gardeners continue to give satisfactory results, we find an account of the formation of a Rock Garden at Kew. The site selected lies between the wall bounding the Herbaceous Ground on the east and the New Range on the west. The general idea in laying out this space was to imitate in some measure the rocky course of some Pyrenean stream; the dry bed is represented by the broad walk (8 feet wide and 514 feet long), while on either side are the rock-piled banks, in the interstices and pockets of which grow the Alpine plants, and above all are thickets of box and rhododendrons. Tree stumps have been

somewhat freely used here and there. That some plants grow well on them will be admitted; that by their decay they require renewal is their chief drawback. The collection of 2630 plants bequeathed to the Gardens by Mr. Joad formed a splendid commencement to the Rock Garden series, and this section of the grounds has long since proved not only a centre of attraction to the general visitors, but has been a source of pleasure and profitable study to many an amateur gardener. An apology is made for not attempting some geographical arrangement of the Alpines; one was hardly needed. Where the plants grow best there ought to be their (artificial) habitat, and the practical gardener well knows what strange bed-fellows plants often are, and how marvellously they vary in their tastes. Within the last six weeks we noted two finely-grown plants of that popular Alpine crackweed, the edelweiss; one was flowering out of a crack in a dry limestone wall, the other was on a deep clay bank.

The elaboration of the natural family of the palms for the "Genera Plantarum" of Bentham and Hooker led the Director to make a critical study of the species of palms in cultivation at Kew, the collection of which proved to be of unexpected richness. In an appendix is a classified list of 420 palms at present in cultivation at Kew. This collection has now but two rivals—the magnificent collection at Herrenhausen, Hanover, chiefly made by Herr Wendland, and that of the unrivalled tropical gardens at Buitenzorg in Java.

The report about the Arboretum shows an enormous amount of work accomplished. While the collection is one of the richest in existence, its importance is gradually more and more dawning upon those interested in planting, and its national importance in this respect should not be overlooked.

The part of the Report giving extracts from the large colonial correspondence that centres at Kew is full of interest, none the less so that much of the information is of a date often far on in 1883. The Argan tree seems likely to be acclimatised at Natal from seeds sent from Kew. The india-rubber (Ceara), introduced from Kew into Ceylon, seems in a fair way of paying as well as Cinchona. Dr. Trimen says it will grow anywhere up to almost 2500 feet, and its commercial success is most satisfactory. "About six months ago (October 24, 1883) some Ceara-rubber seed was imported from Ceylon into Southern India. The produce of these trees may now be seen flourishing in a wonderful manner at the foot of the Neilgherry Hills. The rapid growth of the trees is marvellous. Some which were six months old from seed were fully eight feet high; and a cutting, said to have been planted scarcely six months previously, was quite eight feet high, and was in blossom. It seems to thrive on poor soil, requires shelter but not shade, and very little rain. The demand for the produce seems to be unlimited." Of the mahogany seeds sent from Kew in 1863 to Mauritius, nine of the trees raised bore seeds in 1881, and numerous seedlings were found self-sown. In a report from the Seychelles allusion is made to "three different diseases which have seriously affected the cocoa-nut palms," whereby large forests of these valuable trees have been destroyed. No details are given as to what these diseases are, though they "have nearly stopped their depredations since 1882." In the same report it is mentioned that the remains of the clove plantations cover "about 250 acres"—surely a mistake. It is also stated that the Liberian coffee sent from Kew in 1880 has proved a success, and that about 100 acres of it have been recently planted. The report on *Cinchona robusta* quotes with approval Dr. Trimen's views on the hybrid forms of the Nilgiris—known under the names *pubescens* and *magnifolia*—now settled to be hybrids between *C. succirubra* and *C. officinalis*.

Among the more important additions to the Herbarium may be mentioned the collection of European and exotic lichens made by the Rev. W. A. Leighton, the type speci-

mens of Mr. Wilson Saunders's Refugium Botanicum, the Madagascar collection of the Rev. R. Baron—this latter of over 1100 species.

Reference is also made to the "North Gallery," an illustration of which is added to the Report. The collection of separate pictures of plants in the gallery amounts in number to 627, and has since been added to.

It will be seen from this brief sketch of Sir Joseph Hooker's Report that the work done at Kew is as varied as it is important, and that our colonies directly and our mother country indirectly are under lasting obligations to the zeal and energy of all concerned in the management of this great institution.

MR. THORODDSEN'S GEOLOGICAL EXPLORATIONS

ALTHOUGH situated at a comparatively short distance from Europe, and notwithstanding the frequent visits of late years by English tourists, Iceland is yet very far from being a well-known country. The upland is still, for the most part, an unexplored region, and there are whole districts where no man, native or foreign, ever set his foot, owing, chiefly, to the difficulties and dangers which attend travelling through these wildernesses. Foreigners travel mostly along beaten tracks; they come mostly without having acquired any previous knowledge of the peculiar nature of the country, consequently not knowing what parts are most worth visiting or exploring. Yet these regions are eminently interesting for students of natural science, being filled with innumerable glaciers, some of enormous magnitude, with multitudes of volcanoes, eruptive springs, &c., which it is of the greatest importance should be scientifically explored and described. In order to obtain reliable information about these upland wilds of the country, the Government of Iceland have commissioned Mr. Th. Thoroddsen to undertake systematic explorations with a view to establishing the geology of the country on a sound basis, and correcting its geography where necessary; for this purpose he has already undertaken various expeditions. In the course of last summer (1883) he explored the peninsula of Reykjanes and its upland connections. Although this part lies in close proximity to the inhabited parts of the country, it has hitherto remained for the most part a *terra incognita* on account of the innumerable waterless and utterly barren lavas which are crowded into it, and make travelling excessively arduous. Formerly people only knew that within historic times two volcanoes had been active in these parts. Mr. Thoroddsen has now determined the existence and site of no less than *thirty* separate volcanoes with at least *seven hundred* craters. In each case he has made all necessary measurements, and has constructed a geological map of the whole district.¹ The aggregate extent of the lavas covers about 44 square (geographical) miles. Out of the lavas up and down this tract there rise mountains composed of tufa and breccia, and through these the eruptions of the volcanoes proper have found their vent. Cases of individual volcanoes being built up in one spot by repeated eruptions are rare. The craters are in most cases traceable in distinct long rows, like pearls on a string, along terraces of tufa, situated along chasms through which the lava welled out. In some places there are no craters, the lava having boiled out of the chasm over either side of it, in which cases the rift remains open with its brims covered with a glazed crust of lava. In other localities are found volcanoes of colossal size, broad sublevations or convexities of lava, with a large crater at the apex from 800 to 1000 feet in diameter, instances of which are Skjaldbreid, 3400 feet, and Heidinhá, 2000 feet above the level of the sea. Throughout the lava stretches one comes upon enormous fissures all following the same direction as the rows of the craters,

¹ published by the Geological Association of Stockholm.

namely, south-west to north-east. All about this district there are also found numbers of hot springs, solfataras, and boiling clay-pits. This peninsula, Mr. Thoroddsen maintains, must be one of the most thoroughly burnt spots on the globe, and a pre eminently instructive tract for geologists who make volcanic manifestations the speciality of their study.

This summer Mr. Thoroddsen is engaged in exploring the enormous lava wilderness of Odádhraun, covering the central part of Iceland, and, as yet, for the most part entirely unknown. In the glaciers to the south of this wilderness great eruptions have taken place of late years, about which nothing is known, no one having as yet ventured into these wilds, lying 3000 to 4000 feet above the level of the sea. The difficulties of exploration here are enormously aggravated by the utter barrenness of the region, by scarcity of water, and by the frequent snow tempests by which the region is constantly harried even in the midst of summer. Even the compass is not to be relied upon, on account of the mass of iron which enters to such a large extent into the composition of the lava.

Akreyri, June 24, 1884

Grimsey is the name of a small island, situated in the Arctic Ocean, about 22 English miles due north of the promontory which divides the bays of Eyjafjord and Skagafjord in Northern Iceland. It is inhabited by 88 human beings, debarred from all communication with the outer world, and equally ignorant of its motive thought as of its stirring events. Their intercourse with outward surroundings is confined to Arctic ice and ceaselessly recurring storms. Only once or twice a year they manage in their small open boats, at a perilous risk, to effect a landing on the mainland, for the purpose of obtaining by barter their necessities of life at some of the north coast trading stations.

The island having never before been visited by a naturalist, I eagerly embraced the opportunity of joining the governor of the North District on an expedition to it, undertaken at the instance of the commander of the gun-boat *Diana*, Capt. O. Irminger, of the Danish navy. In the evening of June 19 we steamed, in calm weather, from Akreyri down the broad bay of Eyjafjord, enjoying the imposing scenery of the mountains on either side, lit up by the subdued vermilion tints of the nocturnal sun glare; when we reached the mouth of the bay, we had a full, unintercepted view of the midnight sun, resting on the oceanic sky-line, like a ball of fire behind a veil of blood. Out of the inert calm of the deep, which looked like polished glass, there rose on either side of us black precipitous rocks that formed, as it were, the advanced basis of the snow-capped mountain-tops, which determined our sky-line in the landward distance.

We reached Grimsey at three o'clock in the morning of the 20th, still, as good luck would have it, favoured by the same calm weather and quiet sea—both being the indispensable condition of effecting a safe landing on the island. We took the shore just below the parsonage in a bight formed of precipitous rocks made of basaltic columns, here and there split up by yawning caves; and having succeeded in clambering to the top of the rocks, we set about exploring the island.

The formation of Grimsey is basaltic throughout, and, geologically speaking, resembles, closely on the whole, the stratification of Northern Iceland. From its non-volcanic nature one may therefore fairly assume that, once upon a time, it must have been connected with the mainland. But, though not volcanic itself, it seems that Grimsey is not very far removed from the lines along which the active subterranean fires in Iceland are operating. At various times the inhabitants state they have observed towards the south-east signs of submarine volcanic action, and towards Tjörnes (S.S.E.) a column of fire was distinctly observed breaking through

the surface of the sea in 1868; this, too (one of the northernmost promontories of Iceland), has frequently been visited by violent earthquakes, notably so in 1872. Towards the east the island rises precipitously out of the sea to the height of upwards of 300 feet, but slopes to the westward, where all the habitations of the people are scattered about. The flora is scanty, and the plants stunted in a remarkable degree; as far as I had opportunity to observe, the vegetation seemed to bear a distinct Arctic impress as compared with that of the mainland. The sward is covered with Arctic willow (*Salix herbacea*), resembling the same plant when met with on the mainland at an elevation of 1500 to 2000 feet above the sea-level. The flora of the eastern portion of the island is much more varied, as compared with that of the western, owing to the soil being much more fertile there from the guano deposited by the multitudes of birds which haunt that part of the island. Every ledge of rock is covered with the so-called "Skarfa-kál" (scurvy-kale, scurvy-grass, or spoon-wort, *Cochlearia officinalis*). Altogether I managed to collect here between fifty and sixty species of plants, all of which are also found on the mainland, only these are of a more stunted growth. No heath vegetation occurred, and no ligneous, if I except the above mentioned willow, which only grows to the height of one inch and a half.

The temperature of Grimsey is much milder than might be supposed from the geographical position of the island. Although it is visited every two out of three years by the Arctic ice, the average temperature of the year is $+1^{\circ}4$ Celsius. August is the hottest month in the year, $+7\frac{1}{2}^{\circ}$ C.; March the coldest, $-3\frac{3}{8}^{\circ}$ C. The highest degree of heat in 1876 was $+20^{\circ}$ C.; the greatest cold in 1880, -30° C. The mildness of the temperature is accounted for by the fact, ascertained of late years beyond a doubt, that a small branch of the Gulf Stream splits off from the main current on encountering the resistance of the western submarine spurs of the rocky masses on which Iceland is built up, the flow of which branch, on wheeling round the north-western peninsula of the country, takes an eastward direction along the whole extent of the northern coast. The average temperature of the sea round Grimsey is about 4° C. in January and 3° C. in February. The pastor of the island, M. Pjetur Gudmundsson, has for many years been engaged in exceedingly careful meteorological observations on behalf of the Meteorological Institute of Copenhagen. This most worthy gentleman, living here in conspicuous poverty, like a hermit divorced from the world, though he has the comfort of a good wife to be thankful for, is not only regarded as a father by his primitive congregation, but enjoys moreover the reputation of being in the front rank among sacred poets in modern Iceland.

The inhabitants derive their livelihood, for the most part, from bird-catching, nest-robbing, and deep-sea fisheries. The precipices that form the eastern face of the island are crowded with myriads of various kinds of sea-fowl. On every ledge the birds are seen thickly packed together; the rocks are white with guano, or green-tufted with scurvy-grass; here everything is in ceaseless movement, stir, and flutter, accompanied by a myriad-voiced concert from screamers on the wing, from chatters on domestic affairs in the rock-ledges, and from brawlers at the parliament of love out at sea, the surface of which beneath the rocks is literally thatched at this time of the year with the wooing multitudes of this happy commonwealth. If the peace is broken by a stone rolled over the precipice, or by the report of a gunshot, the air is suddenly darkened by the rising clouds of the disturbed birds, which, viewed from the rocks, resemble what might be taken for gigantic swarms of bees or midges.

The method adopted for collecting eggs is the following:—Provided with a strong rope, some nine or ten stal-

wart men go to the precipice, where it is some 300 feet high, and one of the number volunteers or is singled out by the rest for the perilous "*sig*," i.e. "sink," or "drop," over the edge of the rocks. Round his thighs and waist, thickly padded generally with bags stuffed with feathers or hay, the "*sigamadr*," "sinkman," or "dropman," adjusts the rope in such a manner as to hang, when dropped, in a sitting posture. He is also dressed in a wide smock or sack of coarse calico, open at the breast, and tied round the waist with a belt, into the ample folds of which he slips the eggs he gathers, the capacity of the smock affording accommodation to from 100 to 150 eggs at a time. In one hand the "sinkman" holds a pole, 16 feet long, with a ladle tied to one end, and by this means scoops the eggs out of nests which are beyond the reach of his own hands. When the purpose of this "breath-fetthing" "sink" is accomplished, on a given sign the "drop-man" is hauled up again by his comrades. This, as may readily be imagined, is a most dangerous undertaking, and many a life has been lost over it in Grimsey from accidents occurring to the rope.¹

For the pursuit of the fishery the island possesses fourteen small open boats, in which the men will venture out as far as four to six miles cod-fishing; but this is a most hazardous industry, owing both to the sudden manner in which the sea will rise, sometimes even a long time in advance of travelling storms, and to the difficulty of effecting a landing on a harbourless island.

