THURSDAY, SEPTEMBER 29, 1887.

## THE ORIGIN OF THE FITTEST.

*The Origin of the Fittest: Essays on Evolution.* By E. D. Cope, A.M., Ph.D., &c. (London: Macmillan and Co., 1887.)

CONSIDERING the good work which Prof. Cope has done in the cause of evolution, the present collection of essays appears to us disappointing. Originally published from time to time as independent lectures or articles in journals, they are now republished in the form of a book, apparently without any revision, and certainly without any such revision as would have been required to constitute them a connected treatise. The consequence is that instead of a systematic work on "The Origin of the Fittest," we have a number of disjointed papers bound up together, the larger number of which contain more or less close repetitions of parts of the others—sometimes in the form of long quotations, at other times without special reference. The effect of such frequent reduplications is somewhat tedious, and might easily have been avoided by slightly modifying the constituent essays.

But, apart from the method of compilation, our chief disappointment has reference to some of the leading ideas which characterize the whole series of essays. For example, great store is everywhere set upon the author's doctrine of "growth-force," which so far as we can see is merely an abstraction serving as a shorthand expression of all the phenomena of growth as already known. It is merely a *re-statement* of certain facts, in no way serving to *explain* them. Similarly with the so-called law of acceleration and retardation, which the writer everywhere upholds as a scientific generalization of the highest importance. The idea is that when in any series of generations "growth-force" is accelerated, the organs thus affected will undergo evolution; while, when "growth-force" is retarded, the organs in question will atrophy and disappear. But surely it is hard to see in what other way progressive modification could take place than by one or other of these so-called laws. The laws merely serve to re-state the facts—viz. that organs do evolve and do degenerate.

Another general view which Prof. Cope is fond of frequently insisting upon is that the theory of natural selection does not explain the "*origin* of the fittest" variations, but only the *preservation* of them. This, of course, is an objection to Darwinism which is abundantly familiar in general literature, but we are disappointed to find it so warmly sanctioned by Prof. Cope. In his case, however, Darwinism might reply, "Out of thine own mouth will I judge thee, thou wicked servant." Take, for example, the following passage:—

"Admitting evolution as proved (see Part I.), we perceive that an almost infinite chance exists against any usual amount of variation, as observed, producing a structure which shall be fit to survive in consequence of its superior adaptation to external circumstances. It would be incredible that a blind or undirected variation should not fail in a vast majority of instances to produce a single case of the beautiful adaptation to means and ends which we see so abundantly around us. The amount of attempt, failure, and consequent destruction, would be preposterously large, and in no wise consistent with the facts of teleology as we behold them."

Now the very essence of Darwinism is that, preposterously large as the amount of attempt, failure, and consequent destruction may be if regarded from a teleological point of view, as a matter of fact it does occur in so "vast a majority of instances," that there can be no real question as to its furnishing sufficient material for the mechanical interpretation. Prof. Cope forgets that it is only the lines of fortunate variation (as represented by the successful competitors) that have been allowed to show themselves. And when we calculate the opportunities of favourable variations arising under a geometrical rate of propagation, with "failure and consequent destruction" going on at the rate of thousands—if not of millions—to one, surely we must fail to appreciate the alleged difficulty of explaining the "origin of the fittest." Only if we could suppose that some malign intelligence were always on the look-out for a favourable variation when it does happen to arise, in order to destroy or unfavourably to handicap its chances of survival—only on this supposition of a *super*-natural selection intentionally working against the Darwinian principle could it be said that the facts of organic Nature are not sufficient to justify the Darwinian theory. True enough, "we perceive that an almost infinite chance exists against any usual amount of variation, as observed, producing a structure which shall be fit to survive;" but we likewise perceive that this almost infinite chance is satisfied by "the amount of attempt, failure, and consequent destruction," "which we see so abundantly around us." In short, the doctrine of variation in definite and beneficial lines is incompatible with this large amount of failure and consequent destruction, while the fact of such failure and destruction being everywhere so enormous renders it needless for the Darwinian theory to look further than the chapter of accidents for its "origin of the fittest."

As we have no wish to fall foul of so capable a man of science, we will not pursue further our criticism of his views theoretical and speculative, although there is much else—especially in his long essay on "Metaphysical Evolution"—which appeals to us as sheer nonsense. The writer's strength is in his facts, and in our judgment he would have been wise to have kept within his own province of palæontology. He is full of valuable information upon this important subject, and we may remark that as one result of his studies he gives a very decided opinion upon a matter which has recently been debated in these columns—namely, as to whether or not specific or other typical characters are invariably of adaptive meaning. Premising merely that his opinion has been formed independently, and as a result of his own extensive observations in the sphere of morphological fact, we will conclude by quoting one of the passages in which that opinion is conveyed.

"Another reason why natural selection fails to account for the structures of many organic beings is the fact that in expressing the survival of the fittest it requires that the structures preserved should be especially useful to their possessors. Now, perhaps half of all the peculiarities of the parts of animals (and probably of plants) are of no use to their possessors, or not more useful to them than many other existing structures would have been. . . . Less attention has been directed to the non-adaptive characters, yet they are as numerous as the adaptive. I do not include under this head useless organs or parts only, but also those which are useful, but whose peculiarities do not relate to that use as advantageous to it."

By the last qualification is meant that even useful organs often present peculiarities, which may run through whole orders and classes, and which nevertheless present no utilitarian significance. In the opinion of the present reviewer, the above estimate of the proportion of non-adaptive to adaptive structures is excessive, and some of the instances which are given of the former may be open to question. But even if a Darwinist is not prepared to allow that so many as "one-half of all the peculiarities of the parts of animals (and probably of plants) are of no use to their possessors," he may feel that the mere possibility of such a first-hand observer as Prof. Cope making such a statement is enough to discredit the non-Darwinian assumption of utility as *universal*.

GEORGE J. ROMANES.

## *THE TEACHING OF GEOGRAPHY.*

*The Teaching of Geography.* By Archibald Geikie, LL.D., F.R.S. (London: Macmillan and Co., 1887.)

EIGHTEEN years ago the Royal Geographical Society instituted its public school medals. That was the beginning of its efforts in the cause of geographical education. We believe that it is to Mr. Francis Galton that the honour of having started this policy is due. For many years he, Mr. Clements Markham, and a few others persisted in the face of cold indifference and with little success. At last, in 1884, it was determined to make a fresh and energetic start. Mr. Keltie was appointed Inspector of Geographical Education, and from the date of the publication of his report progress has been very rapid. It was seen at once that one result of that report would be a large crop of geographical text-books. Of those which have already appeared that of Mr. Chisholm is certainly the best; and although it bears sadly too many of the marks of haste, it is a decided advance on all previous work of the kind in the English language. In Dr. Geikie's little book we have before us the first instalment of a still more ambitious scheme. Fourteen more volumes are contemplated to complete the series to which this is an introduction.

It is needless to say that when it was first rumoured in geographical circles that the author of "The Scenery of Scotland" was engaged on a book on the teaching of geography much was expected. After reading the work carefully through we cannot say that we are disappointed. Except in matters of detail, the only criticism we feel inclined to pass has reference to the title. The author has scarcely been just either to his book or to geography in using the present title. We have before us in fact an admirable essay on certain methods of teaching, but applicable to many subjects, and illustrated by many subjects which even the most grasping geographer would scarcely claim as his. It is surely an abuse of terms to say that we are teaching geography when we are giving lessons on the "house fly, grasshopper, dragon-fly, wasp, beetle, and butterfly—showing the similarity and diversity of plan in the great class of insects" (pp. 103–4), or learning that "the breast fins in fishes, the wings in birds, the fore-limbs in quadrupeds, and the arms in man are all modifications of the same parts of the vertebrate skeleton." Again, on p. 106, the teacher is advised to insinuate the laws of health into his geographical teaching, and to explain the physiology on which they are based; and on p. 119 to tell of exchange by barter, and of the value of a medium of exchange. There are many similar instances, but we are reluctant to press this kind of criticism too far, for in this book Dr. Geikie renders great services to the causes both of education and of geography.

There are, in truth, at the present time, several great ideas in the air, destined probably to revolutionize education, but as yet hardly differentiated from one another. It is beginning to be generally recognized that geography, so far from being an elementary subject, is one which requires as a basis a great and most varied fund of information. But there is a tendency to throw geography into confusion by including all this within the subject itself. The essence of geography is topography, and its method is the comparative method of Carl Ritter. Its function is to compare localities, to ascertain their relations in space, and to assign causes for those relations and for the similarities and differences of the localities compared—and all this, as Dr. Geikie says, with especial reference to the earth as a dwelling-place for man. But before we can with advantage compare localities, we must know scientifically and by personal experience at least one. To acquire such knowledge is to learn to observe and to reason independently, to learn the use of our eyes and hands, to learn many of the great laws of science and the scientific explanations of a multitude of every-day experiences. In the greater portion of his book Dr. Geikie is occupied in asserting and demonstrating the possibility of laying this foundation in general science outside the laboratory, and by a skilful use merely of the experience of common life, and he does so with signal success. If teachers will study this method, and if examining authorities will cease to thwart their efforts, there may be some chance of removing the book-bias from our teaching, and of making the decisions of our examiners more nearly resemble those of the great world in after life. It is natural that at first these efforts should be made in the name of geography. But a cleavage is already discernible in the geographical confusion. On the one hand, is a science investigating a definite set of relations, but linked in all directions with other subjects, and in that similar to other composite sciences, like geology and anthropology; and, on the other hand, an educational method for the teaching of the rudiments of scientific thought and facts, an excellent foundation equally for scientific specialism and for practical life.

In matters of detail we have found many valuable hints in the last few chapters, which deal with subjects more strictly geographical. The list of books of reference at p. 46, however, hardly rises to our ideal. The list is, of course, intended for general teachers, and not for geographical experts. Bearing the practical requirements of this class in view, we should have preferred fewer books of early, and more of recent, date. The lack of modern authorities on European lands is especially noticeable. We are aware that this is intentional on the part of the author, but we hardly think that he has been well advised. It is among the multitude of modern books of travel, for the most part indifferent or bad, that guidance would be most valuable. H. J. MACKINDER.

## OUR BOOK SHELF.

*Chemistry and Heat.* By R. G. Durrant, M.A., F.C.S. (London: Rivingtons, 1887.)

THIS little book is a collection of laws and definitions connected with chemistry and heat, intended more especially for the use of students preparing for examination in these subjects. It is to be regarded chiefly as a companion to more extensive treatises, and as a substitute for the extracts and notes which the average student would make for himself.

The various laws are stated very clearly, and the examples illustrating them have been happily chosen. The subject of heat is only considered in so far as it enters into chemical work. The laws relating to atomic weights are particularly well arranged, and zinc being taken as a typical element, a whole chapter is devoted to the method of estimating its atomic weight. A chapter is also devoted to the determination of vapour densities by the well-known methods of Dumas, Hofmann, and Victor Meyer, each being illustrated by a numerical example. In all cases the details of the calculations are gone through with great care.

At the end of the book is a table showing the characteristic tests for the more important metals and acids. This is not nearly up to the same standard as the earlier part of the book, but still it will be of service where expedition is of maximum importance. We are afraid, however, that the results obtained by analyses without separations would not always be perfectly trustworthy. We should have expected the author to be aware that separations are indispensable for most examinations in practical chemistry. Several specimens of analyses are given in detail.

We have no doubt that the book will prove a useful addition to the already large family of hand-books prepared for the use of the fortunate student of chemistry.

A. F.

*On Overwork and Premature Mental Decay.* By C. H. F. Routh, M.D., M.R.C.P. Fourth Edition. (London: Baillière, Tindall, and Cox.)

DR. ROUTH takes a very gloomy view of some of the characteristics of the present age. He holds that insanity and premature mental decay are decidedly on the increase, and this fact he attributes chiefly to overwork. Whether or not he is correct in his interpretation of the statistics relating to insanity, there can be no doubt that overwork is far too common in these days of excessive competition, and Dr. Routh has done good service by showing clearly in this little book the inevitable consequences of any severe and continuous strain upon the powers either of the mind or the body. As to remedies for the evil consequences of overwork, he offers many wise suggestions, and prudent readers will probably be all the more inclined to pay attention to his counsels when they find that he lays stress mainly upon the necessity for periods of rest, for the cultivation of a variety of intellectual interests, and for rigid self-control. Dr. Routh has added to the value of his work by discussing in the present edition the effects of overwork upon women and young persons.

## 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.*]

### Hall and Knight's "Higher Algebra."

IN your issue of September 1 (p. 409), there appeared a review of our "Higher Algebra," bearing the signature "R. B. H." The work under consideration is a sequel to an elementary text-book, as the title-page asserts; it does not profess to be anything more, and we should have thought that any reader would have recognized that "Higher" and "Elementary" are merely used as relative terms. This point has been practically ignored by your reviewer, and in consequence his remarks contain certain inaccuracies and misconceptions likely to leave a false impression on the mind of the reader.

In the first place, "R. B. H." complains that we postpone to our thirty fourth chapter the discussion of the fundamental laws of algebra, the "remainder theorem," symmetrical expressions, and identities. As a matter of fact, these things do not appear here "for the first time;" propositions scattered over the "Elementary Algebra" are here summarized, and in some cases rediscussed; and, with regard to the "remainder theorem," its proof and easy applications are to be found in the twenty-ninth chapter of the elementary work—a chapter which also contains a section on identities and transformations, especially those which can be treated cyclically. Hence, in criticising the miscellaneous chapter of the more advanced work, it should be remembered that for the most part it merely extends and develops what has elsewhere already been treated far more comprehensively than is usual in an Elementary Algebra.

In the chapter on "Miscellaneous Equations," we are told that "there is no hint or caution given that the root obtained may not satisfy the original equation unless the sign of one or more of the radicals involved in it is changed," and our attention is called to an example on p. 99. Surely "R. B. H." must have read this page somewhat carelessly, for at the head of it there stands a remark containing the required hint, while reference is made to a note in the "Elementary Algebra," in which the point is fully discussed.

The remarks on our chapter on permutations and combinations are somewhat vague and indefinite, and we do not gather which proofs are held to be "very difficult to understand." We have used the methods of this chapter very successfully with boys of ordinary intelligence for twelve years or more, and we have always found the proofs contained in Arts. 141, 152, 153, and 156 far more intelligible than those given in other text-books. The illustration given by "R. B. H." may be useful enough for blackboard work, and it is hardly conceivable that any teacher of experience would attempt to handle this part of algebra without a frequent and ready use of such exemplification; but we fail to see how a *proof* of the general formula for the number of permutations of $n$ things $v$ together could be framed on these lines in a form suitable for a text-book.

To the other points raised by your reviewer we do not reply because they are mostly matters of opinion, and whether we have been judicious in our arrangement and subdivision of the subject is a question which can only be decided by the experience of teachers using our books. But we may perhaps remark that the obvious necessities of a school text-book should not be overlooked. In its present form our "Elementary Algebra" contains upwards of 360 pages, and if we had included all the sections now suggested by "R. B. H." the book would have been increased by 150 pages or more, and would have been practically useless, for it would have been published at a price quite prohibitive for school use.

Our two books have been designed to form one complete treatise, and we venture to think that anyone who will fairly criticise the work as a whole will not find the glaring omissions and "defect of plan" suggested by your reviewer.

H. S. HALL.
S. R. KNIGHT.

PERMIT me to remark that far from "ignoring" Messrs. Hall and Knight's use of the terms "Elementary" and "Higher" for the two parts of their Algebra, I have called special attention to it. It seems to me that the term "Higher Algebra" (*algèbre supérieure*) having been employed by Serret as embracing "the algebraic resolution of equations" in general, and that of "Modern Higher Algebra" by Salmon for what "with greater precision might be called the Algebra of Linear Transformations," it is hardly open to the writers of what is really a text-book of elementary algebra in two parts to apply the same term to the second part of their work, and to object to a gentle protest from a reviewer. I am at a loss to see where in my subsequent remarks I have practically ignored their own use of the terms.

I observed that "the fundamental laws of algebra are for the first time *gathered together* and discussed in the thirty-fourth chapter." This implies that they have *appeared dispersedly* in the book before, but the references in this chapter hardly justify the contention that they have appeared as "*the fundamental laws.*" In fact, the distinctive law of ordinary algebra that $ab = ba$, instead of being emphasized, is introduced as a fact "with which the student is familiar in arithmetic" ("Elementary Algebra," Art. 13), and nothing more said, as perhaps at this early stage might be expected. So again the "remainder theorem" does in fact appear in an article, *marked with an asterisk*, at the end of a chapter of "Miscellaneous Theorems" in the "Elementary Algebra," but only as an isolated proposition with a few exemplifications of its use. The point of my remark was that I should have expected such a fundamental theorem to be put in the forefront and largely made use of in the chapter on "Harder Factors." I would suggest this for the consideration of the authors in a future edition.

In like manner, as to my remark on the roots of equations involving radicals, the caution, which I regret that I overlooked in p. 99, appears only as a remark on one particular example, while nothing is said about it in the next, to which it is equally applicable, and in the answers at the end I find roots given which do not satisfy the equations as they stand. It is the practice of not requiring the pupil to select the signs suitable to each root, which I regretted to find that our authors in this way sanction.

Regard for your space prevents my adding more than the single remark that I regret that the practical commercial consideration of the cost of the first part of the book should have necessitated what I have regarded, and what, by urging this plea, the authors seem almost to admit, as, in itself, a "defect of plan." On reconsidering the matter for a future edition, the authors will, I cannot help thinking, find it possible, as it is desirable, to transfer so much from the second to the first part as will make the latter sufficient by itself, as at present it hardly is, for many pupils who need only a small portion of their higher part.

R. B. H.

### On the Constant P in Observations of Terrestrial Magnetism.

HAVING been absent from town, I have to-day for the first time seen the letters of Prof. Harkness and Mr. Ellis on the calculation of P.

Though unaware that it was used at Greenwich, or elsewhere, Dr. Thorpe and I have, for a year at least, employed the formula given by Mr. Ellis in the reduction of observations made for the magnetic survey. We have, in fact, made it still more accurate by the addition of another term. Thus, if we write $l$ and $l_1$ for log A and log $A_1$, and $\mu$ for the modulus, it may easily be shown that—

$$P = \frac{r_1^2 r^2}{r_1^2 - r^2} \times \frac{l - l_1}{\mu} - \frac{r_1^2 r^2 (r_1^2 + r^2)}{2(r_1^2 - r^2)^2} \left(\frac{l - l_1}{\mu}\right)^2 \text{ nearly.}$$

Using the metric system of units and taking as is usual $r = 0{\cdot}3$, $r_1 = 0{\cdot}4$, this becomes—

$$P = 0{\cdot}4737\,(l - l_1) - 1{\cdot}947\,(l - l_1)^2.$$

The value of P for our first year's work calculated by the ordinary method is ·000817. Deduced from the formula given by Mr. Ellis it is ·000824, which the second term given above reduces to ·000818.

In this case the effect of the correction on the value of H is considerably below the error of experiment, but as attention has been drawn to the matter, it may be as well to point out that by means of the second term the accuracy of the approximation can be readily tested without the trouble of calculating P directly.

ARTHUR W. RÜCKER.

September 21.

### A Meteor's Flash and Explosion.

AT 8.52 p.m. (Dublin time) of yesterday, Tuesday, September 13, my wife and I while walking home were startled by a sudden bright flash like lightning, but slower and more regular in its movement. Simultaneously an intensely brilliant meteor shot majestically across the sky from north-north-west towards south-south-east, passing near, but to the eastward of, the zenith in its route. It seemed to take its origin from between the Pointers and the constellation Perseus, and died out at a height of 25° or 30° above the horizon.

Precisely three minutes and a half later a dull report was heard, which resembled that of a very distant field-gun, or of a peal of thunder far away, but it did not reverberate as thunder would have done.

It was impossible not to connect the phenomena of the flash and the report with each other. I accordingly made a rough calculation, which gave 43·4 miles as the distance—not necessarily vertical, but absolute—at which the meteor had become incandescent, and exploded, as a result of its collision with the earth's atmosphere.

JOHN WILLIAM MOORE.

