THURSDAY, OCTOBER 20, 1887.

THE ENCYCLOPÆDIA BRITANNICA.

The Encyclopædia Britannica. Vol. XXII. Sib—Szo. (Edinburgh: A. and C. Black, 1887.)

THE leading mechanical articles in this volume are full of interest to the general reader, and contain all recent information sought after by the specialist. Captain C. A. G. Bridges, R.N., contributes a short and concise article on naval signalling. The article is well written, and contains a large amount of historical information condensed into a small compass. The history of signalling is traced from a very early period. In fact, we are told that Polybius described two methods—one proposed by Æneas Tacitus, 300 B.C., and one introduced by himself, by which any word could be spelled, thus embodying the underlying principle of all recent methods. After an account of signalling by combinations of flags, perfected by different people at different periods, we come to Captain Philip Colomb's flashing system of signalling adopted in the navy in 1867. By means of the Morse alphabet, using long and short flashes of light by night, and blasts of a horn or steam-whistle during a fog, or by waving a flag in day-time, any communication can be made by this system. For short distances the semaphore is now greatly used. This consists of a vertical post with two arms movable in a vertical plane, the changing positions of the arms indicating different letters.

The article on sounding, by Mr. W. E. Hoyle, is a very short *résumé* of the subject. The operations in sounding are described, and the gradual improvement in the apparatus used is traced to the present date; beyond this there is nothing particular to note, and the article might have been extended with advantage.

The most exhaustive article in the volume is by Prof. J. A. Ewing, on the steam-engine. Prof. Ewing has skilfully condensed into twenty-six pages a large amount of useful information. To commence with, we have a good historical account of the early inventions. Hero, Savery, Papin, and Newcomen have each their place, and receive careful attention at the hands of the author. Watt's inventions are described, and the several forms of his engines are clearly illustrated.

The compound engine, the engine of to-day, dates from 1781, when Jonathan Hornblower patented an arrangement of two cylinders of different sizes, the steam being first admitted into the smaller cylinder, then passing into the larger, doing work in each cylinder. Woolf revived this class of engine in 1804, and in 1814 introduced it as a pumping-engine in Cornwall.

Richard Trevithick shortly afterwards introduced, in Cornwall, a single-cylinder high-pressure engine, which very soon was generally adopted, and became known as the "Cornish" pumping-engine. This engine worked with a comparatively high steam-pressure, and with considerable expansion. The cylinder was placed under one end of an over-head beam, and the pump rods were connected to the other end. The steam was admitted above the piston for a short portion of the stroke and then cut off, expanding the remaining portion, and doing work by lifting the pump rods and their attachments. The space above and below the piston was then put into connexion through the equilibrium valve, and the piston ascended by reason of the weight of the pump rods and gear, and did work in the pumps. The frequency of the stroke was regulated by means of a device called a cataract. This class of engine was used for many years and reached a high state of efficiency; we are told that the Fowey Consols engine has a consumption of coal of only 1⅞ lbs. per horse-power per hour, a result considered exceptionally good even to-day.

Prof. Ewing treats the steam-engine as a heat-engine in a masterly manner. Nothing of importance has been omitted; the arrangement of facts being in a carefully condensed form and easily followed. The actual behaviour of steam in the cylinder is demonstrated, and the effects of "wire drawing" and clearance in the cylinder and steam ways are duly explained. He carefully treats the testing of steam-engines; the best modes of taking indicator-diagrams are given, and points liable to be forgotten are well looked after. The actual testing is explained by means of a numerical example, viz. the trial of a compound beam engine, steam-jacketed, with an intermediate receiver between the cylinders. On compound expansion Prof. Ewing has a great deal to say. The indicator-diagrams illustrating the letterpress are very clear and to the point.