Now and then the monotony of the life of the inhabitants is broken by visits from foreigners, mostly Icelandic shark-fishers, or English or French fishermen.

Of domestic animals the islanders now possess only a few sheep. Formerly there were five cows in the island, but the hard winter of 1860 necessitated their extermination, and since that time, for twenty-four years, the people have had to do without a cow! Of horses there are only two at present in the island! Strange to say, the health of the people seems, on the whole, to bear a fair comparison with more favoured localities. Scurvy, which formerly was very prevalent, has now almost disappeared, as has also a disease peculiar to children, which, in the form of spasm, or convulsive fit, used to be very fatal to infant life in former years.

Inexpressibly solitary must be the life of these people in winter, shut out from all communication with the outer world, and having in view, as far as the eye can reach, nothing but Arctic ice. The existence of generation after generation here seems to be spent in one continuous and unavailing Arctic expedition. The only diversion afforded by nature consists in the shifting colours of the flickering aurora borealis, in the twinkling of the stars in the heavens, and the fantastic forms of wandering icebergs. No wonder that such surroundings should serve to produce a quiet, serious, devout, and down-hearted race, in which respect the Grimsey men may perhaps be said to constitute a typical group among their compatriots. However, to dispel the heavy tedium of the long winter days, they seek their amusements in the reading of the Sagas, in chess-playing, and in such mild dissipations at mutual entertainments at Christmas-time as their splendid poverty will allow.

TH. THORODDSEN

SEATS IN RAILWAY CARRIAGES

IN a recent article in *Science et Nature* the writer, after animadverting on the lateness of the day at which shoemakers have at length begun, though still very imperfectly, to take account of the osseous framework of the human foot, proceeds to investigate the relation between

¹ This is a fate that befalls too many of the "sinkmen" of Iceland, for there are numbers of them all round the coast. It would be easy, at a very small cost to the treasury of Iceland, to provide a perfectly safe movable apparatus for every district where life must be sustained at the above-described risk. The authorities would, no doubt, readily meet any reasonable request on the subject.—E. M.

the structure of the human trunk and that of the seat, more particularly in railway carriages, designed for its accommodation. In a sitting posture the pelvis has for its sole function the support of the upper part of the

ports for the back, the shoulders, and the head. So far as these are wanting, the body will tend of itself, unless counteracted by an effort of will and nervous force, to bend forward, till at last the forehead finds the knees to lean on. The position of the body in sitting is all the easier, and its rest all the more complete, the more decided is the inclination of the back of the seat and the more obtuse is the angle formed by the trunk and

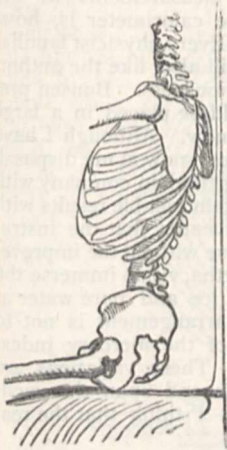


FIG. 1.

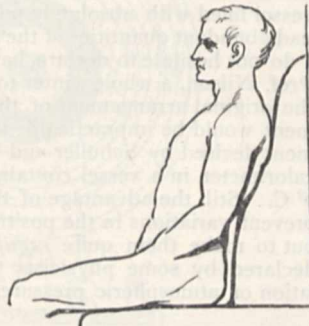


FIG. 2.

body. The spinal column, however, is inserted in the pelvis, not in the form of a straight line but of a curve (Fig. 1). This inflection on the part of the backbone, while adding to the mobility of the trunk, imposes on it



FIG. 7.

the thighs. Seats such as the *dormeuses* realise the most favourable conditions in this respect.

Fig. 2 represents a man comfortably seated and propped. The back of the seat supports him principally under the shoulder-blades, offers the chest a depression to sink in, and altogether keeps the upper part of the body in a free and easy position. Fig. 3 shows the same person in a similar position, but with his head resting



FIG. 3.

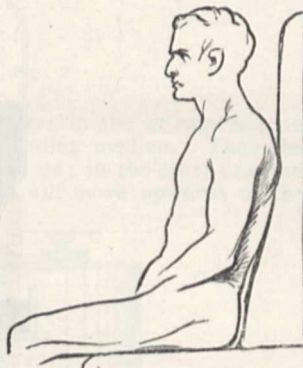


FIG. 4.

the necessity of a continual balancing movement, the centre of gravity being shifted every time the head and thorax sway to one side or the other. Such balancing

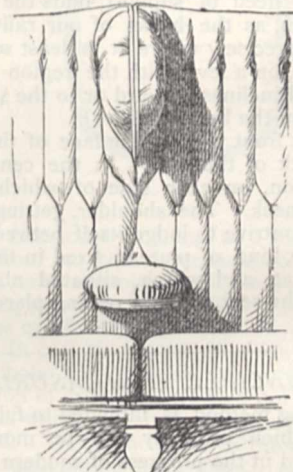


FIG. 8.

behind. In both these figures the back of the seat is seen exactly in profile, and to the writer of the article such seems the construction which is most convenient in railway carriages.

Fig. 4, on the other hand, represents the profile of a man seated as passengers are in many of our actual first-class carriages. His position is perceived to be a forced one in contrast with that just noticed, and alto-

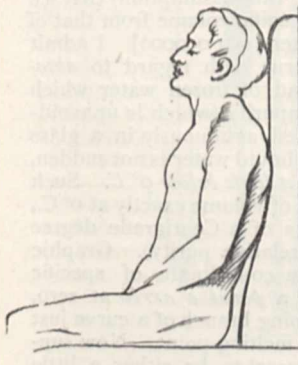


FIG. 5.

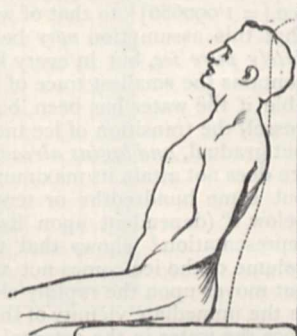


FIG. 6.

movement is necessarily also attended by a certain expenditure of energy. To allow the upper part of the body to remain comfortably at rest there must be sup-

gether disagreeable. Fig. 5 shows exactly the stiff attitude the head is compelled to take in order to rest.

Finally, Fig. 6 reproduces the comfortable position indicated in Fig. 3, and at the same time represents the profile of the back of the seat actually in use in our railway carriages. On comparing this profile with the position of the man comfortably supported, the following defects in the back of the seat are observed:—

1. It is too vertical.
2. It allows an empty space between the lumbar vertebræ and the lower extremity of the shoulder-blade exactly at the place where one is in the habit of putting a cushion "behind the back," as it is called.
3. It is at least half a foot too high, and so makes it impossible for the head to rest behind. It is customary to make the back of the seat tally with the height of a man of average size seated bolt upright.

Under the actual conditions, such as they have been

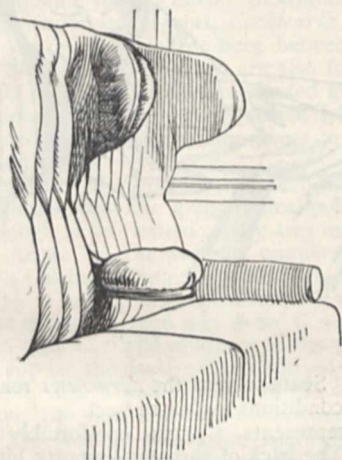


FIG. 9.

described, what becomes of the traveller when sleep at length overtakes him? Little by little he slides down on his seat till the lower extremity of his shoulder-blades, which has most need of support, finds the most sensible projection, which, as the backs of our railway carriages actually are, is precisely where it is least serviceable—at a point, namely, on a level with the region of the pelvis. Lastly, the head inclines forward or to the side, if it does not bury itself in the breast (Fig. 7).

Fig. 8 gives a front view of the face of the bench serving as the back of the seat. In the centre is seen a stuffed projection, on each side of which a passenger may rest his cheek. The shoulder, getting no separate support, must contrive to lodge itself between this stuffed projection and a kind of plateau fixed in the side of the back of the seat, and which, situated about a hand's breadth above the seat, offers a resting-place to the elbow (Figs. 8 and 9).

A NEW PRINCIPLE OF MEASURING HEAT

THE following method is intended to fulfil some conditions which probably will be more and more urgently required in the progress of modern science:—

1. *Measurements of heat should be executed at constant temperature, i.e. without the aid of thermometers.*—Every variation of temperature during calorimetric experiments causes unavoidable errors and necessitates corrections and compensations. The accuracy of the thermometric method ["method of mixture," of Regnault], which now predominates among experimentalists is unrivalled, only in those cases where the amount of heat to be measured is developed in the course of a few seconds or minutes; it is seriously impaired whenever the experiment lasts longer, while the

influence of the corrections for radiation, &c., increases proportionately with the duration of the operation. The first method used in thermo-chemical investigations, the ice-melting method of Lavoisier and Laplace, as well as the modern calorimetric method by Bunsen, avoids this inconvenience by executing all measurements at the melting-point of ice. Bunsen's ice calorimeter is, however, not exempt from corrections. Every physicist familiar with the use of this instrument will also, like the author, be well acquainted with its capriciousness. Bunsen prescribes that the calorimeter should be placed in a large vessel filled with absolutely pure snow. Although I have had abundant quantities of the purest snow at my disposal, I do not hesitate to declare, having tried, in company with Prof. Nilson, a whole winter to obtain reliable results with the original arrangement of the inventor, that the instrument would be impracticable for use without the improvement devised by Schuller and Wartha, viz. to immerse the calorimeter in a vessel containing ice and pure water at 0°C . Still the advantage of this arrangement is not to prevent variations in the position of the mercury index, but to make them quite *regular*. These variations are declared by some physicists to depend upon the fluctuation of atmospheric pressure, but I think that the real

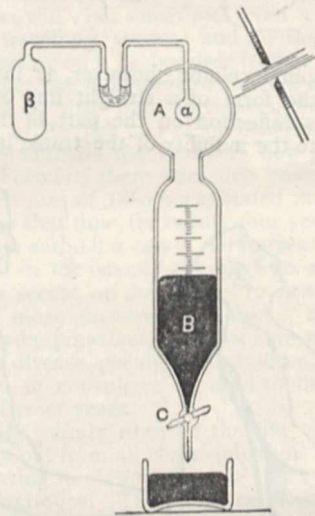


Fig. 1

cause of the unsteadiness of the index of the instrument lies in the peculiar behaviour of the ice in the vicinity of its melting-point. It was believed hitherto (and Bunsen's method theoretically rests upon this assumption) that ice at 0°C . suddenly changes its specific volume from that of ice [= 1.090686]¹ to that of water [= 1.000000]. I admit that this assumption may be true with regard to *absolutely pure ice*, but in every kind of frozen water which contains the smallest trace of impurity (which is unavoidable if the water has been boiled assiduously in a glass vessel) the transition of ice into liquid water is not sudden, but gradual, and begins already a little below 0°C . Such ice does not attain its maximum of volume exactly at 0°C ., but some hundredths or tenths of a Centigrade degree below 0° (dependent upon its relative purity). Graphic representation² shows that the co-ordinate of specific volume of the ice comes not to a *point d'arrêt* at zero, but moves upon the rapidly-sloping branch of a curve just in the immediate vicinity of the melting-point. Now suppose the water in the external vessel to be either a little purer than that of the calorimeter, or *vice versa*. In the

¹ This number, which is almost identical with that of Bunsen, was found by the author in his research "Upon the Properties of Water and Ice," "Vega-expeditionens vet. iakttagels," Bd. ii. p. 275.

² See the paper "Upon Water and Ice," by O. Pettersson, *l.c.*

former case its temperature, *i.e.* its melting-point, will be situated a few thousandths of a Centigrade higher, and the volume of the ice in the calorimeter will move down-

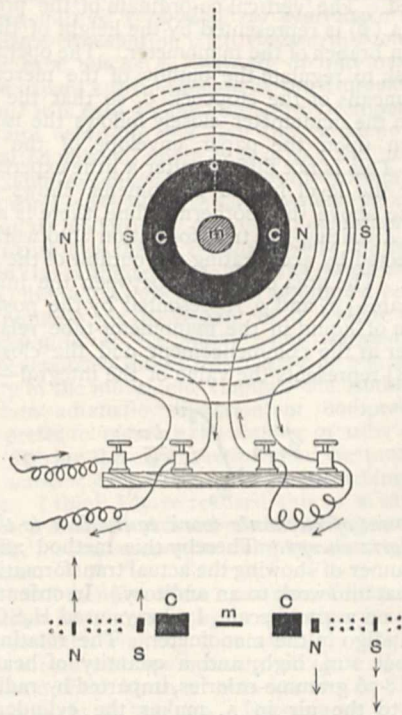


Fig. 2

wards on the branch of the curve in the attempt to gain the temperature of the surrounding medium. Then the index will move slowly backwards; in the other case the co-ordinate of specific volume will move upwards on the

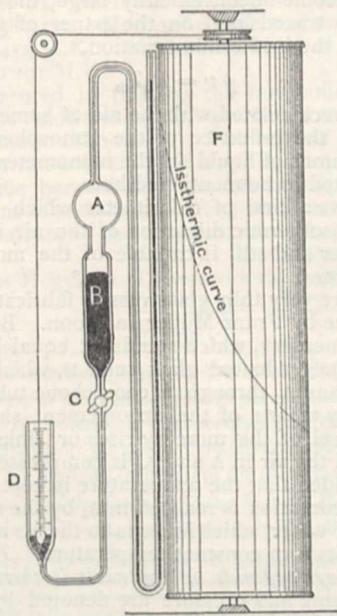


Fig. 3

sloping branch, and the index of the scale-tube will march forwards. These remarks may be sufficient to explain why there has been much dispute about the absolute

magnitude of the caloric units indicated by the ice calorimeter of Bunsen, and why this instrument is always empirically graduated, although its principle ought to allow of absolute measurements.