40 Fitzwilliam Square West, Dublin, September 14.

### A Monstrous Foxglove.

MR. TENNANT in NATURE of September 22 (p. 482), after describing a curiously abnormal specimen of *Digitalis purpurea*, writes to ask if "such monstrous forms are at all usual." Thinking your correspondent may be unacquainted with Mr. Herbert Spencer's "Principles of Biology," I write to draw his attention to p. 226, vol. i. of that work, where, in speaking of some foxgloves growing in Derbyshire, Mr. Spencer says of one :—

"The following are the notes I took of its structure :—First or lowest flower on the stem, very large ; calyx containing eight divisions, one partly transformed into a corolla, and another transformed into a small bud with bract (this bud consisted of a five-cleft calyx, four sessile anthers, a pistil, and a rudimentary corolla) ; the corolla of the main flower, which was complete, contained six stamens, three of them bearing anthers, two others being flattened and coloured, and one rudimentary ; there was no pistil, but, *in place of it*, a large bud, consisting of a three-cleft calyx, of which two divisions were tinted at the ends, an imperfect corolla, marked internally with the usual purple spots and hairs, three anthers sessile on this mal-formed corolla, a pistil, a seed-vessel with ovules, and, growing to it, another bud of which the structure was indistinct. Second flower, large ; calyx of seven divisions, one being transformed into a bud with bract, but much smaller than the other ; corolla large, but cleft along the top ; six stamens with anthers, pistil, and seed-vessel. Third flower, large ; six-cleft calyx, cleft corolla, with six stamens, pistil, and seed-vessel, with a second pistil half unfolded at its apex. Fourth flower, large ; divided along the top, six stamens. Fifth flower, large ; corolla divided into three parts, six stamens. Sixth flower, large ; corolla cleft, calyx six-cleft, the rest of the flower normal. Seventh and all succeeding flowers normal."

F. HOWARD COLLINS.

Churchfield, Edgbaston.

## *THE "UMBRIA'S" WAVE.*

I HAVE been instructed by the Meteorological Council to send you the following report of the *Umbria's* wave from Capt. Watson, F.R.Met.Soc., who is General Superintendent of the Cunard Line of steamers.

HENRY TOYNBEE,
Marine Superintendent.

Meteorological Office, September 18.

MY DEAR CAPT. TOYNBEE,—I send you all the particulars I can get regarding the so-called "big wave" that struck the *Umbria*. No doubt there were some big waves knocking about the Atlantic on the morning of

July 26, but nothing more than could, under the conditions of weather, be expected.

I cannot find out anything about other steamers meeting an exceptionally big wave.

*Abstract of Log, s.s. "Umbria."*

| Date. | Wind. | Bar. | Air. | Water. | Remarks. |
|---|---|---|---|---|---|
| July 25. | | | ° | ° | |
| Noon | S.W. | 29·60 | 62 | 63 | Strong wind and overcast. |
| 4 p.m. | W.S.W. | 29·50 | 60 | 61 | Fresh wind and showery. |
| 8 p.m. | W. by N. | 29·45 | 60 | 61 | Fresh wind and clear. |
| Midnight | W. by N. | 29·31 | 60 | 62 | Moderate gale, force 9. |
| 26th. | | | | | |
| 4 a.m. | N.W. by W. | 29·42 | 59 | 61 | Moderate gale and squally, force 9. |
| 8 a.m. | N.W. by W. | 29·50 | 60 | 62 | |
| Noon | N.W. by W. | 29·70 | 59 | 62 | |

"4.40 a.m. Sea came on board over the bows, breaking No. 2 companion hatch, twisting the forward bridge, breaking some iron stanchions on the bridge, breaking the short bridge between the forward end of the promenade deck and the break of the forecastle, and bending the brass rails on the port side of the main upper bridge, leaving the lower bridge intact. 8 a.m. Fresh gale, force 9, with a heavy, confused sea. Noon. Gale moderating and the sea going down, but still confused."

So much from the log-book; but the following particulars are from the chief officer's report, and the statement of the second officer, who was in charge at the time the sea came on board.

At midnight on the 25th the wind was freshening from west by north, and the weather becoming squally. A long, heavy sea was coming from west-south-west, but the ship was only taking an occasional spray over all. At 2 a.m., 26th, the wind was west-north-west, a gale, with heavy and frequent squalls, sea rising fast from north-west. At 4, the wind had veered to north-west, with heavy and frequent squalls. At this time the west-south-west sea was still very heavy, with a high north-west sea running across and over it, making a very high and confused sea; but the ship was making 16 knots, and though the spray was flying fore and aft, she had not up to this time taken a drop of solid water on board.

At 4.40 a.m., lat. 50° 50′ N., long. 27° 8′ W., the officer of the watch noticed a heavy-breaking sea coming from the north-west; he ordered the officer at the engine telegraphs to reduce to "half speed," but before this could be done the top of this sea came on board, but did no damage. The ship rose quickly to it, but as this wave passed under the stern she plunged heavily, and dipping her bows into the second wave—not breaking, or as the officer of the watch expresses it, "dead water,"—scooped up a mass of water which, running aft over the break of the forecastle, fell upon No. 2 companion hatch, breaking it to pieces, also breaking the short bridge between the fore-end of the promenade deck and the break of the forecastle. The look-out bridge between the lighthouses was twisted, and five iron stanchions and 20 feet of the iron rails on it broken, and four brass stanchions on the port side of the upper main bridge were bent; the middle part of the topgallant forecastle deck for 40 feet in a fore-and-aft line, was sent down 2 inches by the weight of water passing over it. Some water got down No. 2 hatchway and frightened a few passengers.

The second officer is certain that the first sea did no damage, as only the top of it broke over the ship, but he describes the plunge the ship took, as this wave passed astern, as very heavy, and that she went bows into the solid water of the second wave, which he is quite certain was not breaking, but "coming smoothly along." This made the ship "stagger, and the sensation was as if she had struck something hard." After the sea came on board the speed was reduced to 10 knots, and was not increased till noon.

The canvas screen on the port side of the upper main bridge was spread, and the spray striking this bent the brass stanchions. The lower bridge escaped, through there being no canvas screen spread.

Although the wind was three points on the starboard bow, with a heavy sea from the same direction, it seems to me, from the brass stanchions on the upper main bridge having been bent aft and to starboard, and from certain marks on the forecastle deck, that the second officer's statement, as to the damage being done by the second wave (in my opinion the west-south-west sea, which was still running high and fast), is correct; and in my own experience I have seen, on more than one occasion, serious damage done by a sea coming up on the lee bow and breaking on board hours after the wind had been blowing three or four points on the other bow.

If we take into consideration a long and heavy sea from west-south-west, a north-west gale, and heavy sea from the same quarter, we shall have an ugly, confused sea. If a very powerful ship with very fine lines is driven at the rate of 16 knots through this confused sea, I do not think there is the least occasion to call in the aid of tidal or earthquake waves to account for any damage the ship would receive.

In the engine-room there was no shock felt, and the sailors and firemen say they did not notice anything unusual save only some passengers making a noise.

The masthead light was extinguished through the chimney being unshipped and falling across the wick.

Yours very truly,
W. WATSON.

Huskisson Dock, Liverpool, August 18.

## THE GARDEN ROSES OF INDIA.

THE principal garden roses cultivated in Europe and in India may be traced to Western Asia and China. The old-fashioned summer roses, which were the ornament of gardens in Europe forty to fifty years ago, are mostly referred to *Rosa gallica*, which has its home in South Europe and Western Asia, and to *Rosa centifolia* and *damascena*, which probably came from the mountains of Armenia and Northern Persia. All these are distinguished by the incomparable delicacy of their aroma, and of the two last-named kinds one or the other is cultivated on a large scale in Southern France, Italy, Macedonia, Asia Minor, Persia, and Northern India, for rose-water and essence of roses (attar). The flowering season of these kinds is short, lasting a few weeks only, and it was an important event for horticulture when, towards the close of last century, the China roses were introduced in Europe. The most important of these was *Rosa indica*, thus called by Linnæus because it was brought from India, where it has long been grown in gardens. Its home, however, is not India, but China, and its great value consists in this, that it flowers throughout summer and autumn, hence the name autumnal rose, also monthly rose (*Monatsrose*). For this reason a variety was called *Rosa semperflorens*. Another variety, described under the name of *Rosa fragrans*, distinguished by its strong though not always very delicate scent, became the parent of the tea-roses. By crossing these kinds and other species with the old garden roses, the numberless varieties of hybrid perpetuals and tea-roses have been obtained, which now ornament our gardens in Europe as well as in India.

In India nine or ten species of roses are indigenous, but with the exception of *Rosa moschata*, a magnificent climber of wide distribution, none have contributed to the production of garden roses. All have their local names in the language of the district where they grow, but—and this is a most remarkable fact—the rose has no name in Sanskrit. In some dictionaries *Java* is rendered as *Rose*, but this is an altogether different shrub, *Hibiscus Rosa-sinensis*, the well-known shoe-flower (used for blacking shoes) of Indian gardens, believed to be indigenous in China, and possibly also indigenous in tropical Africa.

As far as known at present, the roses of Western Asia have no Sanskrit name, and were not known in ancient India. Yet *Rosa damascena* is extensively grown on a large scale for the manufacture of rose-water and essence of roses, throughout Northern India, as far as Ghazipúr, in 25° N. lat. Hermann Schlagintweit was, I believe, the first to draw attention to this remarkable fact. It is not impossible that the western roses were introduced into India by the Mohammedans. As there is no Sanskrit word, so is there no original term for the rose in Hindi. In most Indian languages the cultivated rose is called *gúl*, which is the Persian name. It is also called *gúláb*, which really means rose-water, unless, indeed, as sometimes stated by Munshis in India, *áb* in this case is a suffix with no separate meaning. In addition to their local names, some of the wild roses of the Himalayas are often called *gúláb*, *bán gúláb* (the rose of the forest, or wild rose).

Besides *Rosa indica*, several other Chinese species are cultivated in India. The origin of one of the Indian garden roses, however, is doubtful: this is *Rosa glandulifera*, well described by Roxburgh in his "Flora Indica." It is a white subscandent cluster rose, which has erroneously been referred to *Rosa alba*. In Hindi and Bengali it is called Seoti, Sivati, Shevati. According to Piddington ("English Index to the Plants of India," 1832), this rose has a Sanskrit name, Sevati, pointing to *shveta* (white). This, however, requires verification. Roxburgh believed its origin to be China.

D. BRANDIS.

## THE IRON AND STEEL INSTITUTE.

THE autumn meeting of this Institute was held at Owens College, Manchester, from the 14th to the 17th inst. The address of the President was of a twofold character, having reference to the metallurgy of steel and to the question of trade. As regarded mild and hard steel, the success that had attended the application of the former was due, in the President's opinion, to the greater ease in its manufacture as compared with hard steels, in which the alloying compounds vary in specific gravity, melting-point or fusibility, and specific heat. Another feature in favour of the manufacture of mild steel is that not more than one-tenth per cent. of the combined elements—sulphur, phosphorus, and silicon—is admissible. As regards working, although the steam-hammer was requisite to force cinder out of puddled iron, with steel such violence is not required, and must be abandoned in favour of the quiet concentrated force of the forging press.

In his reference to trade, and especially the iron and steel trade, Mr. Adamson gave it as his opinion that, so long as we tax ourselves for the benefit of a foreign producer, and pay all the cost incident to the carrying on of our country, and enable the merchant to import manufactured goods from abroad (which bear no portion of the taxation of the country) at a greater profit than he could realize by purchasing at home, so long will our great trade remain depressed and our foreign competitor rejoice at our want of foresight. He also drew attention to the circumstance that the manufacture of goods at home employed not only the hands directly engaged in the industry, but gave work also to cognate industries.

The first paper read was on "Metallurgical and Mechanical Progress as illustrated at the Manchester Exhibition." The object of the paper was to point out to the visitor what was to be seen at the Exhibition; the paper was not discussed.

The paper of Sir Lowthian Bell, on "The Reduction of Ores of Iron in the Blast Furnace," was next read, and gave rise to a very lengthy discussion. The author first explained the general functions of the blast furnace, in which the ores are reduced in the uppermost zone, heated and chemically acted upon in the intermediate region, and melted in the lowest portion. In the reducing zone the ore and limestone are first heated only, but at about 400° F. the oxide of iron begins to lose oxygen; this is found in the gases, together with the carbon and oxygen contained in the carbonic acid of the limestone which is separated at a temperature of about 1500° F. A table was given, indicating generally the increased energy of carbonic oxide as a reducing agent, with increase of temperature, its influence being affected by variations in the ore. The paper is mainly of technical interest.

The next paper read was on "The Basic Open-hearth Process." The subject was treated under the three headings of plant, process, and produce. The furnace described is a modified form of the Siemens furnace, and it is necessary that, a basic-lined hearth having been obtained, a basic slag should be maintained in working.

The last paper read and discussed was on "Electric Lighting in Works and Factories," by Prof. J. A. Fleming. Several interesting points were brought forward. Thus, a table was exhibited comparing a 1200-light dynamo as manufactured in 1882 and 1887. The weight alone of the dynamo of the former machine was 44,820 pounds; that of the armature, 9800 pounds. It occupied 320 cubic feet. With a terminal electromotive force of 108 volts, and an output of 790 amperes, the total horse-power applied to rotate the armature was 154·8, the commercial efficiency was 67 per cent., whilst the price per 1000 watts output was £24. In the 1887 machine the weight is 11,760 pounds; that of the armature alone, 1568 pounds; the cubic space occupied is about 180 cubic feet. The terminal electromotive force is 105 volts, the current 720 amperes, the external electric activity 75,600 watts, and the power required on the pulley about 112 horse-power, the commercial efficiency being over 90 per cent., and the price 6*l.* per 1000 watts output. Statistics from the United States and France show that 117,201 lamps are used in the former country, and 55,321 in the latter; the great majority employed in each case are for workshops and factories. This is a very much larger extension of electric lighting than has taken place in this country. The author recommends, where possible, driving each dynamo from a separate steam-engine, controlled by a good governor, and having all the wiring and fittings carefully tested. In the matter of incandescence lamps attention is drawn to the importance of keeping the electromotive force within a volt of that marked upon the lamps; in this way the length of the life of the lamps is much increased. In the use of naked arc-lights the illumination rapidly falls off as we get away from the light. To obviate this, Mr. A. S. Trotter introduced his dioptric shades. The light is surrounded with a glass shade so cut or grooved into prismatic furrows that whilst causing only a small actual absorption, it will yet refract the rays of light in such a manner as to take away the light from directly under the lamp and increase the illumination at the remote districts. In conclusion, the author makes the statement that, as regards mills, works, and factories, the more closely its advantages and merits are inquired into, the more forcible they will seem, even in face of the fact that gas in the United Kingdom has a lower average price than in any other part of the world.

## THE BRITISH ASSOCIATION.

### SECTION H.

### ANTHROPOLOGY.

### Opening Address by Prof. A. H. Sayce, M.A., President of the Section.

Surprise has sometimes been expressed that anthropology, the science of man, should have been the last of the sciences to come into being. But the fact is not so strange as it seems at first sight to be. Science originated in curiosity, and the curiosity of primitive man, like the curiosity of a child, was first exercised upon the objects around him. The fact that we are separate from the world about us, and that the world about us is our own creation, is a conviction which grows but slowly in the mind either of the individual or of the race in general. The child says, "Charley likes this," before he learns to say, "*I* like this," and in most languages the objective case of the personal pronoun exhibits earlier forms than the nominative.

Moreover, it is only through the relations that exist between mankind and external nature that we can arrive at anything like a scientific knowledge of man. Science, it must be remembered, implies the discovery of general laws, and general laws are only possible if we deal, not with the single individual, but with individuals when grouped together in races, tribes, or communities. We can never take a photograph of the mind of an individual, but we can come to know the principles that govern the actions of bodies of men, and can employ the inductive method of science to discover the physical and moral characteristics of tribes and races. It is through the form of the skull, the nature of the language, the manners and customs, or the religious ideas of a people that we can gain a true conception of their history and character. The thinker who wishes to carry out the precept of the Delphian oracle and to "know himself" must study himself as reflected in the community to which he belongs. The sum of the sciences which deal with the relations of the community to the external world will constitute the science of anthropology.

The field occupied by the science is a vast one, and the several workers in it must be content to cultivate portions of it only. The age of "admirable Crichtons" is past; it would be impossible for a single student to cover with equal success the whole domain of anthropology. All that he can hope to do is to share the labour with others, and to concentrate his energies on but one or two departments in the wide field of research. A day may come when the work we have to perform will be accomplished, and our successsors will reap the harvest that we have sown. But meanwhile we must each keep to our own special line of investigation, asking only that others whose studies have lain a different direction shall help us with the results they have obtained.

I shall therefore make no apology for confining myself on the present occasion to those branches of anthropological study about which I know most. It is more particularly to the study of language, and the evidence we may derive from it as to the history and development of mankind, that I wish to direct your attention. It is in language that the thoughts and feelings of man are mirrored and embodied; it is through language that we learn the little we know about what is passing in the minds of others. Language is not only a means of intercommunication, it is also a record of the ideas and beliefs, the emotions and the hopes of the past generations of the world. In spoken language, accordingly, we may discover the fossilized records of early humanity, as well as the reflection of the thoughts that move the society of to-day. What fossils are to the geologist words are to the comparative philologist.

But we must be careful not to press the testimony of language beyond its legitimate limits. Language is essentially a social product, the creation of a community of men living together and moved by the same wants and desires. It is one of the chief bonds that bind a community together, and its existence and development depend upon the community to which it belongs. If the community is changed by conquest or intermarriage or any other cause the language of the community changes too. The individual who quits one community for another has at the same time to shift his language. The Frenchman who naturalizes himself in England must acquire English; the negro who is born in the United States must adopt the language that is spoken there.

Language is thus a characteristic of a community, and not of an individual. The neglect of this fact has introduced untold mischief not only into philology, but into ethnology as well. Race and language have been confused together, and the fact that a man speaks a particular language has too often been assumed, in spite of daily experience, to prove that he belongs to a particular race. When scholars had discovered that the Sanskrit of India belonged to the same linguistic family as the European languages, they jumped to the conclusion that the dark-skinned Hindu and the light-haired Scandinavian must also belong to one and the same race. Time after time I have taken up books which sought to determine the racial affinities of savage or barbarous tribes by means of their language alone. Language and race, in short, have been used as synonymous terms.

The fallacy is still so common, still so frequently peeps out where we should least expect it, that I think it is hardly superfluous, even now, to draw attention to it. And yet we have only to look around us to see how contrary it is to all the facts of experience. We Englishmen are bound together by a common language, but the historian and the craniologist will alike tell us that the blood that runs in our veins is derived from a very various ancestry. Kelt and Teuton, Scandinavian and Roman, have struggled together for the mastery in our island since it first came within the horizon of history, and in the remoter days of which history and tradition are silent archæology assures us that there were yet other races who fought and mingled together. The Jews have wandered through the world adopting the languages of the peoples amongst whom they have settled, and in Transylvania they even look upon an old form of Spanish as their sacred tongue. The Cornishman now speaks English; is he on that account less of a Kelt than the Welshman or the Breton?

Language, however, is not wholly without value to the ethnologist. Though a common language is not a test of race, it is a test of social contact. And social contact may mean—indeed very generally does mean—a certain amount of intermarriage as well. The penal laws passed against the Welsh in the fifteenth century were not sufficient to prevent marriages now and then between the Welsh and the English, and in spite of the social ostracism of the negro in the Northern States of America intermarriages have taken place there between the black and the white population. But in the case of such intermarrying the racial traits of one member only of the union are as a general rule preserved. The physical and moral type of the stronger parent prevails in the end, though it is often not easy to tell beforehand on which side the strength will lie. Sometimes, indeed, the physical and moral characters are not inherited together, the child following one of his parents in physical type while he inherits his moral and intellectual qualities from the other. But even in such cases the types preserve a wonderful fixity, and testify to the difficulty of changing what we call the characteristics of race.

Herein lies one of the most obvious differences between race and language, a difference which is of itself sufficient to show how impossible it must be to argue from the one to the other. While the characteristics of race seem almost indelible, language is as fluctuating and variable as the waves of the sea. It is perpetually changing in the mouths of its speakers; nay, the individual can even forget the language of his childhood and acquire another which has not the remotest connexion with it. A man cannot rid himself of the characteristics of race, but his language is like his clothing which he can strip off and change almost at will.

It seems to me that this is a fact of which only one explanation is possible. The distinctions of race must be older than the distinctions of language. On the monuments of Egypt, more than four thousand years ago, the Libyans are represented with the same fair European complexion as that of the modern Kabyles, and the painted tomb of Rekh-mâ-ra, a Theban prince who lived in the sixteenth century before our era, portrays the black-skinned negro, the olive-coloured Syrian, and the red-skinned Egyptian with all the physical peculiarities that distinguish their descendants to day. The Egyptian language has ceased to be spoken even in its latest Coptic form, but the wooden figure of the "Sheikh-el-beled" in the Bulaq Museum, carved six thousand years ago, reproduces the features of many a fellah in the modern villages of the Nile. Within the limits of history racial characteristics have undergone no change.