II. The amount of heat developed in calorimetric experiments should be directly transformed into work and measured in absolute units [kilogramme-metres].¹—In every branch of physical science this manner of measurement is beginning to introduce itself, as, for example, in electricity, magnetism, &c. In thermal determinations it has the great advantage that the mechanic units are 430 times greater than the thermic units, and can be far more accurately determined.

III. The principle should be applicable to the measurement of all kinds of caloric energy: as, specific heat, radiant heat, the heat absorbed or developed by chemical reactions, &c.—It must be remarked that I have hitherto experimented only with radiant heat. An apparatus intended for other kinds of heat is under construction,

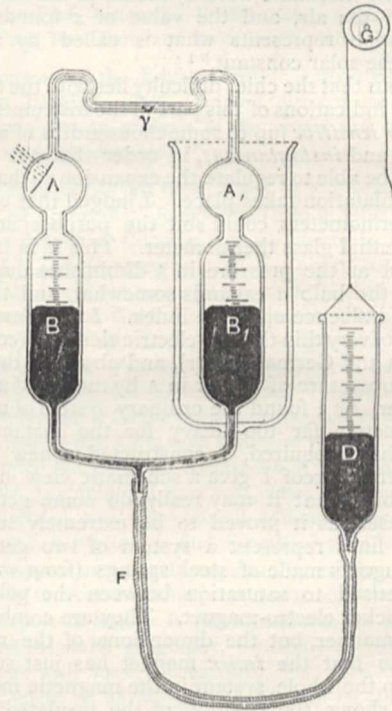


Fig. 4

but as this will take some time, and as I wish specially to direct my labour to the determination of the sun's radiant heat, I take the opportunity now of calling the attention of physicists to the principle of the method, which I foresee can be developed and varied in a multitude of ways. In case the matter should interest anybody sufficiently to make him try it experimentally, I will give some information in order that he may not be detained by those difficulties which have baffled my own efforts during nearly six years. The principle is extremely simple, and will be easily understood by a glance at the diagram (Fig. 1).

Let a beam of heat rays fall upon the thin glass wall of the reservoir A, which contains dry air. As soon as the thermometer $\alpha\beta$ indicates that the temperature of the air in A increases, let mercury escape through the stopcock C. Thereby the air expands, and the heat received by radiation is transformed into mechanic work, as the level of mercury in B sinks under the influence of the expanding force imparted to the air by the radiant heat.

¹ I denote this in the following by the sign M:K^o.

As the air in A in this case has expanded *isothermically*, the mechanic work is represented by the equation

$$x = p_0 v_0 \log_{\text{nat}} \frac{v}{v_0},$$

where $p_0 v_0$ are the initial pressure and volume of the air in A, and v is its volume after the expansion. If we suppose that a beam of sun rays during a minute has fallen upon the blackened surface of A through a hole of a square centimetre, and that the experimenter has neutralised the tendency of the air to increase in temperature by careful manipulation of the stopcock C, which allows the air to expand its volume as it displaces the escaping mercury—suppose that in this way the cooling effect of the expansion has neutralised the tendency of the air to augment its temperature under the influence of the heat radiation, so that the index of the thermometer has been kept *constantly* at its initial point, then the *entire* amount of solar heat imparted to the glass reservoir A is converted into mechanic work by means of the isothermic dilatation of the air, and the value of x found by the above equation represents what is called by modern scientists "the solar constant."¹

It is obvious that the chief difficulty lies with the thermometer. The indications of this part of the instrument must be *extremely sensitive* (up to some thousandths of a degree Centigrade) and *instantaneous*, in order that the experimenter may be able to regulate the expansion so that a real isothermic dilatation takes place. I judged that only two kinds of thermometers could suit the purpose, and tried first a differential glass thermometer. This is in fact very sensitive, but as the pressure in A diminishes during the experiment, the bulb a expands somewhat, and this has a disturbing influence upon the index. I next inserted in A a network of very thin thermo-electric elements (combinations of iron and German silver), and observed the alterations of temperature of the air in A by means of a mirror galvanometer. As I found the ordinary system of magnets in galvanometers far too heavy for the instantaneous deflections here required, I constructed a new kind of galvanometer, whereof I give a schematic view in Fig. 2, because I think that it may really do some good work in other cases, as it proved to be extremely sensitive. The dotted lines represent a system of two concentric (annular) magnets made of steel springs (from watches), each magnetised to saturation between the poles of a powerful Plücker electro-magnet. They are combined in the astatic manner, but the dimensions of the material are chosen so that the *inner* magnet has just sufficient force to keep the whole system in the magnetic meridian. The figure shows the position of the insulated copper wires relatively to the magnets. M is a mirror of very thin silvered glass; CC is a massive copper ring. I tested the sensibility of the instrument by adiabatic expansion of the air in A. This was effected by opening the stopcock C for a moment. The slightest dilatation of the air in this manner immediately showed its cooling effect by a deflection of the scale in the mirror, but as the deflection soon brought the magnets out of the electric field, the *amplitude* of the oscillation was, as I had calculated, not great. However, as the oscillations did not cease instantaneously, I found the method impracticable for *continuous* observation. I then abandoned the project of regulating the isothermic expansion *by means of a thermometer* altogether.²

The next arrangement, which succeeded better, was that shown in Fig. 3. Here the co-ordinates of the isothermic curve are traced out beforehand on the rotating cylinder F. As the mercury in B flows into D, it lifts a float, which, by a combination of wire and blocks,

makes the cylinder rotate at a rate which is proportional to the expansion of the volume of the air in A. Thus the horizontal co-ordinate (v) of the isothermic curve is represented. The vertical co-ordinate of the pressure of the air in A (p) is represented by the height of the liquid in the open branch of the manometer. The operator only has the task to regulate the outflow of the mercury from B to D by means of the stopcock C, so that the level of the fluid in the manometer closely follows the isothermic line drawn upon the paper envelope of the rotating cylinder. This is not difficult after a little experimenting. Whenever the level in the manometer shows a tendency to rise above the isothermic line, there is a surplus of heat in A waiting for transformation into work, which can be effected by accelerating the outflow of the mercury through C. The area contained between the initial and final ordinates [p_0 and p , represented by the positions of the column of liquid in the manometer-tube relatively to the cylinder at the commencement and the close of the experiment] represents the value of the integral—

$$p_0 v_0 \int_{v_0}^v \frac{dv}{v}$$

or the amount of mechanic work equivalent to the transformed caloric energy. Thereby this method affords an elegant manner of showing the actual transformation of all kinds of heat into work to an auditory. In order to obtain indications on a grand scale I always used H_2SO_4 tinted blue with indigo in the manometer. The rotating cylinder is about 2 m. high, and a quantity of heat of not more than 8.76 grammes-calories, imparted by radiation or otherwise to the air in A, makes the cylinder rotate 360° , and the level of the liquid in the manometer sink 1.84 m.¹ The volume of A was 400 c.c., and the initial pressure equal to 1000 mm. (of mercury). But for scientific measurements I cannot recommend this method. The sulphuric acid *adheres* to the glass tube, and does not take up its definitive level *at once*, the dimensions of the apparatus become inconveniently large, the co-ordinate p cannot be traced out on the paper of the cylinder directly from the isothermic equation,

$$pv = RT_0,$$

but must be recalculated with the aid of some corrections arising from the influence of the atmospheric pressure upon the columns of liquid in the manometer and in D, too complicated to be mentioned here.

Fig. 4 shows a kind of calorimeter which realises the condition of isothermic dilatation of the air in the most simple manner and still is capable of the most accurate measurements.

A and A_1 are very thin glass vessels fabricated of equal shape and size by Franz Müller in Bonn. Both contain dry air over mercury, which stands at equal height in B and B_1 . If the graduated glass tube D, which communicates with A and A_2 through a caoutchouc tube, is raised or lowered by means of the arrangement shown in the figure, the level of the mercury rises or sinks equally in B and B_1 , and the air in A and A_1 is compressed or dilated equally, provided that the temperature is kept *constant* in both. This condition is realised in A_1 by the surrounding large mass of water, which imparts to the air and mercury in A_1 and B_1 its own constant temperature. The air in A_1 therefore always expands or contracts *isothermically*. If its initial volume and pressure are denoted by v_0 and p_0 , the law of Mariotte,

$$vp = v_0 p_0,$$

will always regulate the expansion of the air in A_1 . It is easy to see that this will also be the case in A, if the experi-

¹ i.e. theoretically. This height is somewhat reduced by the corrections for the pressure, &c.

² Uncorrected.

³ I think the thing will be very difficult to realise in this way. If another indicator could be substituted for the galvanometer, for example, the Lippmann capillary electrometer in the ingenious form devised by Chr. Lovén, the experiment would be very easy. But, unhappily, this instrument is insensible to thermo-electric currents.

ment is conducted so that during the dilatation of the air in A and A_1 the index of the differential thermometer γ , which combines both instruments, is kept constant. Suppose then a beam of heat rays to fall upon a thin piece of platinum foil¹ in A through the glass wall. The immediate effect of radiation is to elevate the temperature of the air in A, but as an increase of only 0.0016 of a centigrade causes a displacement of the differential index γ of 1 mm,² it is easy for the operator to compensate this tendency and transform the heat into work by lowering the graduated tube D, which makes the air in A and A_1 expand. This expansion is *isothermic* in both, because volume and pressure varies in the same way in A as in A_1 , where it, as shown formerly, follows Mariotte's law.³ The rate of expansion of the air is indicated by the rise of the mercury in the calibrated tube D. The sensibility of the differential index is so great that it requires a very steady hand to regulate the movement of D so that the index keeps constantly at its initial point, without making greater excursions to either side than 1 or 2 mm. Every irregularity in the movement changes the isothermic expansion into adiabatic dilatation or compression. I therefore prefer to regulate the sinking of D by means of a screw. During the experiment A must be protected by isolating screens, &c., from outward disturbing thermal influences. I think I have realised this in a satisfactory way, but as a detailed account of the arrangement would be too long, I must reserve the complete description for a future paper.

Lastly I will mention some examples of determinations of the radiant heat emitted by a regulation gas-burner at 22.5 cm. distance from A. The radiation was admitted through a screen with an opening of $4\frac{1}{2} \times 2\frac{1}{2}$ cm. The initial volume of the air in A^4 was 622.22 c.c. The pressure was brought to 760 mm. Experiment I. was made at noon, 11. in the afternoon of the same day.

Experiment I.—Increase of volume by expansion during 6 minutes = 185.9 c.c. Mechanical equivalent of the radiation during 6 minutes = 1.680 M.K°. Mechanical equivalent of the radiation during 1 minute = 0.280 M.K°.

Experiment II.—Increase of volume, &c., during 5 minutes = 158.5 c.c. Mechanical effect of radiation in 5 minutes = 1.459 M.K°. Mechanical effect of radiation in 1 minute = 0.291 M.K°.

I have measured in this way the mechanical effect of radiations, the caloric energy of which was only 0.08 of a gramme-calorie in the minute. *This method is free from every kind of correction.* It is obvious that, by means of a thin test-tube hermetically inserted into A, calorimetric determinations of specific heat, &c., could be made, but I have not yet arranged the apparatus for this purpose.

OTTO PETERSSON

Stockholms Högskolas Laboratorium, June 25

NOTES

THE Government have directed Dr. Klein, F.R.S., and Dr. Heneage Gibbes, to proceed to India to pursue a scientific inquiry into the nature of cholera. It is understood that these gentlemen will act in conjunction with the Commission nominated a few weeks ago by the Indian Government for the same object.

At the meeting of the Council of the Marine Biological Association on Friday, July 25, Prof. Moseley in the chair, the names

¹ It is blackened in the following way. It is galvanically coated with a thin layer of metallic copper, and afterwards heated in a current of oxygen. This arrangement gives most sensitive indications.

² This is the case in the apparatus constructed by the author. The index there consists of a small drop of coloured alcohol. If H_2SO_4 is substituted for the alcohol, the sensibility of the apparatus is lessened considerably.

³ In my last constructed apparatus I have substituted a vessel of thin copper instead of the upper part of the glass vessel A_1 . This arrangement answers the purpose excellently.

⁴ And also in A_1 , which is of the same size. This condition is, however, by no means indispensable. A_1 can be greater or smaller than A, only the dimensions of A and A_1 , B and B_1 are proportional to each other.

of Prof. Allman, F.R.S., and Sir John St. Aubyn, Bart., M.P., were added to the list of Vice-Presidents, and Mr. Spence Bate of Plymouth was elected on the Council. It was decided that, provided certain arrangements promised by a committee of the Town Council of Plymouth were carried out, the Association should proceed to erect its first laboratory on Plymouth Sound. Plymouth is not only the best position for the laboratory on account of its natural features, but the local committee has offered to the Association a free site on the seashore and a subscription of 1000*l.* A vote of thanks to H.R.H. the Prince of Wales for having become the Patron of the Association was carried. The financial prospects of the Association were reported as highly satisfactory. The building of the laboratory will probably be commenced in the spring.

The eighth International Medical Congress is to be held in Copenhagen from August 10 to 16. President, Prof. Dr. P. L. Panum; Secretary, Dr. C. Lange, both of Copenhagen. Among the most eminent of the 658 medical men who have engaged to attend are:—Prof. Lister, Sir William Gull, Bart., Prof. Dr. L. Pasteur, Prof. Paul Bert, and Prof. Dr. R. Virchow.

THE Congress of the British Medical Association opened in Belfast on Tuesday. Prof. Canning directed his presidential address mainly to an analysis of the origin and causes of the spread of epidemic diseases.

THE prospectus has just been issued of the new "Società di Geografia ed Etnografia," founded in Turin in anticipation of the Italian Geographical Congress, which meets in that city on August 15. The Congress is a passing event, but the Society has probably a brilliant career before it, established as it is under the auspices of Prof. Guido Cora, its first President. The well-known *Cosmos* of the distinguished geographer becomes the authorised scientific *Journal* of the Society, a happy arrangement which cannot but prove mutually beneficial. In other respects everything is for the present provisional, and the council, including besides Sig. Cora such names as those of Luigi, Schiaparelli, Enrico Morselli, and Alessandro di Cesnola, holds office only till the beginning of next year, when the statutes will be definitely settled, and a permanent administration established. Meantime it is satisfactory to find that ethnology, a branch of geographical science so strangely neglected by existing geographical institutes, is to receive all due prominence and encouragement. Another important feature is the attention to be paid to commercial and industrial geography, especially as regards Italy in its relations with foreign countries. This idea also, *mutatis mutandis*, might be advantageously adopted by similar learned bodies elsewhere.

THE *Bollettino* of the Italian Geographical Society for July publishes the circular, regulations, and programme of the first Italian Geographical Congress, which meets in Turin from the 15th to the 19th of next August under the presidency of the President of the Italian Geographical Society. All except honorary members to be specially named will be expected to contribute towards the expenses sums varying from ten to thirty francs. In return they will have free access to all the scientific gatherings, and will be entitled to a copy of the *Proceedings* of the Congress. There will be two Sections—a Scientific and Commercial, and questions will be discussed in connection with mathematical, physical, ethnographic, political, economic, and historic geography. Amongst the subjects proposed for discussion are the following:—"What ethnological conclusions are to be drawn from the more recent anthropological and philological data, regarding the indigenous populations of East Africa?" "Considering the part already taken by Italy in scientific exploration in the Polar seas, what are the best means of organising an independent Italian expedition to the Antarctic regions?" "On the need of preparatory schools for training

travellers in the work of exploration." "On the best means of turning to better account for science and commerce the work of Italian explorers." "On the importance of establishing commercial stations in the Barbary States as a means of gaining access to the Sudan"; and "On Geographical Education."

MR. RIVETT-CARNAC sends us a handy reprint of his valuable paper "On the Stone Implements from the North-Western Provinces of India," originally published in the *Journal* of the Asiatic Society of Bengal. The striking resemblance that the remains of the Palæolithic and Neolithic ages bear to each other wherever found in the Old and New Worlds, has often been commented on, and receives fresh illustration from the three plates of celts, arrowheads, hatchets, hammers, weights, and other objects, accompanying the brochure. These specimens are lithographed from photographs, and all made to scale, whereby their value is greatly enhanced for the comparative study of similar objects elsewhere. It is pleasant to learn that the best specimens have all been presented to the British Museum, while casts of some unique types peculiar to India have been made for the chief museums of India, Europe, and America, and even for some private persons interested in prehistoric research.

EVEN in Rome the aerial disturbances caused by the Krakatoa explosion were clearly indicated on the registering barometers. On examining the curves of the Richard barograph Prof. Tacchini found that, although the daily curves followed regularly in accordance with the normal barometrical conditions in Europe, those of August 27, 28, and 29, 1883, betrayed slight indentations, which, without changing the daily record of the pressure, show that for short intervals its precision oscillated abruptly, owing to the passage of the above-mentioned waves. These barometrical oscillations occurred at the following times:—12.7 of the 27th, 5.6 a.m. of the 28th, 1.48 a.m. of the 29th, and, lastly, about 4 p.m. of the same day. The time of the volcanic explosion was determined by Tacchini by the report of S. Raffo, captain of the Genoese brigantine the *Adriatic*. S. Raffo states that during the night of August 26–27 continual peals were heard, and that at eight o'clock next morning he heard one of extraordinary violence, accompanied by a shock to the vessel, which was then in 10° S. lat. and 105° E. of Greenwich. Tacchini accordingly concludes that the time of the explosion corresponded with 1.30 a.m. of the 27th at Rome. From these data he finds that the wave reached Rome from Krakatoa by the west, leaving the volcano at a velocity of 277 m. per second, and that moving in the opposite direction at a velocity of 296 m. He further calculated by the observations made at Rome that the complete atmospheric circuit round the globe was effected by the east, leaving Rome at a velocity of 295 m., and of 318 m. by the west. Captain Raffo has forwarded to Rome a quantity of the dust collected on board the ship on that day.

WE learn from *El Liberal* of Madrid, July 23, that D. Auguste Arcimis has been observing sunset phenomena very similar to those witnessed last autumn and winter. He has besides noticed an extremely brilliant silver-white corona around the sun, having a horizontal diameter of about 48°.

THE Afghan Frontier Commission will, we are glad to learn, include a geologist and native botanist, as well as three surveyors. But, as Mr. Sclater suggests in the *Times*, it is to be hoped that the scientific staff will also include a zoologist or at least a zoological collector. Mr. Sclater writes:—"The country to be passed through by the Afghan Frontier Commission, although probably in the main part bare and arid, is of the deepest interest to zoologists, as being situated nearly on the boundaries of the Palæarctic and Oriental regions. The numerous Russian and American Surveys which have been sent out of late years with

similar objects have always given a place in the scientific staff to zoology as well as botany and geology. There is no reason, it seems to zoologists, why our Government should not follow such an excellent example, especially when there will be no difficulty among the numerous Indian officers who are now interested in zoology in finding a suitable person. Let me, therefore, express a hope in the name of British naturalists that a zoologist will be added to the 'scientific staff' of the Afghan Frontier Commission."

WE are glad to notice that the new St. Paul's School at Hammersmith includes physical and chemical laboratories.

IN a lecture on the Olympic Festival by Dr. A. Emerson at Johns Hopkins University, the lecturer stated that in the Olympic games uniform training, early registration, and fair play were required of the athletes, under penalty of exclusion, or, if fraud was discovered too late, of heavy fines. Dr. Emerson gave the following as the ancient and modern records of running and leaping:—

Day's run: Good Greek record, 150 km.;
 Good modern record, 168 km.
 Long running jump: Best Greek record, 55 feet;
 Best modern record, 49 feet (Engl.) 3 inches.

As the victors in the horse-races, Dr. Emerson stated, were the registered owners of the animals, such victories could be and often were won by women.

MR. H. M. STANLEY arrived in England from the Congo on Monday.

THE Bangkok Correspondent of the *Times* telegraphs that Mr. Holt Hallett and his party have reached Bangkok after an arduous expedition, lasting five months and thirteen days, from Moulmein to Bangkok through North Siam. Mr. Hallett succeeded in reaching his destination, though severely fatigued. He will return and spend one month in England, and it is hoped that the sea voyage will recruit his health. On his arrival in London he will submit a preliminary report to the Chambers of Commerce and the Geographical Society, and will return and continue the surveying operations in November. The work completed comprises the surveying of over 1500 miles, the determination of the position of the Shan ranges, and a large series of observations on the vocabularies of the aboriginal races and the histories of the several Shan States. A mass of information throwing light on the interior of Indo-China, especially of North Siam, was gathered. The reception of the expedition was from first to last excellent. This fact was due mainly to the favourable attitude of the natives and the tact and conciliation of the leader.

THE Norman coast of the Kola peninsula will be visited this summer by several explorers. MM. Enwald and Edgren will investigate its natural history; M. Kuschleff the fishing along the coast; M. Hartzenstein has undertaken researches into the fauna and flora of the neighbouring sea; M. Istomin is engaged in ethnographical researches; and M. Abels, of the Central Physical Observatory, is now at Archangel, in order to establish meteorological observatories in the north.

AT Forio, in the island of Ischia, a powerful shock of earthquake was felt on the 23rd inst. The tremor was proceeded by loud subterranean rumbling like thunder, or the roar of artillery. The exact time when the event took place was twenty minutes to one o'clock p.m. Fortunately, the phenomenon lasted but momentarily, and passed off without doing any material damage to property, or causing any loss of life. An earthquake also occurred at Massowah on the 24th. Nearly all the houses in the town were destroyed or damaged by the shock. All the ships in the harbour were seen to rock violently.

THE employment of acupuncture and cauterisation by Chinese doctors forms the subject of an article in one of the last numbers

of the *North China Herald*. A native public writer not long since claimed that a skilful physician in this department of medicine could cure such diseases as imbecility, fits, cholera, &c. The principle of cauterisation is simply that of counter-irritation; and the English writer bears personal testimony to its efficacy in the case of a slight sunstroke, although the operator was a simple Manchu peasant, and instrument a couple of copper coins. Very extraordinary cures are attributed to acupuncture by the Chinese. It is first performed in the hollow of the elbow of each arm. If the puncture draws blood there is no danger, but if no blood appears the case is regarded as very grave. But before abandoning the sufferer, puncture of the abdomen is tried. Seizing a handful of flesh, the operator drives the needle right through it, and then draws it backwards and forwards a few times. If the patient manifests any sense of pain, or if any blood is drawn, a poultice of eggs and buckwheat flour is applied over the puncture, and recovery is regarded as almost certain; but if no pain is felt and no blood flows, the case is declared hopeless, and the sufferer is left to die. The case is then quoted of a young Chinese, educated abroad, who was attacked with cholera; his extremities became cold, and cramp set in in a somewhat alarming manner. The barber-surgeon who was called in commenced by running a needle into the pit of the patient's stomach, a jet of very dark blood following; he then punctured the calf, the two breasts, and the forehead of the sufferer, freeing a certain quantity of blood at each prick. The relief is said to have been instantaneous, and in two days recovery was complete. The Chinese explanation of this treatment is that, when the blood is in the poisoned condition which induces the choleraic symptoms, it becomes thick, and accumulates in certain portions of the body. A clever surgeon knows exactly how to put his finger on the particular spots, and, by skilfully "opening the mouth of the heart," as the operation is called, sets free the poisoned fluid which causes all the mischief. It is noteworthy that faith in the efficacy of this mode of treatment is not confined to the masses, but is shared by Chinese who have been abroad and have had ample experience of Western medical practice.

MR. JAMES HOPPS, Indian Engineering College, Cooper's Hill, writes us with regard to his paper on the electric resistance of metals, read before the Physical Society (*NATURE*, vol. xxx. p. 283), that an increase of resistance on uncoiling, and a decrease on coiling takes place with lead, copper, German silver, aluminium, and magnesium, and also during the first few operations on soft iron. An increase almost invariably follows coiling and uncoiling with zinc, but the effects of coiling vary from $\frac{1}{2}$ to $\frac{1}{10}$ of the effects of uncoiling. The full paper will appear in the Society's *Proceedings*.

THE additions to the Zoological Society's Gardens during the past week include a Malbrouck Monkey (*Cercopithecus cynosurus* ♂) from West Africa, presented by Mr. J. H. Harling; a Cape Sea Lion (*Otaria pusilla*) from South Africa, presented by Mr. John Hunt; two Daubenton's Curassows (*Crax daubentoni* ♂ ♀) from Venezuela, a Common Guinea-Fowl (*Vumida meleagris*), British, presented by Mr. W. Burch; two Indian Kites (*Milvus govinda*) from Eastern Asia, presented by Mr. W. Jamrach; a Barn Owl (*Strix flammea*), European, presented by Mr. G. H. Garrett; three Angulated Tortoises (*Chersina angulata*), two Geometric Tortoises (*Testudo geometrica*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; two Smooth Snakes (*Coronella levis*), European, presented respectively by Mr. W. H. B. Pain and Mr. F. H. Jennings; two Black-tailed Deer (*Cariacus columbianus* ♂ ♀) from North America, two White-backed Piping Crows (*Gymnorhina leucornota*) from Australia, two Common Cormorants (*Phalacrocorax carbo*), British, deposited; two Red-capped Parrots (*Pionopsitta*

pileata) from Brazil, a White-bellied Sea-Eagle (*Haliaeetus leucogaster*) from Australia, a Mohr Gazelle (*Gazella mohr* ♀) from North Africa, a Violet-necked Lory (*Eos rinciniata*) from Moluccas, a Black Tortoise (*Testudo carbonaria*), a Common Boa (*Boa constrictor*) from South America, two Electric Eels (*Gymnotus electricus*) from British Guiana, purchased; three Elliot's Pheasants (*Phasianus elioti*), bred in England; a Mule Deer (*Cariacus macrotis*), a Mesopotamian Fallow Deer (*Dama mesopotamica* ♂), born in the Gardens.

OUR ASTRONOMICAL COLUMN

SCHMIDT'S VARIABLE-STAR IN VIRGO.—On June 6, 1866, Schmidt remarked, east and south of Spica, a star which he at first estimated 4 m., subsequently 5'4, not found in Argelander's *Uranometria*; it was much better visible than *i* Virginis, the reddish-yellow fifth magnitude south of Spica. By observations during the next fortnight its light appeared to have slowly diminished, nevertheless on June 19 it was still visible with the naked eye, though there was strong moonlight. On examination of the catalogues, &c., it was found that Lalande estimated it 6'7 on May 10, 1795; Piazzini calls it 6'7 and 7 in the *Storia Celeste*, not 8 as in the printed catalogue; Bremicker entered it of the seventh magnitude on his Berlin chart, while Lamont calls it 8 m. in Zone 355, observed on May 22, 1846. Heis has it 6'7, while Gould says, "Var. 5½-6½." Houzeau judged it a sixth magnitude at the date 1875.11. We have thus evidence that it has been pretty conspicuously visible to the naked eye, while, on the authority of Bremicker and Lamont, it has been at other times beyond average unassisted vision.

Schjellerup has raised a point of much interest in connection with this star. There has been a difficulty in identifying satisfactorily Ptolemy's 19th star in Virgo, which he calls a fifth magnitude (ϵ in his notation). Baily, in his notes to his edition of Ptolemy's Catalogue, published in vol. xiii. of the *Memoirs* of the Royal Astronomical Society, writes: "The star 68 Virginis agrees with the position given by Ptolemy; but it is difficult to make it accord with the description, as being in the 'latus sequens' of the quadrilateral figure." Schjellerup, in his translation of Süfi, remarks: "A l'endroit où, selon la description détaillée que nous a fournie Süfi, doit se trouver la 19^e étoile, il n'y a aucune étoile aujourd'hui visible à l'œil nu, selon *Uranometrii Nova* d'Argelander, pendant qu'il s'accorde très-bien avec celui de Lalande 25086, étoile qui est entre la sixième et la septième grandeur. En faisant la revision de cette note, je me rappelai l'étoile variable au sud-est de α Virginis, dont nous a donné avis M. Schmidt dans le nr. 1597, *Astronomische Nachrichten*. Quelle ne fut ma surprise en m'apercevant de l'identité entre cette variable et la 19^e de Süfi?"