I see, therefore, no escape from the conclusion that the chief distinctions of race were established long before man acquired language. If the statement made by M. de Mortillet is true, that the absence of the mental tubercle, or bony excrescence in which the tongue is inserted, in a skull of the Neanderthal type found at La Naulette, indicates an absence of the faculty of speech, one race at least of Palæolithic man would have existed in Europe before it had as yet invented an articulate language. Indeed, it is difficult to believe that man has known how to speak for any very great length of time. On the one hand, it is true, languages may remain fixed and almost stationary for a long series of generations. Of this the Semitic languages afford a conspicuous example. Not only the very words, but even the very forms of grammar are still used by the Bedouin of Central Arabia that were employed by the Semitic Babylonians on their monuments five thousand years ago. At that early date the Semitic family of speech already existed with all its peculiarities, which have survived with but little alteration up to the present day. And when it is remembered that Old Egyptian, which comes before us as a literary and decaying language a thousand years earlier, was probably a sister of the parent Semitic speech, the period to which we must assign the formation and development of the latter cannot fall much short of ten thousand years before the Christian era. But on the other hand there is no language which does not bear upon its face the marks of its origin. We can still trace through the thin disguise of subsequent modifications and growth the elements, both lexical and grammatical, out of which language must have arisen. The Bushman dialects still preserve the inarticulate clicks which preceded articulate sounds in expressing ideas; behind the roots which the philologist discovers in allied groups of words lie, plainly visible, the imitations of natural sounds, or the instinctive utterances of human emotion; while the grammar of languages like Eskimaux or the Aztec of Mexico carries us back to the first mechanism for conveying the meaning of one speaker to another. The beginnings of articulate language are still too transparent to allow us to refer them to a very remote era. I once calculated that from thirty to forty thousand years is the utmost limit that we can allow to man as a speaking animal. In fact, the evidence that he is a drawing animal, derived from the pictured bones and horns of the Palæolithic Age, mounts back to a much earlier epoch than the evidence that he is a speaking animal.

Mr. Horatio Hale has lately started a very ingenious theory to account, not indeed for the origin of language in general, but for the origin of that vast number of apparently unallied families of speech which have existed in the world. He has come across examples of children who have invented and used languages of their own, refusing at the same time to speak the language they heard around them. As the children belonged to civilized communities the languages they invented did not spread beyond themselves, and after a time were forgotten by their own inventors. In an uncivilized community, however, it is quite conceivable that such a language might continue to be used by the children after they had begun to grow up, and be communicated by them to their descendants. In this case a wholly new language would be started, which would have no affinities with any other, and after splitting into dialects would become the parent of numerous derived tongues. I must confess that the evidence brought forward by Mr. Hale in support of his theory is not quite convincing to me. It is yet to be proved that the words used by the children to whom he refers were not echoes of the words used by their elders. If they were, a language that originated in them would show more signs of lexical affinity to the older language than is the case of one family of speech when compared with another. On the other hand, the theory would tend to throw light on the curious fact that the morphological divisions of language are also geographical.

By the morphology of a language I mean its structure; that is to say, the mode in which the relations of grammar are expressed in a sentence, and the order in which they occur. These vary considerably, the chief variations being represented by the polysynthetic languages of America, the isolating languages of Eastern Asia, the postfixal languages of Central Asia, the prefixal languages of Africa, and the inflectional languages of Europe and Western Asia. Now it will be observed that each of these classes of language is associated with a particular part of the globe, the isolating languages, for example, being practically confined to Eastern Asia, and the polysynthetic languages to America. Within each class there are numerous families of speech between which no relationship can be discovered beyond that of a common structure; they agree morphologically, but their grammar and lexicon show no signs of connexion. If we adopt Mr. Hale's theory we might suppose that the genealogically distinct families of speech grew up in the way he describes, while their morphological agreement would be accounted for by the inherited tendency of the children to run their thinking into a particular mould. The words and contrivances of grammar would be new, the mental framework in which they were set would be an inheritance from former generations.

I have spoken of the inflectional languages as belonging to Europe and Western Asia. This is true if we give a somewhat wide extension to the term inflectional, and make it include not only the Indo-European group, but the Georgian and Semitic groups as well. But, strictly speaking, the Indo-European, or Aryan, languages have a structure of their own, which differs very markedly from that of either the Georgian or the Semitic families. The Semitic mode of expressing the relations of grammar by changing the vowels within a framework of consonants differs as much from the Aryan mode of expressing them by means of suffixes as does the Semitic partiality for words of three consonants from the Indo-European carelessness about the number of syllables in a word. Though it is quite true that the Semitic languages at times approach the Indo-European by using suffixes to denote the forms of grammar, while at other times the Indo-European languages may substitute internal vowel change for external flection, nevertheless, in general, the kind of flection employed by the two families of speech is of a totally different character.

This difference of structure, coupled with a complete difference in phonology, grammar, and lexicon, has always seemed to me to negative the attempts that have been made to connect the Aryan and Semitic families of language together. The attempts have usually been based on the old confusion between language and race: both Aryans and Semites belong to the white race; therefore it was assumed their languages must be akin. As long as it was generally agreed that the primitive home of the Aryan languages was, like that of the Semitic languages, the western part of Asia, the confusion was excusable. If the earliest seats of the speakers of each were in geographical proximity, there was some reason for believing that languages which were alike spoken by members of the white race, and were alike classed as inflectional, would, when properly questioned, show signs of a common origin.

But that general agreement no longer exists. While the Asiatic origin of the Semitic languages is beyond dispute, scholars have of late years been coming more and more to the conclusion that Europe was the cradle of the Aryan tongues. Their European origin was first advocated by our countryman Dr. Latham, and was subsequently defended by the eminent comparative philologist Dr. Benfey; but it is only within the last half-dozen years that the theory has won its way to scientific recognition. Different lines of research have been converging towards the same result, and indicating North-Eastern Europe as the starting-point of the Indo-European languages, while the evidences invoked in favour of their Asiatic origin have one and all broken down.

These evidences chiefly rested on the supposed superiority of Sanskrit over the other Indo-European languages as a representative of the parent-speech from which they were all descended. The grammar and phonology of Sanskrit were imagined to be more archaic, more faithful to the primitive pattern than those of its sister-tongues. It was argued that this implied a less amount of migration and change on the part of the speakers, a nearer residence, in fact, to the region where the parent-speech had once been spoken. As a comparison of the words denoting certain objects in the Indo-European languages showed that this region must have had a cold climate, it was placed on the slopes of the Hindu-Kush or at the sources of the Oxus and Jaxartes.

But we now know that instead of being the most faithful representative of the parent-speech, Sanskrit is in many respects far less so than are its sister-languages of Europe. Its vocabulary, for instance, has been thrown into confusion by the coalescence of the three primitive vowel sounds *ă*, *ĕ*, *ŏ* into the single monotonous *ă*, a corruption which is paralleled by the coalescence of so many vowels in modern cultivated English in the so-called "neutral" *ə*. Greek, or even the Lithuanian, which may still be heard to-day from the lips of unlettered peasants, has preserved more faithfully than the Sanskrit of India the features of the parent Aryan. If the faithfulness of the record is any proof of the geographical proximity of one of the Indo-European languages to their common mother, it is in the neighbourhood of Lithuania, rather than in the neighbourhood of

India, that we ought to look for traces of the first home of the Aryan family.

But the theory of the Asiatic origin of the Indo-European family has not only been deprived of its main support by the dethronement of Sanskrit, and the transfer of its primacy to the languages of Europe; what Prof. Max Müller has termed "linguistic palæontology" has further assisted in overthrowing the crumbling edifice. When we find words of similar phonetic form and similar meaning in both the Asiatic and the European branches of the Aryan family—words, too, which it can be shown have not been borrowed by one Indo-European language from another—we are justified in concluding that the objects or phenomena denoted by them were already known to the speakers of the parent-language. When we find, for instance, that the birch is known by the same name in both Sanskrit and Teutonic, we may infer that it was a tree with which the speakers of the mother-tongue of Sanskrit and Teutonic were acquainted, and that consequently they must have lived in a cold climate. In Europe that would have been westward of a line drawn from Königsberg to the Crimea, to the east of which the birch-tree does not grow.

Four years ago a valuable contribution to the linguistic palæontology of the Aryan languages was made by Prof. Otto Schrader. For the first time the question was approached from the present level of comparative philology, and all words were excluded from comparison which did not satisfy the requirements of phonetic law. The results were sadly disquieting to the believers in that idyllic picture of primitive Aryan life to which we had so long been accustomed. Prof. Schrader proved that the speakers of the parent Aryan language must not only have lived in a cold climate—a fact which was known already—but that they must have lived in the Stone Age, with the skins of wild beasts only to protect them from the rigours of the winter, and nothing better than stone weapons with which to ward off the attacks of savage animals. Their general culture was on a level with their general surroundings. It was little better than that of the Fuegian before he came into contact with European missionaries. The minuteness with which the varying degrees of family relationship were named, instead of indicating an advanced social life, as was formerly imagined, really indicated the direct contrary. The primitive Aryan was indeed acquainted with fire; he could even sew his skins together by means of needles of bone; and possibly could spin a little with the help of rude spindle-whorls; but beyond this his knowledge of the arts does not seem to have extended. If he made use of gold or meteoric iron, it was only of the unwrought pieces which he picked up from the ground and employed as ornaments; of the working of metals he was entirely ignorant. But he already practised a kind of rude agriculture, though the art of grinding corn was as yet unknown, and crushed spelt was eaten instead of bread; while the community to which he belonged was essentially that of pastoral nomads, who changed from season to season the miserable beehive huts of wattled mud in which they lived. They could count at least as far as a hundred, and believed in a multitude of ghosts and goblins, making offerings to the dead, and seeing in the bright sky a potent deity.

In calling the speaker of the Aryan parent-speech the primitive Aryan I must not be supposed to be prejudging the question as to the particular race to which he belonged. This is a question which has recently been handled with great ability by an Austrian anthropologist—Dr. Karl Penka. In a remarkable book, published at the end of last year, he endeavours to substantiate the hypothesis advanced in an earlier work, and to show that the first speakers of the Aryan languages were the fair-haired, blue-eyed, light-complexioned dolichocephalic race which is still found in its greatest purity in Scandinavia; that it was this race which in the Neolithic period spread southwards, imposing its yoke upon subject populations, like the Norsemen and Normans of later days, and carrying with it the dialects which afterwards developed into the Aryan languages; and that, finally, it was the same race which in the remote days of the Palæolithic Age inhabited Western and Central Europe, where it has left its remains in the typical skulls of Cannstatt and Engis. Dr. Penka would ascribe to its long residence in the semi-arctic climate of palæolithic Europe the permanent blanching of its skin and hair—a form of albinoism which Dr. Poesche in 1878 endeavoured to explain by the climatic conditions of the Rokitno marshes in Russia, where he placed the cradle of the white Aryan race.

It cannot be denied that all the probabilities are at present on Dr. Penka's side, so far as his main contention is concerned. Without denying that the speakers of the Aryan parent-speech may have already included slaves or wives of alien race, it is probable that the majority of them were of one blood. They formed a single community, nomad it is true, and therefore less likely to mix with foreigners, but still sufficiently a single community to speak a language the several dialects of which were so alike as to be mutually intelligible. In the social condition in which the speakers were, and in an age when the waste lands of the world were still extensive, the greater part of such a community must necessarily, we should think, have belonged to the same race. The evidences of language, moreover, as we have seen, point to a cold and northerly climate as the original seat of the community; and since they further inform us that the birch was known to it, we may conclude that this climate lay westward of Königsberg and Russia. Penka has striven to show that the animals whose bones or shells are found in the Scandinavian kitchen-middens are just those whose names are common to the Indo-European languages, or at all events the European section of the latter. Now, the skulls disinterred from the prehistoric burial-places of Denmark and the southern districts of Sweden and Norway are, for the most part, identical with the skulls still characteristic of the Scandinavian population where they accompany a fair skin and light hair and eyes. By combining these two facts we arrive at the conclusion that the fair Scandinavian race is the modern descendant of the race which spoke the parent-language of the primitive Aryan community, and left traces of itself in the Scandinavian kitchen-middens. The conclusion is supported by the testimony of history. On the one hand we have the testimony of classical writers that the Aryan-speaking Kelts of the Christian era were not the dark small-limbed population which now occupies the larger part of France, but men of large stature, with the blue eyes and fair hair of their Teutonic brethren; while the ideal specimens of humanity conceived of by the aristocratic art of Italy and Greece were the golden-haired Apollo and the blue-eyed Athênê. On the other hand, it was from Scandinavia that in later times other bands of warriors poured forth, who made their way into the countries of the Mediterranean, and even Asia, and established themselves as conquering aristocracies in the midst of subject populations. The Kelts succeeded in reaching Asia Minor, the Scando-German hordes overthrew the Roman empire, the Northmen established themselves from Russia on the east to Iceland and Greenland on the west, and the Normans made Sicily their own long before the days of the German Frederick. The only point in which the later historical irruptions of the Scandinavian peoples differed from their prehistoric ones was, that while the later irruptions were made by sea, the older were made by land. The sail was unknown to the tribes of the north until the age of their intercourse with the Romans, from whom they borrowed both the conception and the name of the *sagulum*, or "sail." The course of their migrations must have followed the valleys of the great rivers.

If Southern Scandinavia is thus to be regarded as the original home of the Aryan languages, and if the race which first spoke those languages, and which we may therefore call Aryan, is to be identified with the Scandinavian type, it follows that the further south and east we advance from this primary starting-point the less pure will the type become. It will be in the neighbourhood of that starting-point and in Northern Europe that we shall expect to find the largest number of undiluted Aryan languages and the purest examples of the Aryan breed. In Greece and Armenia, in Persia and India, we must look for mixture and decay. And such indeed is the fact. Mr. Wharton has found, by a careful analysis of the Greek lexicon, that out of 2740 primary words only 1580 can be referred with any probability to an Indo-European origin, while the prevailing racial type in ancient as in modern Greece was distinctly non-Aryan. Indeed, I am inclined to believe that the culture revealed by the excavations at Mykênæ, Tiryns, and on other prehistoric Greek sites belonged not to a Hellenic but to a pre-Hellenic population, and that the Aryan Greeks first made their appearance in Hellas at the epoch of what later tradition called the Dorian immigration. It was to the north that Greek legends pointed as the primæval home of the Hellenic race and civilization, and Dôdôna ever continued to be revered as the oldest sanctuary of the Hellenic world. In India it is notorious that the Aryan-speaking Hindus entered the country from the north-west, and failed to spread far into the burning plains of the south. The date of their invasion is uncertain, but for myself I have grave doubts whether it was earlier than the eighth or even the seventh century B.C. At all events it was not until after the seventh century B.C., as we now know from the express testimony of the cuneiform inscriptions of Van, that the Aryan-speaking Armenians entered the land which now bears their name, and recent philological researches have confirmed the assertion of Greek writers that the Armenians were a colony of the Phrygians who had themselves emigrated from Thrace. Up to the closing days of the Assyrian empire the monuments make it clear that no Aryans had as yet settled between the Kurdish ranges on the east and the Halys on the west.

But while the extension into Asia of what I will now, following Penka's example, call the Aryan race, seems to be referred to a comparatively recent period, there is a curious fact which goes to show that the same, or a closely allied, race once spread along the northern coast of Africa. On Egyptian monuments, which date back to the sixteenth century before our era, the Libyan tribes of this district are described and depicted as white. Their descendants are still to be found in the mountainous parts of the coast, those of Algeria being commonly known under the name of Kabyles. I saw a good deal of them last winter, and must confess to being greatly struck by their appearance. I had known, of course, that they belonged to the white race and were characterized by blue eyes and light hair, but I was not prepared to find that their complexion was of that transparent whiteness which freckles readily and is supposed to mark the so-called "red Kelt." They are dolichocephalic, and as their skulls agree with those discovered in the prehistoric cromlechs of Roknia and other places it is plain that their distinctive features are not due, as was formerly supposed, to intermixture with the Vandals.

The cromlechs in which they once buried their dead are quite as remarkable as their physical characteristics. Cromlechs of a similar shape are found extending through Spain and western France to the northern portion of the British Isles. Since dolichocephalic skulls occur in connexion with them, while the physical characteristics of the modern Kabyle resemble so strikingly those of a particular portion of the modern Irish population, we seem driven to infer that the Kabyle and the "red Kelt" are alike fragments of a race that once spread from Scotland and Ireland to the northern coast of Africa and interred its dead in chambers formed of five large blocks of stone. Though the custom of burying in these cromlechs continued into the Bronze Age, the majority of them go back to the Neolithic period.

Are we to suppose, then, that one stream of Aryan immigrants, after making its way to the west, wandered along the western coast of Europe, and eventually crossed the Straits of Gibraltar and took possession of Africa? Or are we to believe that the Aryan race of southern Scandinavia was allied in blood, though not in language, with a population which inhabited the extreme west of Europe, and had, it may be at the close of the Glacial epoch, passed over to the neighbouring mountains of Africa? It must be remembered that the Kabyle complexion is not precisely the same as that of the Scandinavian. Both are white, but the skin of the one has a semi-transparent appearance, while the whiteness of the other may be described as mealy. It will be worth while to determine whether between the dolichocephalism of the Kabyle and the dolichocephalism of the Scandinavian any distinction can be drawn.

The question has a bearing on the origin of a part of our own population. I have already compared the Kabyle with the "red Kelt." But the expression "red Kelt," like most popular expressions, is by no means exact. It confuses in one two distinct types. The large limbed, red-haired Highlander, who calls to mind the description given of the Kelts by the Latin historians, stands in marked contrast to the small-limbed, light-complexioned Kelt of certain districts in Ireland, whose skin is freckled rather than burnt red by the sun. The determination of the several racial elements in these islands is particularly difficult on account of the intermixture of population, and nowhere is the difficulty greater than in the case of the Keltic portion of the community. Long before the Roman conquest the intrusive Aryan Kelt had been intermarrying with the older inhabitants of the country, who doubtless belonged to more than one race, the result being that the so-called Keltic race is an amalgamation of races differing physiologically but dominated by a common moral and intellectual character—the consequence of subjection for a long series of generations to the same conditions of life. It has become a commonplace of ethnology that the so-called Keltic race includes not only the fair-complexioned Aryan Kelt, but also the "black Kelt" or Iberian with dark skin, black hair and eyes, and small limbs. The subject, however, is much more complex than this simple division would imply. We have seen that under the "red Kelt" are included two distinct varieties; the "black Kelt" is equally irreducible to a single type, while the fact that the two types of "red" and "black" recur in the same family—my own, for example—not only indicates their long-continued intermixture, but suggests the existence of intermediate varieties. The limitations and relations of dolichocephalism and brachycephalism within the race also need further investigation. I hope that this meeting, held as it is on the borders of what is still a distinctively Keltic country, may help to settle these and similar problems.

Meanwhile I will conclude this address, which has already extended to an inordinate length, by directing your attention to two lines of evidence which have an important bearing on the question of the extent to which the Keltic element enters into the existing British population. A few years ago it was the fashion to assert that the English people were mainly Teutonic in origin, and that the older British population had been exterminated in the protracted struggle it carried on with the heathen hordes of Anglo-Saxon invaders. The statement in the "Saxon Chronicle" was quoted that the garrison of Anderida, or Pevensey, when captured by the Saxons in A.D. 491, was all put to the sword. But it is obvious that the fact would not have been singled out for special mention had it not been exceptional, while it is equally obvious that invaders who came by sea can hardly have brought their wives and children with them, and must have sought for both wives and slaves in the natives of the island. Mr. Coote, in his "Romans of Britain," and Mr. Seebohm, in his "English Village Community," have pointed out the continuity of laws and customs and territorial rights between the Roman and the Saxon eras, presupposing a continuity of population, and anthropologists have insisted that the survival of early racial types in all parts of the country cannot be accounted for by the settlement of the Bretons who followed William the Conqueror, or of the Welsh who came into England when the penal laws against them were repealed by Henry VIII. But the advocates of the theory of extermination had always one argument which seemed to them unanswerable, and which indeed was the origin of their theory. The language of the Anglo-Saxons contains scarcely any words borrowed from Keltic. Such a fact was held to be inexplicable except on the hypothesis that the speakers of the Keltic dialects were all exterminated before any intercourse was possible between them and the invading Teuton.

But I think I can show that the fact admits of quite another explanation. Roman Britain was in the condition of Roman Gaul; it was a Roman province, so thoroughly Romanized indeed that before the end of the first century, according to Tacitus ("Agric.," 18-21), even the inhabitants of North Wales had adopted the Roman dress and the Roman habits of luxury. After four centuries of Roman domination it is not likely under these circumstances that the dialects of the British tribes would have resisted the encroachments of the Latin language any more than did the dialects of Gaul. The language, not only of government and law, but also of trade and military service, was Latin, while the slaves and servants who cultivated the soil were bound to understand the language of their masters. Moreover, Britain was a military colony; the natives were drafted into the army, and there perforce had to speak Latin. If Latin had not been the language of the country at the time the Romans left it, the fact would have been little short of a miracle.

That it was so is certified by more than one piece of evidence. The inscriptions which have survived from the period of the Roman occupation are numerous; with the exception of three or four Greek ones, they are all in Latin. Of a Keltic language or dialect there is no trace. When the Romans had departed, and the inhabitants of Wales and Cornwall had been cut off from intercourse with the civilized world, Latin was still the ordinary language of the mortuary texts. It is only gradually that Keltic oghams take their place by the side of the Roman characters. When St. Patrick writes a letter to the Welsh prince of Cardiganshire, addressed not only to him but to his people as well, it is in the Latin language; when St. Germanus crosses into Britain to settle a theological controversy, and leads the people to victory against the Saxon invader, he has no difficulty in being understood; and the proper names of the British leaders continue to be Roman long after the departure of the Roman legions. What clinches the matter, however, is the positive statement of Gildas, the British writer, the solitary witness who has survived to us from the dark period of heathen invasion. He asserts that the ships called "keels" by the Saxons were called *longæ naves* "in *our* language" ("nostra lingua," "Hist.," 23). In the middle of the sixth century, therefore, Latin was still the language of the Kelt south of the Roman Wall. Such being the case, it is not Keltic but Latin words that we must expect to have been borrowed by Anglo-Saxon, if the British population, instead of being exterminated, lived under and by the side of their Teutonic invaders. Now these borrowed Latin words exist in plenty. They have come not only from the speech of the towns, but also from the speech of the country, proving that the country population must have used Latin like the inhabitants of the towns. In an interesting little book by Prof. Earle on the Anglo-Saxon names of plants, a list is given of the names of trees and vegetables that have been taken from a Latin source. Where the tree or the vegetable was one with which the invaders had not been acquainted in their original home, the name they gave to it was a Latin one, like the *cherry* or *cerasus*, the *box* or *buxus*, the *fennel* or *feniculum*, the *mallow* or *malva*, the *poppy* or *papaver*, the *radish* or *radix*. Such names they could have heard only from the serfs who tilled the ground for their new lords, not from the traders and soldiers of the cities. It is much the same when we turn to the names of agricultural implements which imply a higher order of culture than the simple plough or mattock, the name of which last, however is itself of Keltic origin. Thus the coulter is the Latin *culter*, the sickle is the Latin *secula*. That other agricultural implements bore Teutonic names proves merely that the Saxons and Angles were already acquainted with them before they had quitted their primitive seats.

The philological argument has thus been cut away from under the feet of the advocates of the theory of extermination, and shown to tell precisely the contrary tale. It has disappeared like the philological argument by which the theory of the origin of the Aryans in Asia was once supposed to be supported. But there still remains one difficulty in our path.

This is the fact that the languages spoken in Wales, and till recently in Cornwall, are Keltic and not Latin. If Latin had been the language of the Keltic population of Southern Britain when the Romans left the island, how is it that where the Keltic population still retains a language of its own that language is Keltic? The answer to this question is to be found in history and tradition. Up to the sixth century the Teutonic invaders gained slowly but steadily upon the resisting Britons. They forced their way to the frontiers of what is now Wales, and there their further course was checked. The period when this took place is the period when Welsh literature first begins. But it begins, not in Wales, but in Strathclyde, or South-Western Scotland, to the north of the Roman Wall. Its first records relate to battles that took place in the neighbourhood of Carlisle. From thence its bards and heroes moved southwards into North Wales. Tradition commemorated the event as the arrival in Wales of "Cunedda's men." The sons of Cunedda founded the lines of princes who subsequently ruled in Wales, and the old genealogies mark the event by suddenly substituting princes with Welsh names for princes with Latin names. The rude Keltic tribes of Strathclyde came to the assistance of their more cultured brethren in the south, checking the further progress of the foreigner and imposing their domination and language upon the older population of the country. It is probable that the disappearance of Latin was further aided not only by the destruction of the cities and the increasing barbarism of the people, but also by the settlement of Irish colonies, more especially in South Wales. At all events the ruin of cities like Caerleon and Caerwent must be ascribed to Irish marauders. We can now explain why it is not only that Wales speaks Welsh and not Latin, but also why a part of the country which, according to Prof. Rhŷs, was mostly peopled by Gaelic tribes before the Roman conquest, speaks Cymric and not Gaelic. As for Cornish, its affinities were with Breton, and since history knows of frequent intercourse between Cornwall and Brittany in the age that followed the departure of the Romans we may see in the Cornish dialect the traces of Breton influence.

The arrival of "Cunedda's men" and the re-Keltization of Wales leads me to the second line of evidence to which I have alluded above. The bearing of the costume of a people upon their ethnography is a matter which has been much neglected. But there are few things about which a population—more especially in an early stage of society—is so conservative as in the matter of dress. When we find the Egyptian sculptor representing the Hittites of the warm plains of Syria clad in the snow-shoes of the mountaineer, we are justified in concluding that they must have descended from the ranges of the Taurus, where the bulk of their brethren continued to live, just as the similar shoes with turned-up ends which the Turks have introduced among the upper classes of Syria, Egypt, and Northern Africa, point to the northern origin of the Turks themselves. Such shoes are utterly unsuited for walking in over a country covered with grass, brushwood, or even stones; they are, on the contrary, admirably adapted for walking on snow.

Now the dress of Keltic Gaul and of Southern Britain also when the Romans first became acquainted with it was the same as the dress which "linguistic palæontology" teaches us had been worn by the primitive Aryans in their first home. One of its chief constituents were the *bracæ*, or trousers, which accordingly became to the Roman the symbol of the barbarian. We learn, however, from sculptures and other works of art, that before the retirement of the Romans from the northern part of Europe they had adopted this article of clothing, at all events during the winter months. That the natives of Southern Britain continued to wear it after their separation from Rome is clear from a statement of Gildas ("Hist." 19) in which he refers in no flattering terms to the kilt of the Pict and the Scot. Yet from within a century after the time of Gildas there are indications that the northern kilt, which he regards as so strange and curious, had become the common garb of Wales. When we come down to the twelfth century we find that it is the national costume. Giraldus Cambrensis gives us a description of the Welsh dress in his own time, from which we learn that it consisted simply of a tunic and plaid. It was not until the age of the Tudors, according to Lluyd, the Welsh historian of the reign of Elizabeth, that the Welsh exchanged their own for the English dress.[1] The Welsh who served in the army of Edward II. at Bannockburn were remarked even by the Lowland Scotch for the scantiness of their attire (Barbour's "Bruce," ix. 600-603), and we have evidence that it was the same a century later.[2] If we turn to Ireland we find that in the days of Spencer, and later, the national costume of the Irish was the same as that of the Welsh and the Highland Scotch. The knee-breeches and sword-coat which characterize the typical Irishman in the comic papers are survivals of the dress worn by the English at the time when it was adopted in Ireland.

The Highland dress, therefore, was once worn not only in the Scotch Highlands and in Ireland, but also in Wales. It characterized the Keltic parts of Britain with the exception of Cornwall and Devonshire. Yet we have seen that up to the middle of the sixth century, at the period when Latin was still the language of the fellow-countrymen of Gildas, and when "Cunedda's men" had not as yet imposed their domination upon Wales, the old Keltic dress with trousers must have been the one in common use. Now we can easily understand how a dress of the kind could have been replaced by the kilt in warm countries like Italy and Greece; what is not easily conceivable is that such a dress could have been replaced by the kilt in the cold regions of the north. In warm climates a lighter form of clothing is readily adopted; in cold climates the converse is the case.

I see, consequently, but one solution of the problem before us. On the one hand, there was the distinctive Keltic dress of the Roman age, which was the same as the dress of the primitive Aryan, and was worn alike by the Kelts of Gaul and Britain and the Teutons of Germany; on the other hand, there was the scantier and colder dress which originally characterized the coldest part of Britain, and subsequently mediæval Wales also. Must we not infer, in the first place, that the aboriginal population of Caledonia and Ireland was not Keltic—or at least not Aryan Keltic? and, secondly, that the dominant class in Wales after the sixth century came from that northern portion of the island where the kilt was worn? Both inferences at all events agree with the conclusions which ethnologists and historians have arrived at upon other grounds.

Perhaps what I have been saying will show that even a subject like the history of dress will yield more results to ethnological study than is usually supposed. It will be another illustration of the fact that the student of humanity cannot

[1] "The Breviary of Brytaine," Twyne's translation, p. 35 (ed. 1573).

[2] See Jones, "History of the County of Brecknock," vol. i. p. 283; comp. "Archæologia Cambrensis," 5th ser. No. 7 (1885), p. 227.

afford to neglect any department of research which has to do with the life of man, however widely removed it may seem to be from science and scientific methods of inquiry. "Homo sum; humani nihil a me alienum puto."

## REPORTS.

*Report of the Committee, consisting of Profs. Tilden, W. Chandler Roberts-Austen, and Mr. T. Turner, on the Influence of Silicon on the Properties of Steel.*—One series of experiments has been completed, and the results obtained are:—On adding silicon to the purest Bessemer iron, the metal is originally red short, especially at a dull red heat, though it works well at a welding temperature; the red shortness is increased by silicon. Silicon increases the elastic limit and tensile strength, but diminishes the elongation and the contraction of area, a few hundredths per cent. having a remarkable influence in this respect. The hardness increases with the increase of silicon. With 0·4 per cent. of silicon and 0·2 per cent. of carbon, a steel was obtained difficult to work at high temperatures, but tough when cold, capable of being hardened in water, and giving a cutting-edge which successfully resisted considerable hard usage.

*Report of the Committee, consisting of Profs. Tilden, Ramsay, and Dr. Nicol, on the Nature of Solution.*—The constants of supersaturated and non-saturated solutions have been examined. Starting from non-saturated solutions, the temperature was lowered until the point of saturation was reached, and the physical properties of solutions near the point of saturation were examined at a constant temperature (20°). There appears to be no difference of physical properties within these limits from those of ordinary solutions. Experiments are also described on the specific viscosity of solutions, and there is added also a report on the bibliography of the subject.

*Report of the Committee on Isomeric Naphthalene Derivatives.*—Prof. Armstrong pointed out how naphthalene obeys the $\alpha$-law, and described the formation of the dichlorides by different methods. He showed that the products, though at first apparently the same, have been now proved distinct. He also went into the sulphonating of $\beta$-naphthols.

*Second Report on the Cae Gwyn Cave, North Wales*, by Dr. H. Hicks.—The main object that the Committee had in view this year was to extend the excavation which had been made in front of the new entrance to the cavern, discovered last year, so that a clear section of the deposits which covered that entrance might be exposed. Work was commenced on June 6 and continued to the 18th, when it was decided that a sufficient excavation had been made, and work was for the time suspended. The excavation was visited daily by some members of the Committee. It was found necessary to remove much of the timber placed last year to support the face in front of the entrance, so that the section might be clearly exposed, and the cutting was widened here sufficiently to show a vertical face of undisturbed deposits. The timber supporting the north-east face of the cutting was allowed to remain, as that portion had been well exposed last year, and it was thought that the excavation in front and to the south-west would yield all necessary evidence without incurring that additional trouble and expense. The cutting was carried in a south-south-west direction from the mouth of the cavern, and beyond the dip in the field supposed to indicate the line of an old fence; the length from the timber on the north-east face to the commencement of the dip in the field being about 30 feet, and the width varying from 5 to 10 feet; the narrowest part being at the furthest point from the cavern. In the face exposed in front of the entrance, and for a distance in the cutting from there of about 25 feet, the soil varied in depth from 18 inches to 2 feet, but at the slope supposed to indicate the line of the old fence it thickened considerably. Underlying this throughout the whole length of the cutting and in the field beyond this point, a boulder-clay of a reddish-brown colour was exposed. This boulder-clay contained thin seams of sand, which were traceable generally at the same horizon along the whole section. At a depth of about 7 feet from the surface, in a continuous band of reddish sandy clay, numerous fragments of marine shells and some perfect ones were met with, and these have been recognized by Mrs. McKenny Hughes to belong to the following species, viz. *Ostrea* sp., *Mytilus* sp., *Nucula nucleus*, *Cardium echinatum*, *C. edule*, *Cyprina islandica*, *Astarte borealis*, *Artemis exoleta*, *Venus gallina?*, *Tellina balthica*, *Psammobia ferröensis*, *Donax?*, *Mya truncata*, *Littorina* sp., *Turritella terebra*, *Buccinum undatum*. Below the boulder-clay, at a depth of about 9 feet from the surface, there was exposed some sandy gravel and fine banded sand with a total thickness of over 6 feet, and under the latter a well-defined band of finely laminated reddish clay. Below the laminated clay the brecciated bone-earth was found to extend as far as the cutting was made in front of the entrance, and also for a distance of 7 feet in a southerly direction from the entrance. This year only a few fragments of bone and bits of stalagmite were obtained from this earth, though it will be remembered that last year it yielded many teeth as well as the flint flake which was discovered near the entrance. The limestone floor under the bone-earth was found to rise gradually outwards from the mouth of the cavern for some distance, forming a shallow basin-shaped space in front of the entrance. In the bone-earth in this space there were several large angular blocks of limestone. It was not thought necessary to dig down to the floor along the whole length of the cutting, but it was traced for 7 feet in that direction by the side of the cliff against which the deposits abutted. Beyond that point the cutting was made deep enough to reach the sandy gravel under the boulder-clay, and at different parts test-holes were sunk still deeper into the gravel and sand. One hole was also sunk in the field in front of the cutting at a distance of over 35 feet from the entrance to the cavern. The deposits here were found to be similar to those in the cutting and in front of the cavern, but the depth of soil over the boulder-clay was only from 1 foot to 18 inches. A very large number of smoothed and ice-scratched boulders were found, many of considerable size; the majority being fragments of Wenlock shale from the neighbourhood and Lower Silurian rocks from the Snowdonian area. Amongst them also were fragments of granite, gneiss, quartzites, flint, diorites, basalts, Carboniferous rocks, &c.

*Report of the Committee, consisting of Mr. John Cordeaux, (secretary), Prof. A. Newton, Mr. J. A. Harvie-Brown, Mr. William Eagle Clarke, Mr. R. M. Barrington, and M. A. G. More, reappointed at Birmingham for the purpose of obtaining (with the consent of the Master and Brethren of the Trinity House and the Commissioners of Northern and Irish Lights) observations on the Migration of Birds at Lighthouses and Light-vessels, and of reporting on the same.*

The General Report[1] of the Committee has been printed in a pamphlet of 174 pages, and includes observations from 126 stations out of a total of 198 supplied with schedules, letters of instruction, and cloth-lined envelopes for wings; altogether 280 schedules have been sent in. In the last report attention was particularly directed to those main highways or lines of migration by which birds approach the east coast of Scotland both in the spring and autumn. Two chief lines seem to be clearly indicated, by the Pentland Firth and Pentland Skerries, also by the entrance of the Firth of Forth as far north as the Bell Rock Lighthouse. Continued observations also indicate that on the east coast of England the stream of migration is not continuous over the whole coast line, but seems to travel along well-established lines, which are persistently followed year by year.

On the east coast of England there seems to be a well-marked line, both of entry and return, off the Farn Islands, on the coast of Northumberland. Scarcely second to this in importance is the mouth of the Tees, both in the spring and autumn. The North Yorkshire coast and the elevated moorland district from the south of Redcar to Flamborough, including the north side of the headland, is comparatively barren, few birds appearing to come in. Bridlington Bay and Holderness to Spurn and Lincolnshire, as far as Gibraltar Point, on the coast of Lincolnshire, give, perhaps, the best returns on the east coast. The north of Norfolk is poor, but there are indications, in the heavy returns annually sent from the Llynwells, Dudgeon, Leman and Ower, and Happisburgh Lightvessels, that a dense stream pours along the coast from east to west, probably to pass inland by the estuary of the Wash and the river systems of the Nene and Welland into the centre of England, thence following the line of the Avon valley and the north bank of the Severn and Bristol Channel, and crossing the Irish Sea to enter Ireland at the Tuskar Rock, off the Wexford coast. This is apparently the great and main

[1] "Report on the Migration of Birds in the Spring and Autumn of 1886." McFarlane and Erskine, 19 St. James's Square, Edinburgh, price 2s.

thoroughfare for birds in transit across England to Ireland in the autumn. Large numbers of migrants also which pass inland from the coasts of Holderness and Lincolnshire may eventually join in with this great western highway by the line of the Trent, avoiding altogether the mountainous districts of Wales. The Norfolk seaboard between Cromer and Yarmouth and the corresponding lightvessels show a large annual immigration, but the returns are much less, and comparatively meagre between Yarmouth and Orfordness. The coast of Essex, with the northern side of the Thames, is fairly good; but the coast of Kent, between the North and South Forelands, including the four Goodwin and the Varne Lightships, is a barren and pre-eminently uninteresting district for arrivals, both as regards numbers and species, the chief migrants seen being such as are apparently following the coast to the south.

Such migrants, both local and otherwise, which in the autumn follow the east coast from north to south, seem, as a rule, to pass directly from the Spurn to the Lincolnshire coast without entering the Humber; and there are no indications that they follow the shores of the Wash in and out, but shape their course from about Gibraltar Point to the Norfolk coast. The well-filled schedules sent in annually from the Shipwash, Swin Middle, Kentish Knock, and Galloper Lightships, indicate that a stream passes from the south-east coast of Suffolk across the North Sea in the line of these stations, to and from the Continent, both in the spring and autumn.

Autumn migrants approaching the Humber from the sea do not appear to follow the course of the river into the interior, that is, from south-east to north-west. The line would seem to cross the river diagonally, and is from east-south-east to west-north-west. This course is so persistently followed that year by year, on such days when migration is visible, birds are observed to cross the same fields and at the same angle. Supposing this course to be continued, they would strike the Trent at or near Gainsborough.

Much information has been obtained from the legs and wings sent in the envelopes provided for that purpose; and by this means already several rare and unusual wanderers have been recorded, not the least interesting being the occurrence of a small Asiatic species, the yellow-browed warbler, at Sumburgh Head, Shetland, on September 25, and an immature example of the American red-winged starling, at 3 a.m. on October 27, at the Nash Lighthouse, Bristol Channel. This station, situated on the coast of Glamorgan and on the north side of the Bristol Channel, lies directly in the track of the great highway followed by migrants from England to Ireland. The black redstart was killed at the Nash Lighthouse on the night of October 29; and another interesting occurrence was that of the green woodpecker, seen on October 26, with many other birds at sunrise passing to the south-east.[1] The black redstart was also received from the Fastnet, co. Cork, found dead on October 30. It is also recorded at four other stations on the south coast of Ireland, and its regular occurrence in the winter on the south and east coasts of that island has now been fully established by this inquiry. The regular occurrence in migration of the black redstart both off and on the east coast of England, as well as the example from the Nash Lighthouse, are suggestive of the route followed annually by some small portion of this Continental species, which curiously select as their winter quarters the south-west coasts of the British Islands. From the Irish coasts the rarities received were numerous, including the second Irish specimen of the wryneck from Arran Island, co. Galway, killed striking at 2 a.m. on October 6. From the Tearaght, co. Kerry, a pied flycatcher was caught at the lantern, September 21, the species only having once before occurred in Ireland—in April 1875. The repeated occurrence of the corncrake, several miles from shore—killed striking against lanterns between 100 to 200 feet above sea-level—must satisfy the sceptical that this well-known species can fly at a high level with great power and velocity. The waterrail, which seems so unwilling to fly, was received from the Fastnet and Tuskar on October 26 and 28; also from Spurn Lightvessel, November 1, one; Llyn Wells Lightvessel, November 4, two; and Coquet Island Lighthouse, same date, one; showing a widely extended migratory movement of this species during the last week in October and early in November.