This identification, however, is hardly so certain as may at first sight appear. Schmidt's star is in the Greenwich Catalogue for 1872, which gives its position for 1880'0—

Right Ascension 202° 4'4 ... Declination -12° 35'9

Ptolemy professes to have reduced his catalogue to the first year of Antoninus, A.D. 138, though it is well known that his longitudes are in defect to the amount of about 1° for that epoch. Unfortunately, for the 19th star of Virgo, though the longitudes agree, the latitudes given in the various editions of the *Almagest* and by Süfi are materially different. Baily has it -3° 0', with a note that in the Venice edition in Latin by Liechtenstein, in 1515, it is +0° 20', which he thought might arise, as regards the difference in amount, from mistaking γ for γ' . While in the two manuscript copies of Süfi (who adopted the positions of the *Almagest*, adding 12° 42' to the longitudes) the latitude is -1° 20'.

To reduce the Greenwich position for 1880 to the year A.D. 138, we have in the usual notation—

$$A = 168^{\circ} 47' 3 \dots A' = 191^{\circ} 0' 8 \dots \theta = 9^{\circ} 40' 6;$$

with which the position for Ptolemy's epoch is found to be—

Right Ascension ... 179° 36'0 Declination ... -3° 5'4;
and assuming the obliquity of the ecliptic to be 23° 41'8, we have—

$$\text{Longitude} \dots 180^{\circ} 53' \quad \text{Latitude} \dots -2^{\circ} 59'$$

The longitude of the 19th of Virgo is apparently 178° in all the editions of the *Almagest*, and the latitude differs 1° 39' from that assigned in the manuscripts used by Schjellerup.

If we similarly reduce the Greenwich position of 68 Virginiæ to Ptolemy's epoch, we find—

Longitude ... $178^{\circ} 53'$ Latitude ... $- 3^{\circ} 14'$

and Baily's identification of the 19th of Virgo would thus appear the more satisfactory, at least if the reading he has adopted for the latitude is admitted; still there is the difficulty pointed out in his note which is given above; 68 Virginiæ is estimated a sixth magnitude both by Argelander and Heis.

In 1879 Mr. S. W. Burnham discovered that this star is a very close double, the mean of his measures giving—

1879.39 Position $81^{\circ}.2$. Distance $0''.47$. Magnitude 6.1 and 6.6 .

He remarks that hitherto close double-stars have not been found among the variables. It remains to be ascertained whether, if the variability of Schmidt's star be established, both or only one of the components vary.

A NEW COMET.—A telegram notifies the discovery of a comet by Mr. E. Barnard, on the 16th inst., though, probably from interruption from unfavourable weather in verifying it, the announcement appears not to have been made for several days subsequently. The position given is as follows:—

h. m. s.

July 16 at $15\ 21\ 2$ G.M.T. ... R.A. $237\ 40''$... N.P.D. $127\ 9''\ 52$

It would be well within reach of the observatories of Southern Europe. From a telegram received at Dun Echt, Dr. Copeland conjectures that the comet has been seen at Melbourne, Madras, and Cape Town; Prof. Krüger has no allusion to this in his note in the *Astronomische Nachrichten*. The comet's motion is stated to be slow.

SCOTTISH METEOROLOGICAL SOCIETY

THE half-yearly general meeting of the Society was held on Monday, July 21, in Edinburgh, Mr. Milne Home in the chair.

Mr. Buchan read the report from the Council. As regards the Society's stations, one has been added since last general meeting at Glencarron, in Ross-shire. It has been established by Lord M'Laren, and from its position it is one of the most important additions recently made to the Society's stations. The effort made to increase the membership has been already attended with marked success. The membership now numbers 601. The first number of the new series of the Society's *Journal* is now mostly in type, and will shortly be in the members' hands. It has been arranged that in future the proceedings will appear annually in March. The Council referred with much satisfaction to the successful manner in which Mr. Omond and his assistants carry on the observations on Ben Nevis. The discussion of the past observations shows that paramount importance must be assigned to a continuous record, not only of the barometer, but also of the temperature, humidity, wind, cloud, and precipitation, on account of their intimate relations to the barometric fluctuations and to coming changes of weather. Every effort will therefore be made to secure to science a continuous hourly record of the weather phenomena of Ben Nevis. Arrangements have been made for the completion of the Observatory buildings during the course of this summer. A beginning of the work is made to-day (July 21), and it is expected that the whole will be finished some time before October. The new buildings include a tower, on the top of which will be placed anemometers, specially designed by Prof. Chrystal and Prof. Crum Brown, for registering the direction, velocity, and pressure of the wind, a correct knowledge of which is of supreme importance in carrying on the scientific and practical inquiries aimed at in the establishment of the Observatory. To the expenses connected with the erection of the anemometers a grant of 50*l.* has been made by the Committee of the Government Research Fund. An exit from the building has been made in the upper part of the tower, which will enable the observers to make outside observations during the winter months, on many occasions when they could not otherwise be attempted. The Council regret to intimate that their application to the Treasury for a grant in aid of the establishment of the Marine Station at Granton was not successful. Notwithstanding the refusal of the Government to give assistance, the Marine Station, to which the Society contributes 300*l.* a year from the Fishery Fund, was established in April. There is every probability that the subscriptions from the general public will shortly permit of very desirable extensions being made to the further equipment of the

station. In response to an offer by the Scottish Sea-Fishing and Curing Company, Mr. Pearcey, of the *Challenger* Office, made observations on a cruise in the ship *Energy* in the North Sea, between Shetland and Norway. The specimens obtained during the cruise, and the observations made, are now under consideration.

A paper was read by Mr. Buchan on the meteorology of Ben Nevis, which we hope to give in an early number.

Dr. Arthur Mitchell described a new instrument for collecting continuously any cosmic dust, volcanic dust, or other impurities mechanically suspended in the atmosphere, the essential part of the instrument being a series of filters of fine platinum wires, through which the air is continuously drawn by an aspirator.

A report of the work done at the Scottish Marine Station at Granton was submitted by Mr. J. T. Cunningham, naturalist in charge. He detailed the nature of the work since the opening of the Station in April. The method of working in the yacht *Medusa* was then described. The position of the yacht is ascertained by means of bearings at the time when the dredge or other apparatus is put down or taken up. At these points the depth of the water and the nature of the bottom are ascertained, and various physical observations taken, including the temperature of the air, and that of the sea at the bottom, at the surface, and at intermediate depths; samples of sea water are also secured from different depths. When the dredge or trawl is hauled on deck, the contents are examined and the relative abundance of the animals and Algæ noted down. Some of the specimens are preserved on the spot, and a number of them are brought alive to the Station, and placed in the floating cages or in aquaria in the laboratory, so that they may be more minutely examined in the living state, and form a stock which may be drawn upon for purposes of special research. The products of the fine tow-nets are treated in the same way; a microscope is always on board, and in calm weather the minute specimens can be examined in the cabin. Samples of the contents of the tow-nets are preserved and labelled on board, and the remainder are brought back to the Station alive and examined in the laboratory. The results of one day's work at sea usually provide material for two or three days' work on shore. The work of dealing with the preserved collections, identifying and separating the animals, goes on continuously at the Station. The materials for faunological and systematic zoological work soon became abundant, and in the inquiries continuously carried on special attention is given to identify the numerous kinds of fish spawn, both floating and attached, which occur in the Firth of Forth and neighbouring parts of the sea. In order that the systematic and general work of the Station might not be neglected, the services of Mr. John Henderson as zoologist have been secured. The study of the Algæ has been energetically carried on by Mr. Rattray. The work carried on by Mr. Mill has been chiefly physical. A regular system of meteorological observations, both on land and in the "ark," has been set on foot. Up to the present time three biologists have availed themselves of the opportunities afforded by the Station for research—Prof. W. A. Herdman, University College, Liverpool; Prof. Haycraft, Mason's College, Birmingham; and Mr. J. R. Davis, University College, Aberystwith.

Mr. Hugh Robert Mill read a paper on the tidal variation of temperature at the Marine Station. He detailed the nature of the experiments, these including hourly and half-hourly observations by night and by day on three occasions, extending in all to ninety-seven hours. The results show interesting relations between the temperature, the time of day, and the state of the tide. Without attempting to generalise, the following facts observed in each series of observations may be stated:—The surface temperature rose when the air temperature rose, and fell when it fell, with no very apparent reference to the tides. The curve for bottom temperature also followed that of air temperature, though to a slight extent; but the crest of the heat wave was retarded for several hours, and the tide produced great modifications in the temperature. When the tide flowed early in the morning it cooled the bottom temperature; when it entered at a later hour it raised it. By day the bottom temperature was lower than that of the surface; by night it was equal to it or slightly higher. The causes which produced these various effects must be very complex. The contour of the bottom of the quarry, the rates of influx of the tide, the direction of the currents it originates, the duration and period of the sunshine, the direction of the wind, the heating of the sand by the sun and its cooling by radiation, the heating and cooling of the surface water by radiation, and

the bottom water by conduction and convection, must all be taken into account before a true explanation could be arrived at. It is intended to devote special attention to the effect of radiation on the sand, and of the heated or chilled sand on the tidal water which flows over it, it being probable that it is in this way the key to the curious tidal perturbations of temperature may be found.

THE PHILOSOPHICAL SOCIETY OF GLASGOW

THE *Proceedings* of the eighty-first session have just been published in the form of a volume of 428 pages, and consisting of twenty-four papers, three plates, and a map. The papers are: an address on some of the chemical industries of the country, by Mr. R. R. Tatlock, President of the Chemical Section; on technical education, by Mr. Henry Dyer, C.E.; a discussion of Mr. Dyer's paper, by Mr. E. M. Dixon, B.Sc.; an introductory address on the definition and scope of geography and ethnology, by Dr. W. G. Blackie, President of the Geographical and Ethnological Section; on the use of litmus, rosolic acid, methyl-orange, phenacetolen, and phenolphthalein as indicators, parts ii. and iii., by Mr. Robert T. Thomson; on an easy way of determining specific gravity of solids, by Dr. Dobbie and Mr. John B. Hutcheson; note on Mr. Joseph Whitley's centrifugal mode of casting steel plates for shipbuilding, &c., by Dr. Henry Muirhead, President; notes on Cleopatra's Needle, by the President, on the occasion of presenting a large bronze model of the Needle to the Society; on a new method of measuring the heat-conducting power of various materials, such as cotton, wool, hair, &c., by Mr. J. J. Coleman; on a new thermometer or thermoscope, by Mr. Coleman; on the measurement of electric currents and potentials, by Sir William Thomson; a sketch of the life and work of Dr. Allen Thomson, by Dr. McKendrick; note on modern forms of the microscope, by Dr. W. Limont; on the chief features of the physical geography of China, by Rev. A. Williamson, B.A., LL.D., Missionary in China; on the recent progress of chemistry at home and abroad, by Prof. J. J. Dobbie; on the analysis of commercial carbonate of potash, by Robert Thomson; on a new process for the separation of nickel and cobalt, by Dr. John Clark; on an endless solenoid galvanometer and voltmeter, by Prof. James Blyth; on the chemical composition of the methyl and ethyl alcohols, by Dr. Otto Richter; on the Island of New Guinea, by Dr. W. G. Blackie, illustrated by a map published by permission of the Royal Geographical Society; on the consumption of smoke, especially in great cities, by Mr. A. Pinkerton; on rickets in Glasgow and neighbourhood, and the relation of the disease to food and water used by the inhabitants, by Mr. James Thomson, F.G.S.; and the Graham Lecture by the late Dr. R. Angus Smith, prepared for publication by Mr. J. J. Coleman.

The last paper is probably the most interesting and important of all, inasmuch as it contains many unpublished letters of Thomas Graham, so full of information as to his work and the circumstances in which his work was done that it cannot fail to attract the notice of all engaged in physico-chemical research. The paper has a mournful interest also as being the last from the late Dr. R. Angus Smith. It will be published separately, in a small volume, for the use of those who desire to have a memorial of Thomas Graham.

The Society has a membership of 690. Its work is carried on not only by the parent Society, but by five sections—Chemistry, Biology, Architecture, Sanitary Science and Social Economy, and Geography and Ethnology.

SCIENCE IN RUSSIA

THE Kazan Society of Naturalists continues its useful work of exploration. The last volume of its *Memoirs* (*Trudy Obshchestva Estestvoispytateley pri Kazanskom Universitate*, vol. xii.) contains two papers by the late M. Shell, on the botanical geography of the provinces of Ufa and Orenburg, being a list of 1054 Spermatophores already known from these two regions which have an intermediate flora between that of South-Eastern Russia and that of the Caspian Steppes. A most useful addition to the knowledge of the flora of these provinces is contained in the second paper by the same author, which gives a list of no less than 511 species of Sporophores (28 Vascular plants, 49 Mosses, 2 Charæ, 181 Algae, 94 Lichens, and 157 Fungi). The importance of this addition may be seen from the fact that, before

M. Shell's work, only 39 species of Sporophores were known from these two provinces. It is worthy of notice that M. Shell has found among the Algae the *Asterionella formosa*, Hassel, which has been discovered in England and was found on the Continent only by Brébisson in France, and by Heiberg in Denmark. The death of M. Shell in 1881 at Vilno was a great loss to Russian science. In the same volume M. Bekarevitch publishes his "Materials for the Flora of Kostroma," being a list of 514 species of Phanerogams and 18 Cryptogams. M. Flavitzky publishes his researches into the pitchers of different Conifers. The author has studied the deviations of their planes of polarisation, and has found that the value of the angle of deviation is quite characteristic for different pitchers; it varies from $-42^{\circ}2$ (*Pinus abies*) to $-13^{\circ}1$, $-10^{\circ}9$, and $-9^{\circ}6$ for the *Pinus sylvestris*, *P. cembra*, and *Abies sibirica*, and from $+9^{\circ}1$ to $+27^{\circ}2$ for the *Abies balsamea* and *Larix europea*. We must notice also the elaborate researches, by A. Dogel, into the structure of the retina of the Ganoid fishes. These researches fill a gap which was pointed out many times; they are accompanied by excellent plates engraved at Leipzig.