[1] Mr. H. Nicholas, of the Nash [East] Lighthouse, under date of September 3, has recorded an enormous arrival of small birds—the greatest number ever seen there at any one time. These include four nightjars at 2.10 a.m., one killed; fifteen to twenty common buntings from 2.15 to 3 a.m., eight killed; fifty to sixty greater whitethroats from 2.15 to 3 a.m., twenty-four killed; twenty to thirty willow wrens from 2.30 to 3.20 a.m., seventeen killed; six young cuckoos at 3 a.m., two killed; fourteen house sparrows and one robin killed at 3 a.m.; thirty to forty wheatears at 3.10 a.m., two killed; three blackbirds from 3 to 3.15 a.m., one killed.

The great spotted woodpecker occurred in considerable numbers in the eastern counties of Scotland about the middle of October. Almost all the specimens examined were either old birds or with very slight traces of immaturity. This immigration extended southward to the coast districts of Lincolnshire, where very considerable numbers were obtained in the autumn and winter.

At Rathlin O'Birne (West Donegal) immense flocks of birds —starlings, thrushes, and fieldfares—passed *west* from December 18 to 23. The nearest land to the west of this rocky island is America. This is not an isolated occurrence. The westerly flight of land-birds at stations off the west coast of Ireland has been noticed on other occasions; the movement is apparently as reckless as that of the lemmings.

The autumnal passage of quails from England is shown by their occurrence at the Smalls Lighthouse, September 3, and the Eddystone on October 5; also a wing from the Shipwash Lightvessel, off the Essex coast, obtained on October 26.

An enormous rush of immigrants is recorded from the east coast of England on October 4, 5, and 6, with easterly and south-easterly winds, pressure system cyclonic, but the adverse meteorological conditions during this period slowly passing away. Much fog and thick weather at the time, which in a great measure may account for the immense numbers of birds seen at the lanterns of lighthouses. The movement was less apparent on the east coast of Scotland, the winds being east-north-east and north-east, having a tendency to crush down migration, giving it a more southerly direction. On the west coast of Scotland, during the same period, at the majority of stations the rush of birds was enormous; but the movement was much less accentuated on the west coast of England, and to a less degree still on the Irish coasts. The rush is by far the largest ever recorded since the opening of this inquiry.

As usual on the east coast of England, rooks, daws, hooded crows, starlings, and larks occupy a considerable portion of the returned schedules. Chaffinches have crossed the North Sea in extraordinary numbers. They are always numerous, but this autumn the immigration has been in considerable excess of previous years. With these exceptions, however, there has been a singular and very marked falling off in the migration of some species whose breeding range lies chiefly in the north of Europe. This has been especially noticeable in the small arrivals recorded of fieldfares, redwings, ring-ousels, bramblings, snow-buntings, short-eared owls, and woodcocks.

Eight reports have now been issued by your Committee, and the stations have again been supplied with the necessary papers for the returns of the observations in the present year. It seems highly desirable that an attempt should shortly be made to analyze, classify, and digest the large mass of facts brought together in these reports, so as to show, statistically and otherwise, the actual results which have been arrived at by the inquiry. It is intended that this shall be carried out at as early a date as possible. The Committee respectfully request their reappointment.

*Report of the Committee, consisting of H. Seebohm, R. Trimen, W. Carruthers, and P. L. Sclater (secretary), appointed for the purpose of Investigating the Flora and Fauna of the Cameroons Mountain.*—The Committee have the pleasure of reporting that a successful ascent of the Cameroons Mountain was made by Mr. H. H. Johnston on their behalf in the autumn of 1886. Mr. Johnston encamped at Mann's Spring, at an altitude of 7350 feet, about 300 feet above the forest region of the mountain, and remained there several weeks. A popular account of his expedition has been published, with illustrations, in the *Graphic* newspaper ("An Ascent of the Cameroons Mountain"). Mr. Johnston made considerable collections in zoology and botany. The zoological collections have been worked out by specialists in different branches, to whom the collections were referred by the Committee, and the results published in a series of papers in the Proceedings of the Zoological Society of London, of which the following are the titles:—

(1) "List of Mammals from the Cameroons Mountain, collected by Mr. H. H. Johnston," by Oldfield Thomas, Proc. Z.S. 1887, p. 121.

(2) "On a Collection of Birds made by Mr. H. H. Johnston on the Cameroons Mountain," by Capt. G. E. Shelley, Proc. Z.S., 1887, p. 122.

(3) "List of the Reptiles collected by Mr. H. H. Johnston, on the Cameroons Mountain," by G. A. Boulenger, Proc. Z.S., 1887, p. 127.

(4) "On the Mollusca collected at the Cameroons Mountain by Mr. H. H. Johnston," by Edgar A. Smith, Proc. Z.S., 1887, p. 127.

(5) "On some Coleopterous Insects collected by Mr. H. H. Johnston on the Cameroons Mountain," by Charles O. Waterhouse, Proc. Z.S. 1887, p. 128.

It will be observed that, although the collections are small, they are by no means devoid of interest. Out of eighteen species of birds of which examples were obtained, four were new to science, and a new land shell, of the genus *Gibbus*, was also discovered. The zoological specimens have been placed in the collection of the British Museum. The botanical specimens collected by Mr. Johnston were sent by the Committee to the Kew Herbarium, where they were placed in Prof. Oliver's hands for determination. As was to be expected, although the specimens were in many case acceptable, they have added very little to our knowledge of the flora of the Cameroons Mountain. With few exceptions all Mr. Johnston's species, of which a complete list is given in the appendix to this Report, are enumerated in Sir Joseph Hooker's paper on Mann's plants of the Cameroons, published in the Journal of the Linnean Society in 1864 ("Bot.," vol. vii. p. 181). A complete set of the duplicates has been deposited in the Botanical Department of the British Museum, and a second set of duplicates has been sent to the Royal Museum of Berlin. The sum of £75, granted to the Committee at Birmingham, has been paid to Mr. Johnston as a contribution towards the expenses of his expedition. The Committee ask to be reappointed, and a further sum of £100 placed at their disposal, as Mr. Johnston will in all probability be able to undertake a second expedition up the Cameroons Mountain in the course of the present autumn.

*Report of the Committee, consisting of Mr. Thiselton Dyer (secretary), Mr. Carruthers, Mr. Ball, Prof. Oliver, and Mr. Forbes, appointed for the purpose of continuing the preparation of a Report on our present knowledge of the Flora of China.*—The grant made by the Association has enabled the Committee to proceed with this important work, the third part of which, carrying the enumeration down to the end of the Rosaceæ, is now in the hands of the printer, and the fourth part has been commenced. Since the work was begun, about two years ago, several collections of dried plants have been received at Kew from China, notably a very extensive one from Dr. A. Henry, made in the little-known district of Ichang, in the province of Hupeh, in the very centre of China. And the Trustees of the British Museum have acquired the herbarium of the late Dr. Hance, containing the types of the large number of species published by him from time to time during a long residence in the country. Dr. Henry's collection includes a large number of novelties, besides the addition of many Himalayan and Japanese forms not previously known, from China; and Dr. Hance's herbarium greatly facilitates the limitation of the species where comparisons with his types are necessary. The published parts of the report have been freely distributed among English residents in China, and have no doubt been the means of stimulating some of them to greater activity now that they perceive that there is a probability of the results of their exertions being promptly published. Dr. Henry is specially interested in the origin of the numerous drugs used in Chinese medicine, and, aided by our determinations of the plants, we may assume that he will be able to make a substantial addition to our knowledge of the Chinese pharmacopœia. Mr. Ford, too, the Superintendent of the Hong Kong Botanic Garden, takes a lively interest in the work, and has rendered valuable assistance, doubtless with advantage to the establishment under his charge. Several eminent foreign botanists have alluded to the work as of great interest and importance, and the Committee have much satisfaction in reporting that circumstances are now favourable to more rapid progress in the future than hitherto. Simultaneously with the appearance of our "Index Floræ Sinensis," a French botanist, M. Franchet, is publishing a very extensive collection of plants made by French missionaries in Yunnan, a province from which there is almost nothing in the London herbaria; hence his labours supplement ours, and cover a distinct floral region. The Committee recommend their reappointment, and that a further grant of £100 be placed at their disposal.

*The Report of the Committee appointed to make suggestions with reference to the production of a bathy-hypsographical map of the British Isles and surrounding seas* was presented by Mr. Ravenstein. Other members of the Committee were General Walker, Sir William Thomson, and Mr. A. Buchan.—The conclusions arrived at by the Committee were that the heights as well as the depths should be referred to the Ordnance datum level, and that contours of the land and ocean-bed should correspond. With regard to the various methods of tinting the maps so as to express height, it was proposed that the sea should be coloured blue, lowlands up to 500 feet green, the next region orange, the really mountainous parts brown, the depth of colour increasing with the height. Maps tinted in various ways were exhibited.

*Report of the Committee, consisting of the Rev. Canon Carver, the Rev. H. B. George, Sir Douglas Galton, Prof. Bonney, Mr. A. G. Vernon Harcourt, Prof. T. McKenny Hughes, the Rev. H. W. Watson, the Rev. E. F. M. McCarthy, the Rev. A. R. Vardy, Prof. Alfred Newton, the Rev. Canon Tristam, Prof. Moseley, and Mr. E. G. Ravenstein (secretary), appointed for the purpose of co-operating with the Royal Geographical Society in endeavouring to bring before the authorities of the Universities of Oxford and Cambridge the advisability of promoting the study of Geography by establishing special Chairs for the purpose.*—The Committee beg leave to report that, at a meeting held on January 12, 1887, at the office of the Association, the following resolutions were adopted:—(1) That the Committee fully recognize the educational value of the scientific study of geography, and are agreed in thinking that geography should occupy a place among the subjects of study at the Universities of Oxford and Cambridge. (2) That the Council of the British Association be requested to give their support to the representations and offers made to the Vice-Chancellors of the two Universities by the Council of the Society in letters dated July 9 and December 9, 1886, of which copies are inclosed.

*Report of the Committee, consisting of Dr. J. H. Gladstone (secretary), Prof. Armstrong, Mr. Stephen Bourne, Miss Lydia Becker, Sir John Lubbock, Bart., Dr. H. W. Crosskey, Sir Richard Temple, Bart., Sir Henry E. Roscoe, Mr. James Heywood, and Prof. N. Story Maskelyne, appointed for the purpose of continuing the inquiries relating to the Teaching of Science in Elementary Schools.*—Your Committee, in continuing their periodic reports upon this subject, have to state that nothing has been done this year in the shape of actual legislation, but that great advance has been made in regard to the public appreciation of the importance of scientific and technical instruction.

The only alteration in the Code of this year that at all bears upon the matter is that drawing is withdrawn from the list of class subjects, which gives an advantage to the claims of geography and elementary science by removing a powerful competitor in those schools that can only take two class subjects.

The return of the Education Department for this year shows that the diminution previously noted in the teaching of science subjects still continues.

The statistics of the class subjects for the four years are given in the subjoined table, which shows an actual decrease in geography and elementary science, notwithstanding the increase in the number of departments examined. It will be seen that drawing begins to figure in this year's return, but the effect of it will be much more apparent in that for next year.

| Class Subjects. | | 1882–83. | 1883–84. | 1884–85. | 1885–86. |
|---|---|---|---|---|---|
| English ... | (Departments) | 18,363 | 19,080 | 19,431 | 19,608 |
| Geography ... | ,, | 12,823 | 12,775 | 12,336 | 12,055 |
| Elementary Science | ,, | 48 | 51 | 45 | 43 |
| History ... | ,, | 367 | 382 | 386 | 375 |
| Drawing ... | ,, | — | — | — | 240 |
| Needlework ... | ,, | 5,286 | 5,929 | 6,499 | 6,809 |
| | | 18,524 | 19,137 | 19,266 | 19,522 |

The return of passes in the scientific specific subjects on the individual examination of children shows again an actual falling off in the total, and either an actual or relative falling off in every subject except Mechanics, A. The large increase in the teaching of mechanics is due to the carrying out of the peripatetic method of teaching it by the School Boards of Liverpool Birmingham, Nottingham, and London. The figures are given in the following table:—

| Specific Subjects. | | 1882–83. | 1883–84. | 1884–85. | 1885–86. |
|---|---|---|---|---|---|
| Algebra ... | (Children) | 26,547 | 24,787 | 25,347 | 25,393 |
| Euclid and Mensuration | ,, | 1,942 | 2,010 | 1,269 | 1,247 |
| Mechanics, A ... | ,, | 2,042 | 3,174 | 3,527 | 4,844 |
| ,, B ... | ,, | — | 206 | 239 | 128 |
| Animal Physiology ... | ,, | 22,759 | 22,857 | 20,869 | 18,523 |
| Botany ... ... | ,, | 3,280 | 2,604 | 2,415 | 1,992 |
| Principles of Agriculture | ,, | 1,357 | 1,859 | 1,481 | 1,351 |
| Chemistry ... ... | ,, | 1,183 | 1,047 | 1,095 | 1,158 |
| Sound, Light, and Heat | ,, | 630 | 1,253 | 1,231 | 1,334 |
| Magnetism and Electricity | ,, | 3,643 | 3,244 | 2,864 | 2,951 |
| Domestic Economy ... | ,, | 19,582 | 21,458 | 19,437 | 10,556 |
| | | 82,965 | 84,499 | 79,774 | 78,477 |
| Number of Scholars in Standards V., VI., VII. | ... | 286,355 | 325,205 | 352,860 | 393,289 |

The rapid and serious decrease of attention paid to these science subjects is shown by the percentage of children who have passed as compared with the number of scholars that might have taken these subjects, viz.:

In 1882–83 ... ... 29·0 per cent.
,, 1883–84 ... ... 26·0 ,,
,, 1884–85 ... ... 22·6 ,,
,, 1885–86 ... ... 19·9 ,,

and it must be remembered that when children have passed in two of these subjects they count twice over.

Of course a good deal of scientific instruction is given in many elementary schools under the name of object-lessons, not only in the infants', but also in the boys' and girls' departments; but this is neither examined by Her Majesty's inspector, nor encouraged by a grant except in the few cases where it comes in as a class subject under the name of elementary science. These object lessons are therefore very apt to be neglected. The same remark applies in the case of pupil teachers. It may be worthy of record that in the pupil-teachers' schools of the London Board natural history and the principles of physics are taught systematically in the junior division, and this year an examination has been held by the Board inspectors, and certificates of proficiency are to be awarded.

The Royal Commission appointed to inquire into the working of the Education Acts of England and Wales issued their first Report in August last, from which it appears that two of the points of inquiry bore directly upon the scope of this Committee. The one was, "Elementary Science: to what extent can it be taught in elementary schools?" The other, "Technical Instruction: as grants are made in girls' schools for needlework, why not for mechanical drawing and handicraft in boys' schools?" Another instalment of the evidence was issued in June last.

With reference to the first-named subject of inquiry, Her Majesty's inspectors and others who were examined appear not only of opinion that elementary science is of importance, but some maintain, with Matthew Arnold, that "*Naturkunde* should be a necessary part of the programme." Most of them agree with the view expressed by this Committee, that the absolute preference given to English as a class subject should be abolished, and the choice thrown perfectly open.

With reference to the second subject of inquiry, the evidence of Sir Philip Magnus, Dr. Crosskey, Mr. Hance (Clerk to the Liverpool School Board), and others is distinctly in favour of it, showing that it is both desirable and practicable.

It appeared to your Committee that the British Association should contribute its views on these subjects to the Royal Commission, and they accordingly passed a resolution to that effect. This met with the approval of the Council. Two of the members of the Committee have since given evidence. The Rev. Dr. Crosskey enforced strongly the importance of elementary science and technical instruction, and more recently Sir Henry Roscoe, as the mouth-piece of the Committee, presented a series of the reports of this Committee and a memorial emphasizing the two points of special importance, viz. as to the absolute preference given to English, and as to the want of provision for insuring the instruction of pupil-teachers in any kind of elementary science. The memorial also repeated their approval of the recommendation of the Royal Commission on Technical Instruction, "That proficiency in the use of tools for working in wood and iron be paid for as a specific subject, arrangements being made for the work being done, as far as practicable, out of school hours. That special grants be made to schools in aid of collections of natural objects, casts, drawings, &c., suitable for school museums."

An important meeting of gentlemen interested in popular education was held at the house of Mr. George Dixon, at Birmingham, last November, at which some of your Committee were present. This has led to several courses of action. The resolutions come to at this meeting were adopted in the following form by the School Board for Birmingham:—

I. That it is desirable that an enabling Bill should be introduced into Parliament to give School Boards power to provide and maintain schools in connexion with the Science and Art Department, in which a course of instruction extending over a period not exceeding three years may be given in accordance with its regulations, such schools to be open only to scholars who have passed the sixth standard in public elementary schools.

II. That in Article 113 of the Code of Regulations of the Education Department, affecting evening schools, Paragraphs IV., V., and VII. of sub-section (b) should be omitted. These paragraphs read thus:—"IV. No scholar may be presented for examination in the additional subjects alone. V. No scholar may be presented for examination in more than two of the additional subjects. VII. Scholars presented for examination in the third or fourth standard, if they take one additional subject, must take English; if they take two, the second subject must be drawing, geography, or elementary science."

III. That the words in Article 13 of the Code of Regulations of the Education Department, which exclude scholars who have passed the seventh standard from the number of grant-earning scholars, and also the words in the Instructions to Her Majesty's Inspectors which bear on this part of the said article of the Code, should be expunged.

These were afterwards brought before the Education Department on December 14 by a deputation of the Birmingham, Leicester, and Nottingham Boards, which was unofficially joined by members of the London Board. Two Bills have been brought into Parliament, and have passed their first reading. The one introduced by Sir Henry Roscoe relates to technical education (day schools), and embodies the substance of the above resolution, No. I. The other is introduced by Prof. Stuart, and relates exclusively to evening continuation schools, embodying the substance of Resolution No. II. Sir Richard Temple, the Vice-Chairman of the London School Board, also propounded a scheme by which technical and commercial instruction might be given in Board schools. Quite recently the Government have brought in a Bill dealing with the same subject, which has been read the first time.[1]

In consequence of the Government having given notice of their intention to introduce such a Bill this session, Mr. George Howell withdrew the resolution of which he had previously given notice—"That in the opinion of this House it is essential to the maintenance and development of our manufacturing and agricultural industries, in view of the rapidly increasing competition of other nations, both at home and abroad, and in consequence of the almost universal abandonment of the system of apprenticeship, that our national scheme of education should be so widened as to bring technical instruction, the teaching of the natural sciences, and manual training within the reach of the working classes throughout the country."

The Brighton School Board has opened an "Organized Science School," under the sanction of the Science and Art Department;

[1] This Bill of Sir Wm. Hart Dyke was read a second time with little opposition, though with some suggestions of amendment; but it had to be abandoned on August 18, on account of press of business.

but the official auditor has decided that all expenses incurred in respect of it are illegal, and has surcharged the Board with the balance not covered by the receipts. Appeal will be made to the Local Government Board against the decision of the auditor.

The experiment in manual instruction at Beethoven Street School was considered by the London School Board so successful that it was resolved to open five more classes of the same kind, but they were suspended in consequence of the official auditor having in the meantime surcharged the Board with the costs incurred for the workshop and tools. Appeal was made in November last against the surcharge of the auditor, but no answer has yet been received from the Local Government Board. The instruction is now being continued at Beethoven Street School, as a specific subject, with the concurrence of the inspector. That this subject finds favour with the elementary teachers is manifest from the fact that eighty of them have availed themselves of the opportunity offered by the City and Guilds of London Institute of qualifying themselves to give instruction in the use of tools, and many more applied who could not be accommodated.

The British and Foreign School Society have started a joinery class at their Training College in the Borough Road, which is attended by all the senior students, in which instruction is given both in the theory and practice of carpentry.

The London School Board on May 19 adopted, by a very large majority, the motion of the Rev. C. D. Lawrence—"That, in the opinion of this Board, it is necessary to introduce into elementary schools some regular system of manual training,"—and the matter was referred to a special committee on the subjects and modes of instruction in the Board's schools, which is now sitting.

The first examination by the Science and Art Department in the alternative first stage of chemistry has taken place, and may be considered to mark a great advance in the teaching of that subject. That the teachers were eager for such instruction is evident from the fact that as many applied for permission to attend Prof. Armstrong's course of lectures established by the City and Guilds of London Institute as that institution could be made to accommodate.

There has recently been formed a "National Association for the Promotion of Technical Education," which includes the leading politicians who have given special attention to the subject of education.

From this review of the present situation it would appear that the action of the Education Department tends positively to frustrate the efforts of those who desire to increase the teaching of natural science in elementary schools; but your Committee do not believe that that is the intention of those in authority, and feel sure that the great advance in public opinion will ultimately lead to a knowledge of the elements of science being made an essential part of all State-aided education.