The minutes of proceedings (*Protokoly*) of the same Society are especially interesting for mathematicians, as they contain a number of notes by MM. Maximowitch, Klark, and others. They are followed by papers on the motion of liquids in elastic tubes, by Prof. Gromeka; on the ichthyology of Kazan, by N. Varpakhovsky; and on the dangerous insects of Samara, by E. Peltam.

The new volume of the *Memoirs* of the Kharkoff Society of Naturalists (*Trudy Obshchestva Ispytateley Prirody pri Khar'kovskom Universitate*, vol. xvii.) contains a paper by N. Koulchitzky, on the structure of the "Grandry corpuscles," being a description of that special form of corpuscle by which the nerve is terminated in the tongue of the duck, which M. Grandry distinguished in 1869 from the corpuscles of Herbst (or Pacini's with other animals). The paper is accompanied by three lithographed plates. M. Byeletzky's posthumous paper, on the physiology of the aerial or natatory bladder of fishes is a very elaborate memoir on this subject. The author, who has taken notice of nearly all the researches made in the same direction during more than a century, gives a detailed anatomical sketch of the bladder, and a summary of all known as to its contents. His own researches have been made on fifty-four individuals belonging to the following six species:—*Cyprinus carpio*, *Carassius vulgaris*, *Tinca vulgaris*, *Abramis brama*, *Idus melanotus*, and *Perca fluviatilis*. The gases contained in the bladder are: nitrogen, from 81 to 96 per cent. of the whole (sometimes even 98); oxygen, mostly less than 10 per cent., and very seldom from 15 to 20 per cent.; and carbonic acid from 2 to 5 per cent., falling to 0.6, and very seldom reaching more than 7 per cent. The contents of carbonic acid depends very much upon the conditions which the fish has been kept in before the experiments; but it stands in no correlation at all with the contents of oxygen. The amount of both may be simultaneously small, or greatly above the average. As to the origin of the gases in the bladder, the author indorses the views of Configliachi (Schweigger's *Journal für Chemie und Physik*, Band i, 1811), and concludes that they are not indebted for their origin either to digestion or to the supposed "swallowing" of air on the surface of the water; individuals kept for months under water, without having the possibility of reaching its surface, having been found to have the same composition of gases in the bladder as free individuals. It would rather seem that, with the raising of the fish on the surface, which is accompanied by a diminution of atmospheric pressure, a part of the gas is expelled from the bladder. The most probable origin of the gases in the bladder seems to be—Configliachi said—that the air contained in the water and entering into the mouth of the fish is in some way (perhaps in that pointed out by Erman) eliminated from it; it is dissolved in the blood of the gills, and the oxygen is slowly assimilated by the blood; while the remainder, that is, nitrogen and some oxygen which has remained dissolved, are secreted from the blood into the bladder. This is also the opinion of M. Byeletzky, who considers that blood, as also the lymph, is the source whence the gases of the bladder originate. Contrary to Configliachi's opinion, they are not secreted, however, by the "red corpuscles," but rather by the capillary vessels of the mucous membrane of the bladder; such was also the opinion of Rathke and Johann Müller; however, the argument by which they tried to establish this view cannot be longer held. In

a paper on the microscopic structure of the coal of the Doltz basin, M. Jenjourist shows that the coal contains remains of Sigillariæ and Lepidopendrons, while several Russian geologists are inclined to consider it as having originated only from marine Algae. M. Dybovsky contributes to this volume a description of a new species of fresh-water sponge from Southern Russia, which is closely allied to the *Dosilia baileyi* of Mr. Carter, and to which he gives the name of *Dosilia stepanowii*; it is figured in a plate. Finally, M. Shevreff gives a list of *Hymenoptera terebrantia* of the Governments of Kharkoff and Poltava; and M. Yaroshevsky publishes his fifth supplement to the list of Diptera of Kharkoff.

The last two volumes of the *Memoirs* of the St. Petersburg Society of Naturalists (*Trudy Sanktpeterburgskago Obschestva Estestvoispytateley*, vol. xiii. fasc. 2, and vol. xiv. fasc. 1) contain, besides the minutes of proceedings (which unhappily do not go further than March 1883), several valuable papers. Geology is the most favoured branch. Thus we find in vol. xiii. an interesting paper on the waterfalls of Northern Esthonia, by P. N. Vemikoff. The orography of the country whose Silurian deposits are cut towards the north by the abrupt terrace of the Glint, the lower parts of which contain looser strata easily destroyed by the water (as in the Niagara), favour the development of waterfalls, the chief of which are described by the author. In the same volume MM. Koudryavtseff and Sokoloff publish a geological description (with a geological map) of the district of Kromy in Orel. The Quaternary formations are represented by the "black earth," loess, and mighty sheets of boulder-clay which cover the chalk, the Jurassic clays, containing sphaeroiderite, and the Devonian limestones, marls, and dolomites, appearing in the north. The paper is accompanied with a map on a large scale. In vol. xiv. we find a very interesting orographical sketch of the Kola peninsula, by N. Koudryavtseff. The author has devoted much attention to the leading features of this tableland, and the modifications its surface has undergone under the action of the ice-sheet of the Glacial period. The structure of the mountains; the parallelism of the valleys; the glacial erosion, which has covered the whole of the country with numberless depressions running in the direction of the glacial striation, and producing what might be called "telescopic striation"; the finer glacial striae, which run north and south, or north-north-west to south-south-east; the "glacial landscape" of the country; and finally its upheaval, are dealt with by the author. Several indications led the author to admit that the peninsula is rapidly rising up, the surest of them being the find of colonies of *Balanides* at a height of 8 metres above the sea, and the discovery of the *Buccinum undatum* (which still inhabits the White Sea), together with broken shells of Brachiopoda and Lamellibranchiata, about 280 feet above the present sea-level, at Kandalaksha. N. A. Sokoloff contributes to the same volume a note (with a plate) on the find of teeth of *Mastodon arvernensis* in the Crimea, at Zamruk, which would imply a wider extension of Pliocene in the yet unexplored steppes of the peninsula; and on the find, also in the Crimea, of teeth of *Hipparion gracile*, which was so widely spread during the Tertiary period from the prairies of the Missouri to the Himalayas. We notice also a note by P. P. Kudryavtseff, on prehistoric man on the Oka; and another note by M. Polyakoff on the bottom-moraine at Wiborg, in Finland.

In other branches of science we have to mention a sketch of the Phanerogam flora of the Government of Minsk, by W. Paszkewicz (vol. xiii.). It contains 958 species, the whole number reaching probably about 1000; 40 of them are new for this region. In vol. xiv. we find a note by M. Szihowsky on the chemical constitution of different parts of the *Zea Mays*, and two preliminary reports, botanical by A. Krasnoff, and zoological by A. Nikolsky, about explorations in the Altai Mountains. The collections of 720 Phanerogams and 100 Cryptogams, which have been brought in by M. Krasnoff, will surely yield interesting data. As to M. Nikolsky, he gives a lively sketch of the fauna of the Altai, followed by a list of observed species: 50 mammals, one of which, *Talpa altaica*, is new; 169 birds, a few reptiles and amphibia, and 16 fishes. A plate gives the comparison of the *T. altaica* with the *T. europea*.

RECENT MORPHOLOGICAL SPECULATIONS¹

III.—Non-segmented Animals

THERE are certain groups of animals about whose systematic position naturalists never seem able to remain long agreed. These groups are changed from place to place in our schemes

of classification; and often each new discovery seems to confute a current theory only to confirm that which preceded it. More than any other groups, the Polyzoa, Brachiopods, and Mollusks have been shifted from point to point, and it seems almost too much to expect that they have even now found a permanent resting-place.

The Polyzoa were brought into connection with "Mollusks" more than fifty years ago, when Milne-Edwards exhibited their supposed affinities with Ascidians, and their Molluscan affinities were more fully admitted when Von Siebold compared the Polyzoan lophophore and tentacles with the arms of a Brachiopod. Milne-Edwards, in combining Polyzoa and Tunicates in his new group Molluscoida, argued the identity of the type in every detail of structure, and Huxley ("English Cyclopædia," 1855), laying more weight than previous writers had done on the affinities of Polyzoa with Brachiopods (as Mr. Albany Hancock was perhaps the first to suggest) definitely included this last class also in the group Molluscoida. The Brachiopods seemed, in the light of that time's knowledge, to take a very natural position among the "neural Mollusks," between the Polyzoa on the one hand and the Lamellibranchs and the Pteropods on the other (*Proc. Roy. Soc.* 1854, p. 117).

But in the course of the next ten years Kowalevsky's discovery of *Loxosoma* seemed to supply a link between the Polyzoa and Worms, and Gegenbaur, and afterwards Haeckel, emphasised this relation, and finally included the Polyzoa in the latter group. The Tunicata had by this time obtained, through Kowalevsky's researches, an established position far removed from their former allies in the "Molluscoida," and Gegenbaur now analysed more critically the differences between Polyzoa and Brachiopods, and (denying that either had any affinity with Mollusks) maintained the eminently isolated position of Brachiopods, and asserted that their arms could no more be compared with the tentacles and lophophore of Polyzoa than these could with the branchial tufts of the Tubicolæ. The discovery by Kowalevsky (1874) of the apparently segmented larva of *Argiope*, &c., seemed to reveal almost obscured genetic relations with the Chætopods, and at the same time Morse, working chiefly on *Lingula*, argued elaborately that the Brachiopods are much modified Annelides. Ray Lankester, on the other hand, upheld the Molluscan affinities of both Polyzoa and Brachiopods, and Huxley, in his "Anatomy of Invertebrates," kept the three groups in close juxtaposition. Lankester compared *Rhabdopleura* minutely with the embryo of *Pisidium* (*Phil. Trans.* 1874), and maintained the common origin from a primitive ciliated girdle of the gill-filaments of Lamellibranchs, the lophophore of Polyzoa, the arms of Brachiopods, the tentacles of *Phoronis*, the velum of embryo Mollusks and of Rotifers, and the ciliated proboscis of *Gephyrea*. Huxley ("Invertebrates," p. 674), influenced on the one hand by Lankester, and by Steenstrup and Morse on the other, proposed to combine Polyzoa and Brachiopods under the name *Malacostracoides*, to indicate relationship both with Mollusks and with Worms. Lastly, Caldwell (*P. R. S.* 1882), by his researches on *Phoronis*, has thrown new light on the structure of both Polyzoa and Brachiopods, and, in Lankester's words ("Encycl. Brit.," Art. "Mollusca," 1884), "has established the conclusion that the agreement of structure supposed to obtain between Polyzoa and true Mollusca is delusive; and accordingly they, together with the Brachiopoda, have to be removed from the Molluscan phylum."

We may examine this last important view more closely, and try afterwards to discuss the probable ancestry of these three much-debated classes.

Actinotrocha, the larva of *Phoronis*, is, according to Caldwell, a perfect and typical trochosphere. The larvæ of Brachiopods and Polyzoa are trochospheres in which, by a shortening of the "dorsal" surface, mouth and anus have been approximated, and the ventral surface has been enormously distended. The same change takes place, and to an even greater extent, in the "metamorphosis" of *Phoronis*: the adult animal has both mouth and anus situated at one end of a long body; the line joining them is the contracted dorsal surface; an epistome, said to be the persistent præ-oral lobe of the larva, lies between mouth and anus; a lophophore, whose new tentacles are added on either side of the median dorsal line, surrounds the mouth; within its concavity, on either side of the anus, lie two ciliated pits, whose homologue is found in *Rhabdopleura*. A single pair of nephridia exist. The body-cavity is traversed by mesenteries, one of which is ventral, and attaches the outside of both descending and ascending limbs of the alimentary canal to the body-wall; two are lateral, and pass from the side of the stomach to the body-wall, dividing the

¹ Continued from p. 227.

cavity into two anterior chambers and one posterior; and lastly a transverse septum shuts off the space within the epistome and tentacles from the rest of the body-cavity. The nephridia open into the posterior chamber of the body-cavity on the sides of the lateral mesentery. At no stage, either in the embryo or the adult, is any trace to be found of segmentation.

The parallelism between Phoronis and Brachiopoda is full and clear. An ectodermal post-oral nerve-ring exists in both. The body-cavity of the præ-oral lobe is in both separated from the rest of the body-cavity by a septum. The tentacles are arranged and developed similarly in both. In both the nephridia have the same relations and the alimentary canal is divided into the same four parts. And in both the præ-oral lobe of the larva is represented in the adult by an epistome. The Polyzoa, though immensely simplified in structure, seem undoubtedly to be built upon the same plan; and Caldwell considers it probable that the epistome of Endoproct and Hippocrepan Polyzoa and the so-called foot in Rhabdopleura represent, like the epistome of Phoronis and Brachiopods, the præ-oral lobe.

Mr. Caldwell closes the abstract of his yet unpublished paper with a remark upon the affinities of the Gephyrea. We know nothing to show that Sipunculus and Phascolosoma are not referable to the same type of structure as Phoronis, Brachiopoda, and Polyzoa.