*Report of the Egyptian Photographs Committee.*—A full account was given of the valuable work done by Mr. Flinders Petrie, on behalf of the Committee, in the early part of the year. In addition to the photographs, Mr. Petrie obtained 180 casts from paper squeezes of the sculptures, and from these casts photographs have been taken on a uniform scale; a full list of the casts and photographs is appended to the report.

*Report of the North American Indian Committee.*—This report contains a Circular of Inquiry drawn up for distribution amongst those most likely to be able to supply the Committee with information; and a Report on the Blackfoot Tribes, drawn up by the Rev. Edward F. Wilson, and supplemented by some notes by Mr. Horatio Hale.

*Report of the Electrolysis Committee*, by Dr. Oliver Lodge.—In laying before the Section this report of the Committee appointed by Sections A and B to consider the subject of electrolysis in its physical and chemical bearings, I should first say that, whereas the main lines of the report have been approved and ordered by the Committee, the details and wording have not yet received final sanction, so that if the first person singular should accidentally occur in places where it ought not, it is to be understood that the real official report is that which will appear in the annual volume of the Association, and that the present is to be regarded as merely a general outline of that report.

Work has been carried on during the past year by several members of the Committee; and nearly all the questions issued after the Aberdeen meeting by the secretary have been in some shape or other attacked.

The first, on the accuracy of Ohm's law of electrolysis, by Prof. FitzGerald and Mr. Trouton, who reported last year and will make a further report to-day.

The second, on conduction in semi-insulators, by Prof. J. J. Thomson and Mr. Newall. See the Proceedings of the Royal Society, No. 256, 1887.

On the third question, the mode of conduction of alloys, Prof. Roberts-Austen will inform us of his experiments to-day.

Mr. Shelford Bidwell has experimented on the subject of the fourth question, concerning the transparency of electrolytes.

The sixth, seventh, and eighth, on the velocity of ions, are being worked at by the secretary.

Concerning the ninth we have heard from Mr. J. Brown, of Belfast; and on the tenth we have had a letter from Prof. Willard Gibbs.

In order to enable the members of so large a Committee to work with some knowledge of what each other is doing, and also to keep up a general intercommunication and interest in the subject, it has been thought desirable and proper to spend a certain portion of the sum granted to the Committee in printing and postage. Periodical circulars have been sent among the members and to a few outsiders likely to be interested, and these have been the means of drawing out one or two communications of very distinct interest and value.

It is felt that such informal reports of discussion and free circulation of provisional communications are sufficiently useful to justify the Committee in continuing the practice, which was begun as an experiment, and they accordingly are asking for reappointment, with another grant of £50, of which not more than £20 is to be spent in printing and postage. They should explain that of the grant made last year to the Committee £20 has been purposely allowed to lapse, for it had been intended to try some chemical experiments on very pure substances, and these experiments have not yet been begun. The £30 applied for has been spent, about £15 in printing, £4 in postage, and £11 in experimental expenses contracted by the secretary.

Your Committee feel that the expenditure of a small sum such as this has acted, and may be expected to act, as a trigger capable of liberating in useful directions a considerable amount of energy, which otherwise might have remained potential.

There are several moot points at present more or less under discussion within the Committee, and I am instructed to lay them before this meeting with the object of eliciting some opinions, suggestions, or information.

First I may instance the obvious question whether electrolytic conduction and metallic conduction are sharply separated off from one another by a line of demarcation, so that no substance distinctly possessing one also possesses a trace of the other.

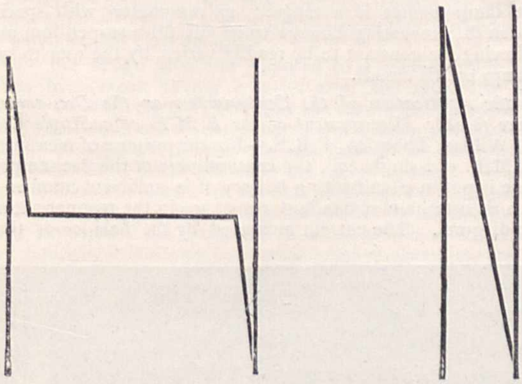
Certain contributions by von Helmholtz, among which we must reckon one on our list for to-day, lead one to believe that the conduction of ordinary electrolytes is *purely* electrolytic, and that no trace of current slips through them without carrying the atoms with it, *i.e.* without incipient decomposition.

A contribution expected from Prof. Roberts-Austen may perhaps answer the opposite question, viz. whether any ordinary metallic alloy can conduct in the least electrolytically—*i.e.* whether a well-marked metallic alloy or *quasi*-compound can be in the slightest degree electrolyzed by an exceedingly intense electric current.

Supposing both these questions answered in the simplest manner, viz. in the negative, there must surely remain a group of bodies on the borderland between alloys proper and electrolytes proper, among which some shading off of properties, some gradual change from wholly metallic to wholly electrolytic conduction is to be looked for. Until all such bodies as are tractable to experiment have been cautiously and strenuously examined, we are unable to say whether there is a hard and fast line between the two modes of conduction, or in what manner the gradation from one to the other occurs.

That is the first question. A second concerns the very vital point whether an electric current actually decomposes or tears asunder the molecules of a liquid through which it passes; or whether it finds a certain number of them already torn asunder or dissociated into their atoms by chemical, or at any rate non-electrical, means, these loose and wandering atoms thus falling an easy prey to the guiding tendency of the electric slope, and joining unresistingly one or other of two processions towards either electrode, only at the last moment attempting a brief and unavailing struggle, when the electrode suddenly looms foreign and forbidding across a molecular distance of $10^{-8}$ centimetres.

One mode of regarding the facts is to say that across this molecular range of $10^{-8}$ the electrical forces *are* competent to tear atoms asunder. The E.M.F. of a volt or so can be shown by calculation to be able to do this, so that the difference between an electrolyte and a dielectric may be typified diagrammatically thus:—



Electrolyte. Dielectric.

The two vertical lines are electrodes, the slant or broken line represents the slope of potential in the two cases respectively.

Prof. Schuster has now discovered one way in which dielectrics shade off into electrolytes; for he finds that in the neighbourhood of an electric discharge rarefied gases are able to conduct as electrolytically as liquids themselves. This discovery that the atoms of gas possess atomic charge as well as those of liquids, if confirmed by further research, is one of considerable interest.

But why do we assert the horizontality of the line of slope in the fluid? Why do physicists feel constrained to assert that no internal static electric stress is possible in the interior of a mass of fluid? The question is but the paraphrase of another—Why do we believe liquids to obey quite accurately Ohm's law for very minute forces? On this head we have direct experimental evidence by Prof. FitzGerald and Mr. Trouton, and less direct but equally conclusive evidence from von Helmholtz. Whether the evidence is perfect and thorough is doubtless a debatable point, but this much is not debatable: it is out of the question to assert that liquids obey Ohm's law and at the same time to assert the existence of a finite electrostatic stress in the interior of a fluid. In other words, however chemists are able to explain the fact of unresisting atomic processions through the liquid—whether by actual procession of individuals or by continual directed interchange—they will be rigorously driven to some form of such doctrine as soon as they accept the evidence for the accuracy of Ohm's law in electrolytic conduction.[1]

We all know that this doctrine of non-resistance is in some shape or another the old Williamson-Clausius hypothesis, which was based on then newly-known facts concerning dissociation.

It would appear, however, that some chemists demur to the existence of a constant average of dissociation among the molecules of a liquid; and it behoves us of Section A to receive their scruples with great respect, being, we may suppose, based upon intimate familiarity with all manner of circumstances and reactions of which we physicists are only superficially cognizant.

But there are ways of picturing all that is necessary to free atomic interchange without postulating actual and constant dissociation. A *potential* dissociation will be granted, sufficient for all purposes, provided chemists admit the probability of a frequent interchange of atoms among the molecules of an electrolyte going on always before any E.M.F. has been applied.

Concerning this or other mode in which electrolytic conduction takes place, we may congratulate ourselves on the presence here of Prof. Quincke and Prof. Wiedemann, and we hope to hear something from them. The experiments of Dr. Gladstone, and also some unpublished ones of Prof. J. J. Thomson, communicated to the Committee in a letter, will probably be found to have a bearing on this point.

The question whether there is any radical distinction to be drawn between ordinary compounds and so-called molecular compounds appears to be an open one. Various physical facts lead one to suppose that whereas the ordinary forces of chemical affinity are strictly electrical there may be other non-electrical forces as well, and that such compounds as are held together by these latter forces are intractable to electrical influence. It is difficult for physicists to understand certain facts without the hypothesis of some non-electrical forces between atoms; but on such a subject as this chemists are likely to have in their hands evidence which, if at all decided and distinct, would be entitled to very great weight.

The subject of the partition of the current among different electrolytes when mixed together, and the question of the part the solvent plays in the conduction seem scarcely suitable for discussion at the present stage, because they only require a few rigorous experiments on lines already laid down to settle them. But I may just say that whereas at a former meeting I thought I had obtained experimental evidence that the water conducted some fourth part of the current in certain solutions, I have since found that, using purer substances, and taking extreme care to avoid loss of weight by spray, which source of loss is very subtle, this evidence puts on another complexion; and at the present time I am disposed to coincide more cordially with the orthodox view, that water conducts almost as little when forming part of a solution as when existing alone. Further experimental evidence is still being obtained, however, and perhaps Mr. Shaw has something to communicate on this head.

Among several communications received by the Committee from non-British philosophers is an exceedingly suggestive one by Prof. Willard Gibbs, which raises a very interesting point.

It is perfectly well known that in 1851 our present chairman, Sir William Thomson, reasoning from some experiments of Joule, taught us how to calculate the E.M.F. of a cell from thermo-chemical data,

$$E = \Sigma(J\epsilon\theta);$$

or

$$\frac{\Sigma\theta''}{46000} \text{ volts.}$$

Strictly speaking he hedged with regard to reversible heat effects in a way equivalent to the complete equation—

$$E = \Sigma(J\epsilon\theta) - \Sigma(J\Pi) \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Where $\Pi_1$ is the heat developed at junction 1 per unit quantity of electricity conveyed across it, $\Pi_2$ the same at the second junction, and so on.

But the value of $\Pi$, in any given case, is extremely difficult to measure, especially at metal-liquid and liquid-liquid junctions. Bouty has attempted it with but small success.

Fortunately Helmholtz has thought of applying the second law of thermodynamics to the subject, and shown that it was only necessary to know the rate at which the E.M.F. of a cell varied with temperature in order to know the sum of the $\Pi$. For, quite analogous to Prof. James Thomson's freezing-point relation—

$$dp\delta v = J\frac{dT}{T}L,$$

is the following E.M.F. relation—

$$dE\delta Q = J\frac{dT}{T}\delta H,$$

or

$$\Sigma\Pi = \frac{\delta H}{\delta Q} = \frac{T\,dE}{J\,dT} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Putting the two equations together we get—

$$E = JT\epsilon\int\frac{\theta\,dT}{T^2} \quad . \quad . \quad . \quad . \quad . \quad (3)$$

which we may say is certainly true.

But now Prof. Willard Gibbs suggests a novel mode of applying the second law or doctrine of entropy.

He takes into account the temperature of dissociation, or temperature at which the reaction could reversibly take place; and, calling this $T_0$, he writes the E.M.F. at any actual temperature T thus—

$$E = J\theta\epsilon\frac{T_0 - T}{T_0} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

[1] This sentence must be modified in the final report, because of some interesting observations of a controversial character made by Prof. FitzGerald at the meeting concerning it.

This he gives as the complete expression; wherein, therefore, $J\theta\epsilon$ is the chemical portion of the total E.M.F., and $J\theta\epsilon\frac{T}{T_0}$ the thermal portion of the whole E.M.F., equal to $J\Sigma\Pi$.

If this were a correct mode of regarding the matter, it would be of the highest interest to be able to calculate dissociation temperatures in this way. Unfortunately, several of the best judges in this country have expressed to the Committee their serious doubts as to the validity of thus stepping, unguided, outside the region of safe knowledge, across the great gap separating ordinary from dissociation temperatures. We wish Prof. Willard Gibbs were here to support and strengthen his position.

These are the main problems at present under discussion among the members of the Committee, and with this summary of them and reference to such of to-day's papers as seem likely to contribute towards their solution the report proper may be understood to close.

I think, however, I am only expressing the feeling of the Committee if I say that they view this joint sitting of Sections A and B with great interest, and with the anticipation and hope that it may be the precursor of many other such gatherings during the era of development in the borderland of chemistry and physics which in many directions they feel to be now imminent.

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## SECTION A—MATHEMATICAL AND PHYSICAL SCIENCE.

*New Electric Balances*, by Sir William Thomson, F.R.S.—These balances are founded on the mutual forces, discovered by Ampère, between the fixed and movable portions of an electric circuit. The mutually-influencing portions are usually circular rings. Circular coils or rings are fixed, with their planes horizontal, to the ends of the beam of a balance, and are each acted on by two horizontal fixed rings placed one above and the other below the movable ring. Six grades of instrument are made, named centi-ampere, deci-ampere, ampere, deca-ampere, hecto-ampere, and kilo-ampere balance. The range of each balance is about 25. Thus, the centi-ampere balance will measure currents of from 2 to 50 centi-amperes, while the kilo-ampere balance will measure currents of from 100 to 2500 amperes. Since the indications of the instrument depend on the mutual forces between two parts of an electric circuit of permanent form and relative position, they are not subject to the changes with time which are so troublesome in instruments the constants of which depend on the strength of permanent magnets.

The most important novelty in these balances is the connexion between the movable and the fixed parts of the circuit. The beam of the balance is suspended by two flat ligaments made up of fine copper wires placed side by side. These ligaments serve instead of knife-edges for the balance, and at the same time allow the current to pass into and out from the movable coils. The number of wires in each ligament varies from 20 in the centi-ampere to 900 in the kilo-ampere balance. The diameter of the wire is about $\frac{1}{10}$ of a millimetre, and each centimetre breadth of the ligament contains about 100 wires.

The electric forces produced by the current are balanced by means of weights which can be moved along a graduated scale by means of a self-relieving pendant. Two scales are provided—one a scale of equal divisions, the other a scale the numbers on which are double the square roots of the numbers on the scale of equal divisions. The square-root scale allows the current to be read off directly to a sufficient degree of accuracy for most purposes. When high accuracy is required, the fine scale of equal divisions may be used, and the exact value of the current obtained from a table of doubled square roots supplied with the instrument.

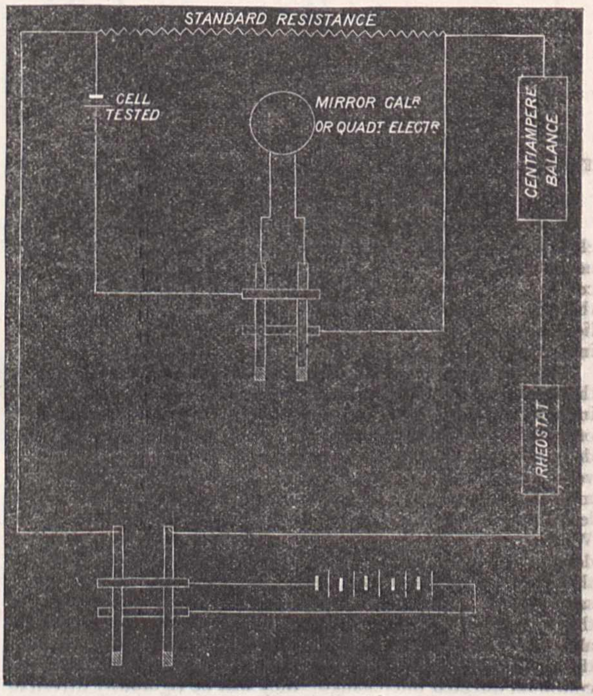
An engine-room voltmeter on a similar plan was described. It consists of a coil fixed to the end of a balance arm (suspended as above described) and acted on by one fixed coil placed below it. The distance apart of the two coils is indicated by means of a magnifying lever, and serves to indicate the difference of potential between the leads to which the instrument is connected. The coils of the instrument are of copper wire, and an external platinoid resistance of considerably greater amount is joined in circuit with it. The electrical forces are balanced by means of a weight placed in a trough fixed to the front of the movable coil and weights suited to the temperatures 15°, 20°, 25°, 30° C., as indicated by a thermometer with its bulb in the centre of the coil, are provided.

Two other instruments were described—namely, a marine voltmeter suitable for measuring the potential of an electric circuit on board ship at sea, and a magneto-static current-meter suitable for a lamp-counter.

In the marine voltmeter an oblate spheroid of soft iron is suspended in the centre of, and with its equatorial plane inclined at about 40° to, the axis of a small coil of fine wire, by means of a stretched platinoid wire. When a current is passed through the coil, the oblate of soft iron tends to set its equatorial plane parallel to the axis of the coil, and this tendency is resisted by the rigidity of the suspension wire.

The lamp-counter is a tangent galvanometer with special provision for preventing damage to its silk fibre suspension, and for allowing the constant to be readily varied by the user to suit the lamps on his circuit.

*On the Application of the Centi-ampere or the Deci-ampere Balance for the Measurement of the E.M.F. of a Single Cell*, by Sir William Thomson, F.R.S.—For the purpose of measuring the E.M.F. of a single cell, the centi-ampere or the deci-ampere balance is put in circuit with a battery of a sufficient number of cells, a rheostat, and a standard resistance in the manner shown in the diagram. The current measured by the balance is then




varied by means of the rheostat until the difference of potential between the ends of the standard resistance is exactly equal to the potential of the cell. The equality is tested by placing the cell in series with a mirror galvanometer or a quadrant electrometer in a derived circuit, the ends of which are connected with the ends of the standard resistance, and observing whether any deflection is obtained by closing this circuit. Suppose, for example, the standard resistance to be 10 ohms, and the current, as indicated by the balance, 0·108 amperes, when no deflection is obtained on the mirror galvanometer by closing its circuit, the potential of the cell is 10 × 0·108, or 1·08 volts. Proper precautions must, of course, be taken to eliminate thermo-electric or other disturbances in the circuit. The quadrant electrometer may be used with advantage in the derived circuit when it is important that no current should flow through the cell, but the mirror galvanometer has the advantage of much greater sensibility.

*Conduction of Electricity through Gases*, by Prof. A. Schuster, F.R.S.—A short time ago he communicated to the Royal Society the results of certain experiments which showed that, although a current can usually be sent through a gas only by employing a high electromotive force, yet a steady current can be obtained in air from electrodes which are at a difference of potential of only a fraction of a volt, provided that an independent current is maintained in the same closed vessel. He was now prepared to show the experiments in his laboratory.

*On the Nature of the Photographic Star-Disks and the Removal of a Difficulty in Measurements for Parallax*, by Prof. Pritchard, F.R.S.—If the telescope could be made to follow the star with perfect accuracy during the whole time of exposure of the photographic plate, the photographic image should be circular.

It is necessary, in order that photography may be of use, say in measuring parallax, that this condition should be approximately fulfilled. For it is from the centre of the star-image that the measurement must be made.

Now the image of a star exposed to a photographic plate driven by a clock having a small rate, and subject to small periodic oscillations, as is generally the case with the majority of driving-clocks, is not a simple linear trace, but a series of black dots joined together by intervals less dense. By hand-driving, those black dots, &c., coalesce or are superimposed. If for the purpose of measurement for parallax or otherwise a bright star be covered over by a stop during the greater part of the duration of the exposure of the plate, and the stop be then removed for a brief interval, it is shown by experimental measurement that the bright star is accurately represented on the plate.

*Instruments for Stellar Photography*, by Sir Howard Grubb, F.R.S.—He said that in considering the best form of object-glass for photographic purposes, one important point was to have as large a field as possible. An arrangement suggested by Prof. Stokes by which the first and second surfaces of refraction could be readily interchanged afforded the means of providing amateurs with an instrument which could be used at will either for ordinary or for photographic work. But by far the most important point in stellar photography was the clockwork. It was true that, no matter how perfect our clockwork might be, we could never dispense with the guidance of the hand. But if the clockwork be as good as it can be made, one is not tied down to the telescope as one is with bad clock-work. He thought it Utopian to expect that it might be possible to construct a clock accurate to 1/75 of a second, which some supposed to be necessary. He was at present able to correct any error greater than $\frac{1}{10}$ or at any rate than $\frac{1}{8}$ of a second, and he expected to be able to reduce the error to 1/20 of a second, but not farther. He did not believe that greater accuracy than this would be of any use.

In the course of a discussion which followed, Dr. Pritchard said he had actually traced the origin of the dots in the trail of his star-photographs to the periodicity of the screw.

*On the Turbulent Motion of Water between Two Planes*, by Prof. Sir W. Thomson, F.R.S.—He said that one of the most important questions in practical hydraulics was the flow or slipping of a liquid on a solid. He supposed for simplicity that there was nothing of finite slip of the fluid on the solid; but this was not essential to the reasoning. He considered the case of water flowing between two parallel planes; as an example of which a river with a plane bottom and covered with a sheet of ice might be taken. If the motion be laminar, *i.e.* free from turbulence, then the line of flow is represented by a parabola, supposing that there is no finite slip. The fluid moving in this way under the influence of gravity and possessing viscosity is in a state of stable equilibrium. If we suppose gravity and viscosity both suddenly reduced to zero, the motion becomes one of unstable equilibrium. The smallest amount of viscosity gives stability to the laminar motion, but the limits of stability are narrowed by either diminishing the viscosity, or increasing the effective component of gravity. Osborne Reynolds made experiments some years ago on the flow of water through tubes. With great pressure there is always eddying, because the limits between which stable equilibrium is possible are narrow, and narrower the greater the pressure. He found that the laminar flow continued in a central film of the water for a certain distance, and then broke up suddenly into turbulence. Froude had made experiments on the resistance which a very smooth thin board met with in being moved at a uniform rate through water. His results show that, if one of two infinite planes (both at rest to begin with, and bounding a piece of water) be suddenly set in uniform motion, the water will at first move turbulently, and the turbulence will gradually pass into shearing motion. In conclusion Sir W. Thomson expressed the hope that candidates for the Adams prize would take up this subject.

Lord Rayleigh mentioned experiments which he had made on jets of coloured liquids and of smoky air. In the case of a jet projected into air the motion is unstable from the first, but the instability only shows itself at a certain distance. This distance diminishes with the velocity. He thought it possible that in Reynolds's experiments the instability was in like manner present from the first in the central film, and that the film remained distinct for a certain distance only in virtue of the purchase it had obtained.

*On the Theory of Electrical Endosmose and Allied Phenomena, and on the Existence of a Sliding Coefficient for a Fluid in Contact with a Solid*, by Prof. Lamb, F.R.S.—This paper deals with the laws governing the electric transport of conducting liquids through the walls of porous vessels or along capillary tubes, and other related phenomena, which have been investigated experimentally by Wiedemann and Quincke, and explained by the latter writer on the assumption of a contact difference of potential between the fluid and its solid boundaries. This explanation has been developed mathematically by Von Helmholtz. Applying the known laws of viscous fluids, he finds that the calculated results, so far as they depend on quantities which admit of measurement, are in satisfactory agreement with the experiments, and that the values which it is necessary to assign to the contact difference above spoken of are in all cases comparable with the E.M.F. of a Daniell's cell. Incidentally he arrives at the conclusion that in the cases considered there is no slipping of the fluid over the surface of the solid with which it is in contact. In the present paper a slightly different view is taken, and it is assumed that a certain finite (though possibly very minute) amount of slipping takes place, and that it forms an essential feature in the phenomena. The various cases considered by Von Helmholtz are treated on this assumption, and in some respects extended. In all cases the results differ from those obtained by Von Helmholtz by a factor $\frac{l}{d}$, where $l$ is a linear magnitude measuring the "slip," viz. $\beta = \mu/l$, and $d$ denotes the distance between the plates of an air-condenser whose capacity per unit area is the same as that of the apposed surfaces of solid and fluid. For example, by comparison with Wiedemann's experiments, Von Helmholtz infers that, for a certain solution of $CuSO_4$ in the pores of a clay vessel, $E/D = 1 \cdot 77$, where D is the E.M.F. of a Daniell's cell. On the modified hypothesis adopted in the present paper, the inference would be that $\frac{E}{D} \cdot \frac{l}{d} = 1 \cdot 77$.

As this involves two unknown ratios, no such definite conclusion can be drawn, but it is evident that the phenomena are consistent even with very small values of $E/D$, provided $l$ be a sufficient multiple of $d$. Since $d$ is a quantity of molecular order of magnitude (comparable probably with $10^{-8}$ centimetres) the value of $l$ may still be so minute as to render the effects of slipping quite insensible in such experiments as those of Poiseille. They come to be of importance in the cases at present under consideration only in consequence of the relatively great forces, due to the fall of potential along the course of the current, which act on the outer electrified layer of fluid and drag it over the surface of the solid.

*On the Ratio of the Two Elasticities of Air*, by Prof. S. P. Thompson, D.Sc.—Prof. Thompson said his paper would be chiefly interesting to those who had to teach thermo-dynamics to beginners. It was important to have some simple form of experiment for determining the ratio of the two elasticities of air, such as might readily be shown to a student. He described a simple form of apparatus which he considered more suitable than the usual one.

*A Null Method in Electro-Calorimetry*, by Prof. Stroud, D.Sc., and Mr. W. W. Haldane Gee, B.Sc.—The method is a modification of Joule's method for determining the specific heats of liquids and solids, possessing, however, the unique advantages of eliminating the correction for radiation as well as that for the thermal capacity of calorimeter and stirrer. The liquids for comparison in the two calorimeters are heated by wires carrying electric currents in such a way that the rises in temperature are the same in each case as tested thermo-electrically. The adjustment is effected by shunting the current through one of the calorimeters.

Prof. H. A. Rowland gave a description of a map of the solar spectrum. He said that for several years he has worked with concave gratings. He first tried a grating of 12 feet focal length, and the results were not as good as he thought they should be, so he then constructed a grating of 21 feet focal length, and the results he would be able to submit to the Section in his photographs. Having made the negatives, the next thing was to place the scale upon them. He first tried Ångström's numbers, but they would not match. He had therefore to determine the relative wave-lengths, and this he did by using overlapping spectra and micrometer measurements. As the spectrum was normal, all that was necessary was to get the scale to agree at two points of the photograph, and then it would agree at all. He had found it necessary to adopt a new scale. He was now engaged in making measurements in the red end of the spectrum in order to complete his work. This he is doing by the eye, and not by photography, as in this part of the spectrum photographs do not show so much as the eye. In laying the maps before the Section Prof. Rowland said that it would be seen how crowded the lines were in the ultra-violet region. He believed that on this account it would be almost impossible to determine the metals to which they belonged.

Capt. Abney thought it a serious thing to change the standard of wave-length, and suggested that a Committee of the Association should be appointed to confer with an American Committee on the subject.

Prof. Rowland said that Ångström's numbers do not agree among themselves, and therefore he could not fit a scale to his map in any way until he had made a new determination.

Prof. Young, of America, agreed with Prof. Rowland in thinking that Ångström's numbers were not consistent.

Mr. R. T. Glazebrook, F.R.S., exhibited negatives of photographs of the solar spectroscope taken by Mr. G. Higgs. The spectroscope was one constructed by Mr. Higgs himself. Twenty-one lines can be counted on the negatives between $H_1$ and $H_2$. There is a length of about 4 inches between G and H, and from 900 to 1000 lines can be counted between them.

*Recent Determinations of Absolute Wave-length*, by Mr. L. Bell, of Baltimore.—Some two or three years before Ångström's death he became aware that there was an error in the standard metre used in his researches. Nothing in the way of correction was done, however, until some three years ago, when Thalèn obtained a more accurate value for the metre and applied the appropriate correction to Ångström's wave-lengths. This amounted to 1 part in 8500.

Some few years ago a very careful determination was made by Mr. C. S. Pierce, and it was with the view of confirming or correcting his result that the writer began work. Pierce had found an absolute value corresponding to the wave-length 5896·26 for the less refrangible of the D lines, as the mean result from four gratings. The writer using two of Prof. Rowland's glass gratings, obtained for the same quantity respectively 5893·95 and 5896·11. The outstanding error must be ascribed to faults in the gratings. Nearly all gratings are afflicted with variations in the distance between the lines in various portions of the ruling. If the irregularity is extensive, the grating is likely to show false lines and give bad definition.

If, however, the abnormal spacing—however great—is confined to a few hundred lines, this portion, having little defining power, takes no part in the formation of the spectra actually seen, but simply scatters light, and of course introduces an error in the average of grating-space obtained by measuring the whole ruled surface.

The gratings used by the writer were therefore calibrated, and corrections calculated and applied to the above wave-lengths, reducing them to 5896·04 and 5896·09. The mean value taken was 5896·08.

On subjecting Pierce's gratings to a like examination, values nearly coincident with the above were obtained. During the present summer an admirable thesis by Dr. Kurlbaum has appeared giving results quite close to the writer's—about 5895·93 for the mean of two gratings, uncorrected, however, for errors of ruling.

We can, from the close agreement of the results obtained by Kurlbaum, Pierce (corrected), and the writer, feel sure that the wave-length of D is very near to 5896·00, and consequently all wave-lengths based on Angstrom's value are incorrect by at least one part in 8000. But this would not be a very serious matter if Ångström's relative wave-lengths were exact, which they are not.

*On the Existence of Reflection when the Relative Refractive Index is Unity*, by Lord Rayleigh, Sec.R.S.—He wished to find whether there was any reflection from a plate of glass immersed in a liquid of the same refractive index as the glass. The liquid used was a mixture of carbon bisulphide and benzole, and it was contained in a hollow prism. The glass plate was roughened behind to get rid of the second surface of reflection, and was mounted in the prism.

It was found that when the index was the same there was nothing like abolition of the reflection. The flame of a candle could be seen distinctly reflected in the glass. The phenomenon may be better followed by mounting the glass in such a way that it is possible to pass from a grazing to a perpendicular incidence. The ray for which the refractive index is made the same being chosen about the middle of the spectrum, as you alter the obliquity of the light, total reflection occurs for either end of the spectrum, and a dark band occupies the middle region. No doubt this band appears dark by contrast. In this way one could be certain that the index had really been equalized.

He next tried freshly-polished glass, and the reflection from it was not more than one-fourth of that from old glass, although the latter had been carefully cleaned. Still even from the polished glass the reflection was very copious. It did not need any care of adjustment in order to get the reflection of the candle-flame. The light so reflected was not coloured. There was a moderate reflection of all kinds. He confirmed this by using sunlight.

Where dispersion exists there is no reason to suppose that reflection should cease merely because the refractive index is equalized. If recently-fractured glass should give the same result, one might safely conclude that there was no residual film in play, and there would then be no doubt of the inaccuracy of Fresnel's law.

*On the Action of an Electric Current in hastening the Formation of Lagging Compounds*, by Dr. Gladstone, F.R.S.—The influence of the current was tried on various solutions from which, under normal conditions, precipitation takes place only slowly. A mixture of tartaric acid and potassium nitrate, a mixture of potassium oxalate and magnesium sulphate, a mixture of calcium sulphate and strontium nitrate, and some other mixtures were used. It was demonstrated that the current does hasten the action.

## *NOTES.*

THE International Hygienic Congress at Vienna (attended by no fewer than 2250 members) was opened on Monday by the Austrian Crown Prince, who in a brief address referred to the vast importance of hygiene. After the Crown Prince's speech, which was much applauded, Prof. Grüber, the Hon. Secretary, read a report on the organization of the Congress. Two addresses were delivered by M. Brouardel and Herr Pettenkofer, the former of whom spoke on *typhus abdominalis*, the latter on hygienic instruction in Universities and technical schools. M. Brouardel said that the disease of which he spoke is far more dangerous to man than cholera, and that it is still an open question whether it owes its origin to the decomposition of organic matter or whether there is a specific virus. He maintained that in 80 cases out of 100 typhoid fever is caused by polluted water, and that the question of water supply must always take a foremost rank in hygienic administration. Herr Pettenkofer lectured on hygienic instruction in Universities and technical schools, and dwelt on the necessity of spreading hygienic principles among all classes of society. He largely quoted English authorities, and, in alluding to the English proverb "Cleanliness is next to godliness," remarked that the statistics of the mortality of London show how hygienic piety has been rewarded by the heavens. In the course of his address he dealt with the question of quarantine arrangements. He denied that the English are responsible for cholera coming to Europe through the Suez Canal. "This opinion," he said, "is clearly refuted by the fact that we were frequently visited by the disease before the Suez Canal was opened, and that since that time the epidemic has appeared in many European countries, while Great Britain, which now stands accused, and has suffered much through cholera in former times, remains free from it. Why do the English, in spite of their enormous traffic with India, where the cholera is never extinct, not transfer the disease to their own country? On looking more closely into the matter it must be admitted that England's immunity from cholera since 1866 is not caused by quarantines and other expensive obstructions to international traffic, and it is to be hoped that Italy, France, and Spain, as well as Russia, Germany, and Austria-Hungary, will follow England's example." The business of the Sections began on Tuesday. In the First Section, Mr. E. Frankland, who spoke in German, reported on the present state in England of the purification of sewage, with special reference to the prevention of river pollution, and on the legislation connected therewith. In the Second Section the necessity of placing schools under medical supervision was discussed, especially with reference to the prevention of the spread of infectious diseases and shortsightedness. The influence of drinking-water in the production and spread of epidemic disease was fully discussed in the Third Section. In the Fourth Section, Dr. Strulens, of Belgium, read a paper on phosphor necrosis of the jaws, and M. Violi, of Constantinople, a paper on vaccination and anti-vaccination. In the Demographical Section, M. Bertillon, of Paris, discussed the papers sent in by Dr. Grimshaw, of Dublin, and Prof. Koeroesi, of Buda Pesth, on the methods of drawing up census returns. There was an animated discussion, which was brought to a close by a resolution accepting the regulations of the International Statistical Institute. On Tuesday it was decided that the next meeting of the Congress should be held in London in 1889.

AT the meeting, in Toulouse, of the French Association for the Advancement of Science an address of welcome was delivered by the Mayor of the town, President of the Local Committee. M. Rochard, President of the Association, delivered an address on the future of hygiene. The annual report and the annual financial statement were read—the former by M. Schlumberger, Secretary, the latter by M. Galante, Treasurer. The most important subject dealt with in the annual report was the recent fusion of the French Association for the Advancement of Science with the Scientific Association of France.

WE learn from the *Montreal Gazette* that letters to date of July 29 have been received from Dr. G. M. Dawson, who is in charge of the geological party exploring the Yukon district. The party constructed two boats on Dease Lake, and left on June 3 to descend the Dease River to its junction with the Liard. From that place Mr. McConnell left with two men to descend the Liard. The remainder of the party, with five Indians, ascended the north fork of the Liard to Lake Francis, and leaving their boats crossed a long portage of sixty miles to Pelly River near the abandoned Hudson's Bay post of Pelly banks, where they arrived on July 29, all well. From this place the Indians were sent back, and Dr. Dawson, with Mr. McEvoy and two white men, remained to construct a boat and descend the Pelly to its junction with the Yukon. The country north of Dease Lake proved somewhat varied in structure, having a granitic nucleus with Palæozoic rocks on its flanks ranging from Cambrian to Carboniferous, and overlying Tertiary beds. The old portage was found to be entirely disused, and the party had to struggle through tangled woods, often knee-deep in moss. They got over, however, with a month's supply of provisions for the advancing party, and leaving stores for the returning Indians. Being north of the latitude of 60°, they enjoyed almost perpetual daylight, and the weather was good. The country is described as possessing well-grown trees, and a great number of the ordinary eastern plants were seen in flower, with some northern and western strangers. Only the great growth of sphagnous mosses and the abundance of reindeer moss give the country a different aspect from that of British Columbia. No Indians had been seen, except those the party brought with them from the coast. Though somewhat later in the season than he had expected to be, Dr. Dawson had hopes of reaching the coast before the freezing of the rivers, and the lines of section made by Mr. McConnell and himself will give a good general idea of the structure and resources of the country.

A PAPER on "Chemical Teaching" was read before the Chemical Section of the British Association at the recent meeting at Manchester. The paper was followed by a discussion wherein it was made apparent that teachers of chemistry are very dissatisfied with the methods now in use, and are anxious for great and wide-reaching changes. A Committee was appointed by the Association to inquire into and report on the methods adopted for teaching chemistry. The Committee consists of representatives of the universities and colleges, and also of the schools and technical institutions where chemistry is taught. The Committee is to begin its work by gathering facts regarding the courses of chemical teaching given in the various institutions where chemistry forms a part of the curriculum.

DR. CLEMENS WINKLER publishes in No. 15 of the *Journal für praktische Chemie* an account of his latest work upon the new element germanium, recently discovered by him in the Freiberg mineral argyrodite. In his first announcement last year, Dr. Winkler stated that the metal was obtained by reduction of the oxide in a stream of hydrogen gas, but since that time large quantities of the mineral have been found and dealt with on a much larger scale. The powdered oxide, after undergoing an elaborate process of purification, is intimately mixed with 15 to 20 per cent. of starch-meal, made into a paste with boiling water, and rolled into balls. These balls are then placed in a crucible in contact with powdered wood charcoal and heated to redness; on cooling, each ball is found to be converted into a regulus of metallic germanium. After removal of the adhering charcoal they are placed in a second crucible, covered with a layer of powdered borax-glass and melted in a gas furnace, when they fuse together to a single brittle regulus, fine octahedral crystals being formed at the outer surface. Among the numerous compounds of germanium prepared by Dr. Winkler, two are of great importance, as conclusively indicating the position of this new element in the periodic system. The first is germanium chloroform, $GeHCl_3$, analogous to the similar well-known compounds of carbon and silicon, which is obtained by gently heating germanium in a stream of dry hydrochloric acid gas; the metal glows and continues to do so after removal of the lamp, the chloroform passing along with the excess of hydrochloric acid, and being condensed to a liquid by means of a freezing mixture of ice and salt. The second is germanium ethide, $Ge(C_2H_5)_4$, analogous to the ethides of silicon and tin, which is obtained by the action of two volumes of zinc ethide upon one volume of germanium tetrachloride. The operation is performed in an apparatus filled with carbonic acid gas, and the reaction is very violent; if, however, the temperature be kept down by immersion in cold water, the action is more regular, and after 2 or 3 hours the whole solidifies. On the addition of water, gas is evolved and a layer of the oily ethide separates out; when pure, it is colourless and of weak garlic odour, slightly lighter than water, and boils at 160°. It burns with an orange-coloured light, giving off white clouds of the oxide. There can no longer be the slightest doubt that the gap in the periodic table between silicon and tin must be occupied by germanium, for Dr. Mendelejeff predicted that the metal thus filling up this particular gap would be found to form, if discovered, a tetrethide of specific gravity about 0·96 and boiling at 160°.

WE notice, from the prospectus of the University College (London) Engineering Department, that the work of this College begins for the session on October 5. The instruction in surveying and the lectures on the various branches of civil engineering are given by Prof. L. F. Vernon Harcourt. The general lectures on engineering and machine design, as well as the work in the engineering laboratory, are in the hands of Prof. Alex. W. Kennedy. In this laboratory, the arrangements of which formed a principal subject of the paper on the use and equipment of engineering laboratories read by Prof. Kennedy before the Institute of Civil Engineers last winter, students go through for themselves, during the session, a systematically arranged course of experimental work in connexion with elasticity and the strength of materials, the efficiency and economy of steam-boilers and engines, the appliances for which have been considerably extended during the last few months. Electrical technology is under the care of Prof. Fleming, by whom (with Prof. Carey Foster) a dynamo installation has lately been fitted up for the purpose of practical experimentation in applied electricity. Building construction forms the subject of lectures by Prof. T. Roger Smith, as a part of his course on architecture. Economic geology is treated as a special subject in a short course of lectures by Prof. T. G. Bonney, and chemistry as applied to engineering and architecture in a course by Prof. Chas. Graham. In addition to these matters directly connected with engineering, the College provides ample instruction in all the sciences on which engineering is based—mathematics, mechanics, physics, chemistry, geology, &c., and very special attention is given to graphic methods of calculation as applied to scientific and technical problems in the lectures and drawing class of Prof. Karl Pearson.

WE have received the Calendar of the Glasgow and West of Scotland Technical College for the ensuing session. It is proposed, we observe, to make extensive additions to "Allan Glen's School," especially by providing laboratories, rooms for freehand and mechanical drawing, and a large workshop. These will not be fully ready for use until the session of 1888-89. No change will be made in the course of study pursued since its reorganization in 1878.