But as regards the types from which all these mutually-con-

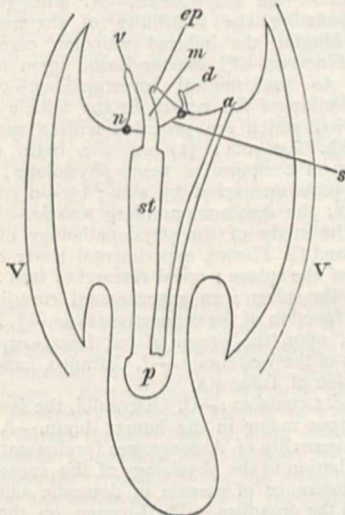


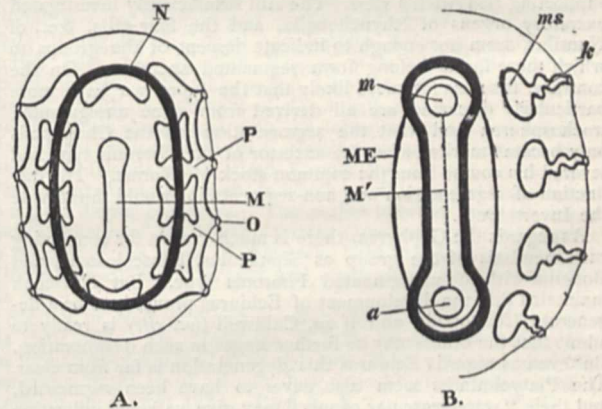
Diagram of body plan of *Brachiopod*, *Polyzoan*, and *Phoronis* (after Caldwell).—*m*, mouth; *a*, anus; *s*, septum; *n*, nervous system; *st*, stomach; *p*, second stomach; *ep*, epistome; *v*, tentacle of ventral series; *d*, tentacle of dorsal series; *V* valves of Brachiopod skull.

nected forms sprang, we know little or nothing, and we look in vain for an unsegmented worm which shall show clear affinity with them.

Van Bemmelen, in a recent paper (*Jenaische Zeitschrift*, 1883) has compared at great length the Brachiopods with Sagitta, and arrives at the conclusion that the two types show such intimate agreement that they must be looked upon as very closely related. In the first place Dr. van Bemmelen recounts the histological resemblance between Sagitta and Brachiopods; and if he ascribes more weight to these than his readers may be inclined to do, he is not without weightier considerations in support of them. In both groups connective tissue is conspicuously scanty; in both a homogeneous intercellular substance or mesenchymelayer is abundant. The epithelial layers are extremely simple and alike in both; the muscles in both are "built on an epithelial type;" the histological characters of the nervous system are identical in both. The chitinous hairs developed in ectodermal follicles on the mantle of Brachiopods are not without analogues in the Chaetognatha. The three metameres of the larval Brachiopod are compared with the divisions of the adult Sagitta; the four genital glands of the former (Testicardines) are identified with the ovaries and testes of the latter. The gastro- and ileoparietal bands of the Brachiopod are made homologous with the transverse septa of Sagitta, and the hood of Sagitta with the arms of the Brachiopod. It is obvious that the above characters, many of which are mentioned in the Hertwig's "Coelomtheorie,"

are of very unequal value; and some are even wrong, for the gastro- and ileo-parietal bands of a Brachiopod are parallel with the gut, and in no way comparable to the transverse septa of Sagitta. But, on the other hand, there are other suggestive points of resemblance, and, though further developmental evidence in the case of Sagitta is sorely needed, I think that its possible affinity to the Phoronis type cannot be altogether passed over. Not only is the development of the mesoblast and body-cavity strikingly similar, but the dorsal and ventral mesenteries at first present in Phoronis agree with those of Sagitta, and the septum dividing off a part of the body-cavity within the head seems the same in both. Nothing in the nervous system offers great difficulty, and the relations of the hood in Sagitta seem not discordant with those of a lophophore. If we approximate the anus and mouth dorsally in Sagitta, the "olfactory organ" will assume the position of the two sense-organs of Phoronis and Rhabdopleura. The lateral mesenteries of Phoronis and Brachiopods arise late and secondarily, as does the transverse septum of the trunk in Sagitta. The anterior and posterior generative masses, arising first together, are no sign of true segmentation, and our embryological knowledge of the nephridia of Sagitta is too slight to permit us to make much use of them as arguments on either side.

If all this is true (and I am far from insisting upon it), it means that Sagitta (though extremely modified for a pelagic life) is akin to the unflexed, unsegmented worm, which, as it acquired a dorsal flexure and a more complex lophophore, gave rise to the proximate ancestors of the Phoronis type.



Sedgwick's theory of segmentation: A. Ideal ancestor of segmented animals; B. Invertebrate.—*m*, primitive mouth; *m'*, mouth; *a*, anus; *M'*, middle portion of primitive mouth or blastopore closed up; *N*, nervous system; *P*, pouch of gut; *ms*, mesoblastic somite; *k*, nephridium; *o*, external pore; *ME*, mesenteron.

And if we admit this even for a moment, it becomes worth while to consider the possibility of a distant Molluscan connection with the same line; for, possessing a trochosphere larva, a single pair of nephridia, and a nervous system with no trace of genuine segmentation, they are so far in agreement with our type. I cannot see that Caldwell's discoveries necessarily invalidate Lankester's old comparison of the Lamellibranch gills (and labial palps) with a lophophore; and even Lankester himself, in spite of his opinion already quoted, that, owing to Caldwell's research, Polyzoa, &c., must now be removed from the Molluscan phylum, yet still admits (*loc. cit.* p. 688) that "it is very probable that the labial tentacles and gill-plates are modifications of a double horseshoe-shaped area of ciliated filamentous processes, which existed in ancestral Mollusks much as in Phoronis and the Polyzoa, and is to be compared with the continuous præ- and post-oral ciliated band of the Echinid larva Pluteus, and of Tornaria;" and Langerhans' close comparison between the nervous systems of Sagitta and a Mollusk may be worth more consideration. The molluscan foot may, after all, be an epistome, as Lankester formerly said, and the "osphradia" of the Mollusk may turn out homologous with the sense-organs of Phoronis and Rhabdopleura. But the extreme modifications of the Molluscan type has undergone—the reduction of the body-cavity, the development of the foot, the various flexures, and so forth—leave any connection that we may trace with it and our Sagitta type at best a distant one; if such exists, a distant relationship will be again traceable between Mollusks and

Brachiopods, though every argument on which their former connection was based is demonstrably false.

But to a great extent the whole matter turns upon our conception of *segmentation*, a subject which Mr. Sedgwick's recent speculations (*Q. J. M. S.*, No. xciii. 1884) may very seriously modify. Sedgwick derives all metameric segmentation from a Coelenterate-like ancestor, with a *pouched gut* like that of all the Actinozoa. The blastopore, including both mouth and anus, is derived from the Actinozoan mouth, the double nerve-cord from the aggregation of the nervous system round the mouth of the polyp, and the nephridia from specialised parts of the pouches represented now by the circular canal of Medusæ or the mesenteric perforations of Actinozoa and the pores leading to the exterior in those forms from the mesenteric chambers. But it is impossible to discuss this theory fully; it is enough to point out that it postulates segmented ancestors of all animals above Coelenterates. Mollusks, Brachiopods, and Sagitta must according to it have been once segmented, just like Vertebrates, Arthropods, and Worms. But surely this is a violent assumption. There is no evidence of segmentation among Mollusks save in Nautilus, for even the pedal commissures of Chiton in no way indicate a truly segmented condition; nor any among Polyzoa or Brachiopods save the four nephridia of Rhynchonella. And it is by no means clear that the development of Sagitta indicates its descent from an ancestor with "three pairs of gut-pouches." The vast number of animals with a single pair of nephridia can scarcely all be derived from ancestors with many pairs; and Hatschek's description of the origin of segmented nephridia (in *Polygordius*) from a single pair seems far from supporting Sedgwick's view. The still insufficiently investigated excretory organs of Rhynchonella, and the four gills, &c., of Nautilus, seem not enough to indicate descent of the groups to which these forms belong from segmented ancestors. On the contrary, it seems far more likely that the types we have more particularly discussed are all derived from some unsegmented trochosphere; and that the segmentation of the Chatopods only became marked after the ancestor of the Phoronis type had severed his course from the common stock of Worms. The distinction of segmentation and non-segmentation would thus divide the Invertebrata.

As regards the Gephyrea, there is much reason for connecting such members of the group as *Sipunculus*, *Phascolosoma*, and *Bonellia* with the unsegmented Phoronis type. But Hatschek maintains that the development of *Echiurus* proves it to be a degenerate Chatopod; and if so, Caldwell (*loc. cit.*) is ready to admit that the others may be further stages in such degeneration. But even as regards *Echiurus* this degeneration is far from clear. The Platyelminths seem also never to have been segmented, and their "water-vascular canals" may give us some indication of the organs from which are derived the nephridia of Phoronis, Gephyrea, Brachiopods, and Mollusks. The larva of *Thysanozoon* has many points in common with the trochosphere, though its want of an anus is strange and difficult to explain. The Rotifers are acknowledged to be persistent trochospheres. And accordingly all these forms may be older and more primitive, by virtue of their lack of segmentation, than all the Chatopods.

D. W. T.

SCIENTIFIC SERIALS

The *Journal of Anatomy and Physiology*, January 1884, contains:—A. Milnes Marshall, M.D., certain abnormal conditions of the reproductive organs of the frog.—S. A. Waddell, M.B., the urea elimination under the use of potassium fluoride in health.—B. C. A. Windle, M.A., M.D., primary sarcoma of the kidney.—R. J. Anderson, M.D., transverse measurements of human ribs.—Arthur W. Hare, M.B., a method of determining the position of the fissure of Rolando and some other cerebral fissures in the living subject.—G. Hoggan, M.B., new forms of nerve terminations in mammalian skin.—J. Symington, M.B., the fold of the nates.—W. Ainslie Holles, M.D., researches into the histology of the central gray substance of the spinal cord and medulla oblongata.—D. J. Cunningham, M.D., the musculus sternalis.—C. W. Cathcart, M.B., movements of the shoulder-girdle involved in those of the arm on the trunk.—J. B. Sutton, the relation of the orbito-sphenoid to the trigon pterion in the side wall of the skull.—Anatomical notices.

April contains:—J. B. Sutton, the nature of certain ligaments.—F. Le Gros Clark, F.R.S., some remarks on nervous exhaustion,

and on vasomotor action.—C. B. Lockwood, F.R.C.S. Lond., the development of the great omentum and the transverse mesocolon.—Arthur Thomson, M.B., notes of two instances of abnormality in the course and distribution of the radial artery.—Js. W. Barrett, M.B., the cause of the first sound of the heart, and the mode of action of the cardiac muscle.—Prof. Cleland, F.R.S., notes on raising the arm.—R. W. Shufeldt, M.D., osteology of *Ceryle alcyon*.—A. M. Patterson, M.B., notes on abnormalities, with special reference to the vertebral arteries.—Geo. Hoggan, M.B., on multiple lymphatic naevi of the skin, and their relation to some kindred diseases of the lymphatics.—Prof. Cleland, F.R.S., notes on the viscera of the porpoise and white-beaked dolphin.—W. Arbuthnot Lane, F.R.C.S., costal and sternal asymmetry.—Anatomical notices.

The *Journal of Physiology*, vol. v. No. 1, contains:—E. Klein, M.D., F.R.S., the bacteria of swine-plague.—T. Lauder Brunton, on the rhythmic contraction of the capillaries in man, and on the physiological action of condurango.—J. Blake, on the connection between physiological action and chemical constitution.—H. H. Donaldson, and L. T. Stevens, note on the action of digitalis.—W. H. Gaskell, on the augmentator (accelerator) nerves of the heart of cold-blooded animals.

Archives Italiennes de Biologie, tome iv. fasc. 3, contains:—B. Grassi, the development of the vertebral column in bony fish.—L. Luciani, on the mechanical stimulation of the sensory centres of the brain-cortex.—A. Moriggia, on a new method of isolating the sensibility of the mobility of the nerves.—G. Magini, the induced unipolar current and the stimulation of nerves.—F. Marino-Zuco, upon the ptomaines with regard to toxicological investigations.—S. Richiardi, on the distribution of the nerves in the follicle of the tactile hairs of the ox, which are provided with a vascular erectile apparatus.—Ph. Lussana: (1) on the brain of the boa: considerations on comparative neuro-physiology; (2) on the sensibility of parts uncovered by skin; (3) on colour-hearing.—A. Marcacci, the areola-mammillary muscle.—P. Foà, contribution to the study of the physiopathology of the spleen.—L. Griffini and G. Tizzoni, experimental study of the partial reproduction of the spleen; novel researches into the total reproduction of the spleen: an experimental contribution to the hematopoietic function of the connective tissue.—J. Bizzozero and A. A. Torre, upon the origin of red blood-corpuscles in the various orders of the Vertebrata.—J. Cattaneo, fixation, staining, and preservation of Infusoria.

Tome v. fasc. 1 contains:—C. Giacomini, the fascia dentata of the hippocampus major in the human brain.—A. Borzi, new studies in the sexuality of Ascomycetes (preliminary note).—L. Solera, contribution to the physiology of the succus intestinalis.—F. Selmi, tolerance of arsenic in domestic animals, and its distribution in the organism.—Ph. Lussana, on the quantitative and qualitative secretion of bile in the state of inanition after the section of the two pneumo-gastric nerves.—L. Camerano, (1) on the development of the Amphibia, and on what has been called their "Neotenia"; (2) researches on the prolongation of the branchial periods of the Amphibia.—G. Romiti, anatomical investigation of a case of death from the bite of a viper.—P. Fanago, on the nest of *Geophilus flavus*.—E. Levier, the origin of the tulips of Savoy and of Italy.—P. Albertoni, critical and experimental studies upon the action and metamorphosis of certain substances in the organism, with respect to the pathogenesis of acetonæmia and diabetes.—L. Griffini, (1) an experimental study of the partial regeneration of the liver (preliminary communication); (2) on the total and partial reproduction of the follicular apparatus and of the calyciform papillæ in the rabbit (preliminary communication).—M. H. Peracca and C. Deregibus, note on *Calopeltis insignitus*.—L. Vincenzi, histological note on the true origin of some cerebral nerves.—A. Mosso, employment of the balance in the study of the circulation in man.