THE session of the Science and Technical Classes at the Royal Victoria Hall, Waterloo Bridge Road, begins on Tuesday, October 4, when a lecture on "Museums for the People" will be delivered by Prof. H. G. Seeley, F.R.S. After the lecture, prizes will be distributed, and Dr. J. A. Fleming will give an address on the importance of scientific teaching. The lecture arrangements for the remainder of the month are as follows:—October 11, Prof. Kennedy, F.R.S., "Camping out in Wyoming"; October 18, Rev. Blomfield Jackson, "Rome and its Ruins"; October 25, Prof. A. W. Rücker, "A Ship's Compass." From lectures such as these has sprung the desire for systematic teaching which has resulted in the formation of the classes. These are held in rooms at the back of the stage, a new room having been built during the summer, to prevent inconvenient crowding in some of the classes. The subjects comprise arithmetic, mathematics, animal physiology, applied mechanics, machine construction and drawing, electricity and chemistry, with the possible addition of physics and astronomy. Many of the classes are in connexion with the Science and Art Department, and the fees (1*s*. 6*d*. per class per session, with an entrance-fee of 1*s*. for new students) are suited to the working-class neighbourhood where the Hall is situated.

A COURSE of about eighteen lectures on "Agriculture" will be delivered during the ensuing winter session at King's College, London, by Mr. Frederick James Lloyd.

IN the *Bollettino* of the Italian Geographical Society for July Dr. G. A. Collini describes some important additions recently made to the Prehistoric and Ethnological Museum of Rome. These include a part of the collections made by Count Giacomo di Brazzà Savorgnan and the Cavaliere Attilio Pecile during their late explorations in the Ogoway and Lower Congo basins. Although most of the objects remain in Paris, enough was secured for the Roman Museum to illustrate the arts and industries of numerous African peoples about whom next to nothing was known till quite recently. The objects are divided into two distinct categories: the first comprising the industrial and artistic products of the Fans, Adumas, Obambas, and Ondumbos of the Ogoway; the second those of the Bakongos, Bayanzi, and Batekes of the Congo, the Apfurus and Mboshi of the Alima, the Mbokos of the Likwala, and even some tribes of the lately discovered Ubanghi. Both classes contain personal ornaments, skins, fabrics woven of the raphia fibre, shields, hunting and fishing nets, musical instruments, earthenware remarkable for its correct forms, varied colours and artistic designs, besides a great diversity of iron implements and weapons such as axes, hatchets, spears, darts, hoes, knives, razors. The great skill possessed by these natives in wood-carving is shown by the spoons, domestic vessels, idols, stools, canoes, and other wooden objects included in this valuable collection.

MESSRS. MARION AND CO., of Soho Square, inform us that they have just introduced a set of universal 10 per cent. developing solutions for the use of photographers. The complicated constructions which accompany the majority of dry plates are made perfectly simple by them; and what is of more importance, the inconvenience of keeping different solutions for each kind of plate used is also done away with. Nothing can be simpler than their plan of first ascertaining the proportions of each constituent in the developer required, and then mixing solutions of known strengths in like proportions. The solutions are contained in three bottles, on each of which is given a list of the plates in common use and the quantity of solution required for each.

MESSRS. CASSELL AND CO. announce a new edition of "Colour," by Prof. A. H. Church; a cheap edition of Prof. H. G. Seeley's "History of the Fresh-water Fishes of Europe," and of "Short Studies from Nature"; the completion of "Familiar Garden Flowers," by Shirley Hibberd; the third series of "Familiar Wild Birds," by W. Swaysland.

WE understand that "A Quekett Club Man" is engaged upon another microscopical manual, "The Student's Hand-book to the Microscope," which will treat practically of the working of the instrument. Another well-known microscopist, Mr. T. Charters White, F.R.M.S., &c., is preparing a treatise on the mounting of objects. Both works will be published shortly by Messrs. Roper and Drowley.

WE have received an interesting little pamphlet on the natural history of the coast of Lancashire by Dr. Thomas Alcock (Heywood, Manchester). The portion of the coast treated is that extending from the mouth of the Wyre nearly to the estuary of the Mersey, including Fleetwood, Blackpool, St. Anne's, Lytham, and Southport, although most attention is devoted to the latter place. The work is written in a popular style, and we can imagine no more interesting guide for visitors to Lancashire watering-places, even if their taste for natural history studies is imperfectly developed.

THE September Bulletin of Miscellaneous Information, issued from the Royal Gardens, Kew, presents some facts about annatto (to which attention was called in the Bulletin for July), and a number of valuable notes on articles contributed to the Museums at Kew from the Colonial and Indian Exhibition, 1886.

THE Signal Service of the United States lately ordered the abandonment of the following stations on the Pacific coast:—Monterey, San Luis Obispo, Bakersfield, Modesto, Indio, San Bernardino, Carson, Yreka, Santa Rosa, and Mendocino City. *Science* says that as soon as this order was made known the publisher of the San Francisco *Chronicle* came forward and offered to provide observers, pay for telegrams, warnings, and so forth, if the Government would allow the instruments to remain. The offer has been accepted.

WE regret to announce the death of the Rev. W. S. Symonds, well known as a geologist and archæologist. He died at Cheltenham on September 15, and was buried at Pendock. He was sixty-nine years of age.

THE additions to the Zoological Society's Gardens during the past week include a Pig-tailed Monkey (*Macacus nemestrinus* ♂) from Java, presented by Mr. S. P. Grieve; a Black-eared Marmoset (*Hapale penicillata*) from South-east Brazil, presented by Mr. J. J. Foster; a White-collared Mangabey (*Cercocebus collaris*) from West Africa, presented by Mr. W. Tudor; a Vulpine Phalanger (*Phalangista vulpina*) from Australia, presented by Mr. Oscar F. Armytage; a Red Fox (*Canis fulvus*) from Canada, presented by Miss Cameron; a Common Jackal (*Canis aureus*) from Ceylon, presented by Capt. W. J. Geake; a Chinese Jay Thrush (*Garrulax chinensis*) from China, a Crested Lark (*Alauda cristata*) from India, presented by Colonel Verner; a Pale-headed Tree Boa (*Epicrates angulifer*) from Bahama, presented by Mr. H. A. Blake; an Alligator Terrapin (*Chelydra serpentina*) from North America, presented by Mr. G. S. Blythe; an Aldrovandi's Skink (*Plestiodon auratus*) from North Africa, presented by Mr. Arthur Colls; a Raven (*Corvus corax*), British, deposited; two Crested Pigeons (*Ocyphaps lophotes*) bred in the Gardens.

## OUR ASTRONOMICAL COLUMN.

THE CORDOBA OBSERVATORY.—The sixth volume of the observations of the Cordoba Observatory, which has recently been published, is mainly occupied by the observations made in the year 1875 for the great Zone Catalogue which Dr. Gould brought to so successful a conclusion. In all, 38,121 stellar positions were obtained in the year 1875, of which 22,315 were made in zones, the zones bearing the numbers 620 to 754. The remaining observations comprised 12,661 observations of 4373 stars for the General Catalogue, 1463 of circumpolar stars, and 1682 of stars for clock error. The individual members of certain star clusters were also observed. The volume illustrates forcibly, as do all the volumes issued by Dr. Gould, the energy, thoroughness, and system with which he carried out the great enterprise he had undertaken. Every care was taken that the observations should be as accurate, as well as numerous, as possible. For the General Catalogue stars, all four microscopes were read and the transits taken over three tallies of transit threads. For each zone, two time-stars and a circumpolar at upper and at lower transit were observed before the beginning of the zone, and the same after, together with observations of level, collimation, and nadir point. The separate determinations of the places of the stars for the General Catalogue are given, as well as their mean places in catalogue form. The tables used in the reduction of the various zones are also printed, together with corrigenda tables for the present and previous volumes, and an index to the 135 zones of this volume.

NEW MINOR PLANET.—A new minor planet, No. 269, was discovered by Herr Palisa on September 21 at Vienna. This is the sixtieth discovered by this observer.

OLBERS' COMET, 1887.—The comet discovered by Mr. W. H. Brooks on August 24 is now evidently the expected comet of Olbers, 1815 I. The following ephemeris for Paris midnight is by M. Lebeuf (*Astr. Nach.*, No. 2805):—

| 1887. | R.A. h. m. s. | Decl. ° ′ | Log *r*. | Log Δ. | Brightness. |
|---|---|---|---|---|---|
| Oct. 1 | 11 30 59 | 27 41·3 N. | 0·0757 | 0·2731 | 1·71 |
| 3 | 41 2 | 27 12·4 | | | |
| 5 | 51 0 | 26 41·1 | 0·0735 | 0·2714 | 1·74 |
| 7 | 12 0 54 | 26 7·5 | | | |
| 9 | 10 42 | 25 31·9 | 0·0724 | 0·2709 | 1·75 |
| 11 | 20 23 | 24 54·2 | | | |
| 13 | 29 57 | 24 14·8 N. | 0·0726 | 0·2715 | 1·75 |

The brightness on August 27 is taken as unity.

## ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 OCTOBER 2–8.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on October 2*

Sun rises, 6h. 4m.; souths, 11h. 49m. 23·8s.; sets, 17h. 35m.; decl. on meridian, 3° 33′ S.: Sidereal Time at Sunset, 18h. 19m.

Moon (Full October 2, 4h.) rises, 18h. 11m.; souths, 0h. 31m.*; sets, 7h. 2m.*; decl. on meridian, 3° 16′ N.

| Planet | Rises. h. m. | Souths. h. m. | Sets. h. m. | Decl. on meridian ° ′ |
|---|---|---|---|---|
| Mercury ... | ... 7 35 ... | 12 47 ... | 17 59 ... | 10 4 S. |
| Venus ... | ... 4 52 ... | 10 37 ... | 16 22 ... | 3 40 S. |
| Mars ... | ... 1 35 ... | 8 59 ... | 16 23 ... | 15 11 N. |
| Jupiter ... | ... 8 47 ... | 13 41 ... | 18 35 ... | 13 24 S. |
| Saturn ... | ... 23 56* ... | 7 45 ... | 15 34 ... | 19 22 N. |

* Indicates that the rising is that of the preceding evening and the southing and setting those of the following morning.

*Occultations of Stars by the Moon* (visible at Greenwich).

| Oct. | Star. | Mag. | Disap. h. m. | Reap. h. m. | Corresponding angles from vertex to right for inverted image. ° ° |
|---|---|---|---|---|---|
| 2 ... | 15 Ceti ... | ... 6½ ... | 1 9 ... | 1 50 ... | 192 260 |
| 2 ... | 35 Ceti ... | ... 6½ ... | 18 15 | near approach | 161 — |
| 4 ... | μ Ceti ... | ... 4 ... | 19 15 | near approach | 161 — |
| 6 ... | 75 Tauri ... | ... 6 ... | 22 45 ... | 23 39 ... | 102 215 |
| 6 ... | θ¹ Tauri ... | ... 4½ ... | 22 54 ... | 23 8 ... | 350 325 |
| 6 ... | θ² Tauri ... | ... 4½ ... | 23 4 | near approach | 338 — |
| 6 ... | B.A.C. 1391 | ... 5 ... | 23 45 ... | 0 40† ... | 29 295 |
| 7 ... | Aldebaran | ... 1 ... | 3 20 ... | 4 2 ... | 42 354 |
| 8 ... | 71 Orionis | ... 5½ ... | 23 56 ... | 1 1† ... | 59 237 |

† Occurs on the following morning.

| Oct. | h. | |
|---|---|---|
| 8 ... | 1 ... | Mercury at greatest distance from the Sun. |

Saturn, October 2.—Outer major axis of outer ring = 39″·7; outer minor axis of outer ring = 13″·0; southern surface visible.

*Variable Stars.*

| Star. | R.A. h. m. | Decl. ° ′ | | h. m. | |
|---|---|---|---|---|---|
| U Cephei ... | ... 0 52·3 ... | 81 16 N. ... | Oct. 8, | 4 53 | *m* |
| Algol ... | ... 3 0·8 ... | 40 31 N. ... | „ 4, | 0 50 | *m* |
| | | | „ 6, | 21 39 | *m* |
| λ Tauri ... | .. 3 54·4 ... | 12 10 N. ... | „ 4, | 20 20 | *m* |
| V Cancri ... | ... 8 15·3 ... | 17 39 N. ... | „ 8, | | *M* |
| S Cancri ... | ... 8 37·5 ... | 19 26 N. ... | „ 7, | 2 55 | *m* |
| δ Libræ ... | ... 14 54·9 ... | 8 4 S. ... | „ 3, | 2 47 | *m* |
| U Coronæ ... | ... 15 13·6 ... | 32 4 N. ... | „ 6, | 19 42 | *m* |
| W Ophiuchi ... | ... 16 15·3 ... | 7 26 S. ... | „ 7, | | *M* |
| U Herculis ... | ... 16 20·8 ... | 19 9 N. ... | „ 6, | | *M* |
| U Ophiuchi ... | ... 17 10·8 ... | 1 20 N. ... | „ 2, | 21 46 | *m* |
| | | and at intervals of | | 20 8 | |
| X Sagittarii ... | ... 17 40·5 ... | 27 47 S. ... | Oct. 6, | 0 0 | *m* |
| | | | „ 8, | 21 0 | *M* |
| W Sagittarii | ... 17 57·8 ... | 29 35 S. ... | „ 4, | 23 0 | *M* |
| R Scuti ... | ... 18 41·3 ... | 5 50 S. ... | „ 2, | | *M* |
| β Lyræ ... | ... 18 45·9 ... | 33 14 N. ... | „ 4, | 20 0 | *M* |
| U Capricorni | ... 20 41·9 ... | 15 12 S. ... | „ 6, | | *M* |
| T Cephei ... | ... 21 8·1 ... | 68 2 N. ... | „ 7, | | *m* |

*M* signifies maximum; *m* minimum.

## SOCIETIES AND ACADEMIES.

### LONDON.

**Entomological Society**, September 7.—Dr. Sharp, President, in the chair.—Mr. Arthur Sidgwick, M.A., was elected a Fellow.—Mr. Jenner-Weir exhibited a living larva of *Myrmeleon europæus*, which he had taken at Fontainebleau on August 6 last.—Mr. Elisha exhibited a series of bred specimens of *Zelleria hepariella*, Stn., and also, on behalf of Mr. C. S. Gregson, a long series of varieties of *Abraxas grossulariata*. Mr. Stainton remarked that the female of *Zelleria hepariella* had until lately been considered a distinct species, and was known as *Z. in-*

*signipennella*, but directly Mr. Elisha began breeding the insect its identity with *Z. hepariella* was established.—Mr. Tutt exhibited specimens of *Crambus alpinellus*, *C. contaminellus*, *Lita semidecandrella*, *L. marmorea*, and *L. blandulella* (a new species), *Doryphora palustrella*, and *Depressaria yeatiana*, all collected at Deal during last July and August. Mr. Stainton observed that *Crambus alpinellus* was so named from the earliest captures of the species having been made on the lower parts of the Alps, but that it had since been found on the low sandy ground of North Germany, and its capture at Deal quite agreed with what was now known of the distribution of the species in Germany. It was first recorded as a British species by Dr. Knaggs in 1871. Mr. Stainton further observed that he had named Mr. Tutt's new species *blandulella*, from its similarity to a small *maculea*, of which one of the best known synonyms was *blandella*. He also remarked that Deal was a new locality for *Doryphora palustrella*, which had hitherto only been recorded from Wicken Fen and the Norfolk Fens in England.—Mr. Waterhouse exhibited a variety of *Lycæna phlœas*; also a number of *Stenobothrus rufipes*, and three specimens of *Coccinella labilis*.—Mr. M. Jacoby exhibited several species of *Galerucidæ*, belonging to a genus which he proposed to call *Neobrotica*, closely resembling in shape and coloration certain species of *Diabrotica*, but differing therefrom in structural characters. He remarked that the late Baron Von Harold had described a *Galeruca* from Africa, which, except in generic characters, exactly resembled the South American genus *Dircema*.—Dr. Sharp communicated a paper, by Mr. T. L. Casey, "On a new genus of African *Pselaphidæ*."—Mr. Bridgman communicated a paper entitled "Further Additions to the Rev. T. A. Marshall's Catalogue of British *Ichneumonidæ*."—Mr. Distant read a paper entitled "Contributions to a Knowledge of Oriental *Rhynchota*."—Mr. Enock read notes "On the Parasites of the Hessian Fly," and exhibited specimens of injured barley. A discussion ensued, in which Dr. Sharp, Mr. Jacoby, Mr. Billups, Mr. Waterhouse, and others took part.

### PARIS.

**Academy of Sciences**, September 19.—M. Hervé Mangon in the chair.—Remarks accompanying the presentation of a copy of his treatise on "Thermo-dynamics," by M. J. Bertrand. Reference is made exclusively to the function long known to physicists under the name of Carnot's function, and the principle of which was accepted by Carnot's pupil Clapeyron. The author has sought, for the general case, the form that, according to their principles, Carnot and Clapeyron should have given to this unknown function, which they themselves did not determine. This form, as here rigorously deduced from those principles, is found to be very different from that which the progress of science has caused to be generally accepted.—Observations on the rotation of crops, by M. P. P. Dehérain. The system generally adopted in the North of France lasts five years, beginning with beetroot or potatoes, and followed by wheat with clover sown in the spring and yielding two crops the third year. The ground being then broken in the autumn, is again prepared for wheat, followed in the fifth and last year by oats. In this system two crops are here shown to be badly placed, the first wheat succeeding badly after beetroot, and oats badly after the second wheat. The author's experiments prove that the four years' rotation, as practised in England, and known as the Norfolk system, is in every way the best and most profitable.—Provisional elements of Brooks's new comet (August 24), by MM. Rambaud and Sy. These elements, based on the observations made at the Observatory of Algiers during the period from August 29 to September 2, are as under:—

$$T = 1887 \text{ October } 13{\cdot}9499$$

$$\pi = 157^\circ\ 54'{\cdot}5$$
$$\Omega = 85\ 39{\cdot}8$$
$$\iota = 45\ 58{\cdot}1$$
$$\log q = 0{\cdot}05717$$

Representation of the mean observation O – C

$$\Delta\alpha \cos\beta = +0''{\cdot}2, \quad \Delta\beta = 0''{\cdot}0.$$

—Observations of the same comet made with the Brunner 6-inch equatorial at the Observatory of Lyons, by M. Le Cadet.—On the organization of the astronomical service in the United States, by M. A. Laussedat. The author's remarks, made in connexion with a recent visit to the Naval Observatory of Washington, deal more especially with the chronometer department, and with the arrangements made for transmitting the astronomical time to all the chief ports on the Atlantic sea-board. The same current corrects at noon the three or four hundred clocks in the public offices, schools, and other establishments in Washington. Certain important services, such as those of the Signal Service, the Coast Survey, and fire-stations, are directly connected by telegraph wires with the Naval Observatory, while private houses and firms can also obtain the time by paying a yearly subscription to the Telegraph Company.—On the reduction of alumina, by M. G. A. Faurie. Two parts of pure and finely-powdered alumina with one of petroleum or other hydrocarburet are worked into a paste, which is well kneaded, and one part of sulphuric acid added. When the mass becomes homogeneous, with a uniform yellow colour, and begins to liberate sulphuric acid, it is put in a paper bag, and placed in a crucible heated to a good red over 800° C., so as to decompose the petroleum. After cooling, the product thus obtained is carefully pulverized, mixed with its weight of a powdered metal, placed in a well-closed crucible in plumbago, and brought to a white heat with the blow-pipe. After again cooling, more or less rich grains of aluminium alloy will be found in the middle of a black metallic powder. The process is equally applicable to silica, lime, magnesia, &c.

## BOOKS, PAMPHLETS, and SERIALS RECEIVED.

The Photographer's Indispensable Hand-book.—Annals of Botany, vol. i. No. 1 (Clarendon Press).—The Earth in Space: E. P. Jackson (Heath, Boston).—British Dogs, No. 11: H. Dalziel (Gill).—Bees and Bee-keeping, vol. ii. No. 12: F. R. Cheshire (Gill).—The State—The Rudiments of New Zealand Sociology: J. H. Pope (Wellington).—The Realistic Teaching of Geography: W. Jolly (Blackie).—Results of Meteorological Observations made in New South Wales during 1885: H. C. Russell (Sydney).—Morse Collection of Japanese Pottery (Salem).—The Advance of Science, Three Sermons (John Heywood).—Proceedings of the Academy of Natural Science of Philadelphia, Part 1, 1887 (Philadelphia).—Proceedings of the American Philosophical Society, vol. xxiv. No. 125 (Philadelphia).—Bulletin of the U.S. Geological Survey, Parts 34–39 (Washington).—Beobachtungs Ergebnisse der Norwegischen Polarstation Bossekop in Alten, i. Theil (Christiania).—Transactions of Vassar Brothers' Institute and its Scientific Section vol. iv. Part 1 (Poughkeepsie, N.Y.).

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