SOCIETIES AND ACADEMIES

EDINBURGH

Mineralogical Society, June 24.—This meeting was held at the Museum of Science and Art, Edinburgh.—Prof. Jas. Geikie, F.R.S., in the chair.—The following papers were read:—On forms of silica, by Prof. John Ruskin, D.C.L. The Chairman and Dr. Dudgeon made some remarks.—On the application of the periodical law to mineralogy, by Prof. Thos. Carnelley of Dundee.—On the origin of the Andalusite schists of Aberdeenshire, by

Mr. John Horne, F.G.S.—On the occurrence of Prehnite and other zeolites in the rocks of Samson's Ribs and Salisbury Crags, by Mr. Andrew Taylor.—On a new locality for zoisite at Loch Garve, Ross-shire, by Mr. Hamilton-Bell.—On diatomaceous deposits in Scotland, by Prof. W. Ivison Macadam. The author drew attention to the vast extent of some of these beds, and gave particulars as to the proportions of silica, &c., contained in them. The deposits were being worked up to yield an absorbent for dynamite manufacture, and gave a material having double the liquid retaining power of samples of "kieselguhr" experimented on.—On the albertite beds of Strathpeffer, Ross-shire, by Mr. Wm. Morrison. Mr. J. Stuart Thomson referred to the fact that an allied jet mineral was found embedded in the oil-yielding bituminous shales of Midlothian. The substance only occurred in small quantities, the largest pieces not exceeding a pound in weight. It is capable of taking a fine polish, being similar to jet. In fact a jet-worker pronounced it at first to be Spanish jet.—On new localities for kyanite in Glen Urquhart, Drumlach Glen, Inverness-shire, and for staurolite at Presholme, Enzie, Banffshire, by Mr. Thomas Walker.—On the crystallography of Bournonite, by Mr. H. R. Miers, British Museum. The paper criticised the history of the subject, and corrected various errors which have crept into the earlier literature. To those crystallographic forms hitherto recorded twenty-nine new forms are added as determined without doubt, and twenty-one as probable. A list of over 1000 angles, calculated from the elements of Miller, is given. The twinning (twin-plate the prism 110) is discussed; the observations of Hessenberg are supported, and it is concluded that the twinning is always by juxtaposition, not by interpenetration, but that Cornish crystals afford an example of composition perpendicular to, as well as parallel to, the plane of composition.—On a peculiar development of tourmaline from Lockport, New York County, by Mr. R. H. Solly, F.G.S.—Notes on the metallic veins of the Upper Hartz, Germany, by Mr. H. M. Cadell.—Scottish localities for actinolites, by Mr. Peyton.—On Welsh gold, by Mr. T. A. Readwin. A specimen weighing 160 grains, from the Mawddach Valley, Merionethshire, was exhibited.

DUBLIN

Royal Society, June 16.—Section of Physical and Experimental Science.—G. Johnstone Stoney, D.Sc., F.R.S., Vice-President, in the chair.—The following papers were read by Prof. G. F. Fitzgerald, M.A., F.R.S., Hon. Sec. :—(1) On a non-sparking dynamo. By applying the principles of Maxwell's modification of Thomson's electrical doubler to a dynamo in which the current passes through two or more coils in parallel circuit, it is possible to arrange the magnetic field and the brushes so that when the terminals of any coil come into contact with their brushes, the terminals shall be at the same difference of potential as the brushes, and that when they break contact there shall be no current running in the coil, thus avoiding all sparking. The energy of self-induction usually wasted on local currents and sparks will in this case be spent in producing useful current.—(2) On dust repulsion. Prof. Osborne Reynolds's theory of the action of the radiometer leads to the conclusion that a very small body in dense gas is subject to similar forces as the vanes of a radiometer in rare gas, and he made experiments which showed that silk fibres in air at considerable pressures were subject to apparent repulsion by radiation: a similar action on dust would explain the dust repulsion observed by Dr. Lodge.—(3) On currents of gas on the vortex atom theory of gases. As the momentum of a simple ring vortex is not proportional to its velocity and varies with its temperature, the momentum of a current of vortex rings would do so too. This and the variations with temperature of the velocity of sound and of the diffusion of gas through small apertures all point to the conclusion that a simple vortex ring is certainly too simple to explain the laws of material atoms. A difficulty is raised as to the amount by which the medium is carried forward by the translation and rotation of the earth.—(4) On a method of studying transient currents by means of an electro-dynamometer. By comparing the initial swing of a ballistic galvanometer which depends on $SCdt$ with the initial swing of an electro-dynamometer which depends on SC^2dt it is possible in many cases to determine, in addition to the total quantity of electricity that passes in the current, several matters as to the distribution of the current during its time of passage.—Prof. E. Hull, LL.D., F.R.S., on the geological age of the North Atlantic Ocean as bearing on the question of the permanency of continents and oceans. After referring to the views

of those who hold the doctrine of "the permanency of oceans and continents" as opposed to those who, with Lyell, hold that continents and oceans have been interchanged during the past history of the globe, the author proceeded to consider how the formation of the North Atlantic Ocean might be adduced in support of one or other of these views. Remarking that this ocean was the only one at present known which could be used in evidence, inasmuch as we were in possession of sufficient knowledge of the geological structure of the regions by which it is bounded to the east and to the west, he proceeded to show how the distribution of the Silurian and Carboniferous rocks of North America, on the one hand, and of the British Isles and Western Europe on the other, pointed to the existence of the derivative lands in the direction of the Atlantic Ocean during these periods. In each case it was shown, by reference to details, that the sedimentary portions of these formations swell out towards the borders of the ocean, and tail out or become attenuated towards the interior of the continents in the opposite directions. From this it was inferred that the lands from which the sediment was derived occupied the region now overspread by the ocean; and, considering the great thickness of the sediments of these formations, the derivative lands were inferred to be of continental proportions. An additional argument in support of this view was also adduced from the distribution of the calcareous with the sedimentary deposits; for it was shown that the calcareous deposits (which were in the main of marine organic origin) swell out and sometimes replace the sedimentary deposits, as we recede from the borders of the ocean on either hand. From these considerations the author concluded that down to the close of the Carboniferous period the North Atlantic was for the most part in the condition of a continent, while the regions of Central and Eastern America, and of the British Isles and Western Europe, were submerged under oceanic waters. After this period, however, the relations were altered. With the upheaval of the Alleghanies at the close of the Palæozoic epoch, and with the terrestrial movement which at the same time affected the Carboniferous and older rocks of the British Isles and Western Europe, the Atlantic continent was converted into an ocean, in which condition it has remained to a great degree ever since. The author inferred from all this that the history of the North Atlantic Ocean might be adduced in support of the views of those who hold the doctrine of the "interchangeability of oceans and continents" rather than of the other.

Section of Natural Science.—Rev. M. H. Close, M.A., in the chair.—Rev. Dr. Houghton, F.R.S., on the possibility of the formation of coloured solar and lunar halos produced by the suspension in the air of volcanic dust caused by the explosion of Krakatoa in August 1883.—Prof. C. R. C. Tichborne, Ph.D., on an argentiferous galenitic blende found at Ovoca, Co. Wicklow. This mineral is very little known; it has been called "kilmacooite" locally in Ovoca, and it is generally termed "blue-stone" in the Island of Anglesey, the only two places in the United Kingdom where it is found. An analysis of the mineral made by the author gave the following results:—

Silver ¹	...	...	...	...	...	0'024
Zinc	...	...	...	...	...	25'27
Lead	...	...	...	...	...	25'18
Iron	...	...	...	...	...	5'51
Manganese	...	...	...	...	...	trace
Antimony	...	...	...	...	...	0'21
Arsenic	...	...	...	...	...	0'08
Copper	...	...	...	...	...	2'50
Alumina	...	...	...	...	...	0'60
Magnesia, with traces of Calcium	...	...	...	...	...	0'02
Sulphur	...	...	...	...	...	23'71
Silica	...	...	...	...	...	16'896

100'000

This mineral contains various amounts of pyrites according to the situation of the lode. The specific gravity was 4'73—intermediate between blende and galena—but it was harder than either of these minerals, and was therefore raised by blasting. The author finds by experiments that this mineral is a mechanical

¹ Equal to about 8 troy ounces per ton, or 8½ ounces avoirdupois. The mineral may be said therefore to consist of—
 Sulphide of zinc 39'68 per cent.
 Sulphide of lead 29'07 "
 Sulphide of silver 0'0275 "

mixture of microscopic crystals of blende and galena; it forms a fine-grained saccharoidal mass, very homogeneous in structure, except as regards the pyrites, and occurs in isolated crystals easily discernible by the eye. The author objected to the terms which had been applied to this mineral on the grounds that they were too local, and did not describe the ore. He explained his method of determining the actual physical as well as the chemical composition of the ore. In conclusion, he said that he was tempted to quote from his report upon the Dublin International Exhibition of 1865 in connection with the raising of silver in Ireland. At that time he found that this country was a large supplier of silver, but he was almost afraid to make the calculation now that he then made of the silver supplied by Ireland. He stated that in 1865 Ireland yielded 14,000 ounces of silver per annum, or 2.4 per cent. of the whole of the silver raised in the world, and its value might be estimated at 3850*l.* per annum, exclusive of the accompanying lead. If 1000 tons of this ore could be supplied, which represented of silver alone 8000 ounces, how lamentable it seemed that this valuable industrial resource should remain unworked.—G. H. Kinahan, M.R.I.A., notes on the earthquake that took place in Essex on the morning of April 22, 1884.

SYDNEY

Royal Society of New South Wales, June 4.—H. C. Russell, B.A., F.R.A.S., President, in the chair.—Three new members were elected, and forty-six donations were received.—The following papers were read:—On rain and its causes, by Edwin Lowe, in which he advocated the firing of cannon and of explosives for bringing about the precipitation of rain.—On the removal of bars from the entrances to our rivers, by Walter Shellshear, Assoc. M. Inst. C.E.—A specimen of scum from a pond near Campbelltown was exhibited. It had been noticed that the surface of the water was covered with a rich green growth in the mornings, and that this changed to a deep red in the afternoons. Messrs. Morris, M.R.C.S., and Wright, M.R.C.S., stated that it appeared to be due to *Astasia hamatodes*, Ehr.

PARIS

Academy of Sciences, July 21.—M. Rolland, President, in the chair.—Presentation of two unpublished essays of Augustin Fresnel, found among the papers of Ampère, by M. Bertrand. The subjects of these essays are the following:—(1) Comparison of the hypothesis of electric currents round the axis of a magnet with that of electric currents round each molecule of matter; (2) Second note on the hypothesis of particular electric currents. These documents are both in the handwriting of Fresnel, but without title or signature, and one only bears a date, that of June 5, 1821.—A study of the geometrical deformations determined by the crushing of a straight cylinder in the direction of its axis between two planes (two illustrations), by M. Tresca.—On two theorems of Prof. Sylvester in connection with his complete demonstration of the rule of Newton in the form given to it by Newton himself, by M. de Jonquières.—Note on the equation in matrices $\rho x = xq$ (continued), by Prof. Sylvester.—On the solution of the most general case of linear equations in binary quantities, that is to say, in quaternions or in matrices of the second order, by Prof. Sylvester.—Note on the maritime canals of Suez and Panama, by M. de Lesseps. In presenting the report of the International Commission on the widening of the Suez Canal, the author expresses the hope that it will soon be able to afford easy passage to ten or twelve million tons of shipping yearly. The Panama Canal, he expects on the report of Mr. Dingler, will be completed in the year 1888.—On the proposed formation of a so-called inland sea in Algeria and Tunisia, by M. E. Cosson. The author repeats the objections already urged against M. Roudaire's project, which, in the discussion that ensued, was supported by M. de Lesseps.—Remarks in connection with the last letter received from Lapérouse, dated Botany Bay, February 7, 1788, by M. de Jonquières.—On electrocapillary relations, by M. P. Garbe.—Direct measure of the two static components and of the dynamic component of the magnetic field of condensing-machines, by M. G. Cabanellas.—Researches on magnetism, by M. Duter.—On a new electric pile with carbon electrodes, producing an electromotor force equal to 0.6 volt, by MM. D. Tommasi and Radiguet.—On the numerical value of Poisson's coefficient as determined by experiments made with caoutchouc, by M. E. H. Amagat.—Temperature and critical pressure of nitrogen; boiling points of nitrogen and ethylene under slight pressures, by M. K. Olszewski.—On the properties of the liquefied vapour of

ethylene, and on its employment as a refrigerator, by M. S. Wroblewski.—Action of the induction spark on benzine, toluene, and aniline, by M. A. Destrem.—On the production of a crystallised manganite of baryta, by MM. G. Rousseau and A. Saglier.—On the combinations formed by the sesquichloride of chromium with the other metallic chlorides, by M. L. Godefroy.—On a general reaction of the polyatomic alcohols in presence of borax, and of the paratungstates, by M. D. Klein.—Remarks on the disinfecting properties of borax applied inwardly, by M. E. de Cyon. From experiments continued over six years the author concludes that borax is a powerful antiseptic, and that it may be introduced in any required quantity into the system to preserve it from all contagions caused by parasites or microbes. As a prophylactic against cholera he recommends boric acid or a solution of borax to be applied to all the external mucous membranes, and about six grains of borax to be taken every twenty-four hours with the food and drink. It appears not only to act directly on the microbes contained in the intestinal canal, but also to attack the bacilli that may have penetrated into the blood.—Researches on the physiological development of *Cerocoma schreberi*, *Stenoria apicalis*, and other insects of the order of Cantharides, by M. H. Beauregard.—Remarks on the action of the heart in insects during their metamorphosis, by M. J. Künckel.—Note on the origin and distribution of phosphorus in coal and cannel-coal, by M. Ad. Carnot.—On the variation, under pressure, of the temperature determining the transformation of the iodide of silver, by MM. Mallard and Le Chatelier.—Researches on the influence of light on the respiration of vegetable tissues destitute of chlorophyll, by MM. G. Bonnier and L. Mangin.

VIENNA

Imperial Academy of Sciences, June 13.—E. Mach and T. Wentzel, on the fixation of a very transitory phenomenon by instantaneous photography.—E. Tangl, on the continuity of protoplasm in vegetable tissue.—M. Loewit, contributions to theory of blood-coagulation, ii., on the importance of the blood-disks.—B. Schudel, on propylidene-dipropyl-ether.

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