Next we find a good general description of steam-engines and boilers for stationary, marine, and locomotive purposes. These are well described, and few, if any, important points omitted. Under the head of locomotives we have an account of Mr. F. W. Webb's compound locomotive. This is a three-cylinder engine, having two equal high-pressure cylinders fixed outside the frame, and driving the trailing-wheels by means of two crank-pins at right angles; a single low-pressure cylinder of suitable dimensions is set under the smoke-box, and is coupled to the driving-wheels by means of a single-throw cranked axle. The two high-pressure cylinders exhaust into the low-pressure valve-chest, and this in its turn exhausts into the atmosphere through the blast-pipe. These engines are doing good service on the London and North-Western Railway, and a considerable saving of fuel is claimed for them over the quantity used by ordinary locomotives working the same traffic.

Prof. Ewing has, however, omitted to mention Mr. T. W. Worsdell's successful compound locomotive, first tried on the Great Eastern Railway, and now being used on the North-Eastern for passenger and goods traffic. This engine is very little different from the ordinary locomotive, the only difference being that the two cylinders used are of unequal diameters to suit compound working. This is probably a special gain because no radical change is made in the general arrangement, and the different parts of the valve motion, &c., come in equally well for the compound as for the ordinary engine. The main feature of the Worsdell engine lies in the starting arrangements. A locomotive must be able to start in any position with considerable power to fully answer its purpose, and the ordinary engine, after an eighth of a revolution of the driving-wheels, has both its cylinders thoroughly effective. In the two-cylinder compound the low-pressure cylinder does not get an efficient steam-pressure at once, because the steam must first work in, and be exhausted from, the high-pressure cylinder before reaching the low-pressure cylinder. Thus, it is evident that the high-pressure piston has to move the engine through at least half a revolution of the driving-wheels before the low-pressure piston is able to do any work; and further, if the high-pressure crank happens to be at or near the dead centre, it is impossible for the engine to move one way or the other, unless some means are adopted to make the low-pressure piston effective to move the high-pressure piston past the dead point. Mr. Worsdell's starting-gear entirely gets over this difficulty, and makes the two-cylinder compound locomotive a handy engine and a good starter.

By means of this arrangement the engine-driver is able to close the pipe connecting the high- and low-pressure valve-chests by a valve opening towards the low-pressure valve-chest. At the same time, steam direct from the boiler is admitted into the low-pressure cylinder, the intercepting valve preventing it blowing back into the high-pressure cylinder. On the engine moving for half a revolution of the driving-wheels, the high-pressure cylinder exhausts into the low-pressure valve-chest, blowing the intercepting valve open on its way, and compound working commences. As soon as the engine moves, the supply of steam from the boiler is of course discontinued in the low-pressure cylinder. In actual practice this gear is more or less self-acting, and is set in motion by moving one small lever.

At the end of the article a useful index is given, and throughout copious references are made to many authorities, which will be of service to anyone searching for information in any particular branch.

Prof. Ewing also contributes an interesting article on the strength of materials, and has treated the subject in a very satisfactory manner. After a clear introduction to the subject, we find a really practical description of tensile testing of materials. This is very well done, including as it does all recent information and experiments. After the general adoption of steel in the construction of engineering structures, whether bridges or ships, tensile testing of the material came into every-day use, and a testing machine is now to be found in every steel-works worthy of the name. Engineers were slow in adopting steel, and rightly so, considering the many unaccountable failures of that material which took place a year or two ago. Even now, when its manufacture is much better understood, stringent tests are specified by our leading engineers before the material is allowed to be used; and, as an example, all steel plates used in the bridge work for certain railways are tested as follows. *Every plate rolled* has a side and end shearing tested by tensile tests, besides the usual quenched and cold bends, in order to guard against the possible use of brittle or dangerous steel. It is not to be wondered at, therefore, that the tensile testing machine has reached a high state of perfection, the latest improvement being the addition of an autographic recorder by which the results of each test piece broken are recorded by the machine itself. This article contains all the information likely to be required, and has been put together in a concise form, Prof. Ewing making the most of the limited space placed at his disposal. Both articles are quite models of encyclopædic articles.

The principal articles relating to natural history are the following:—On the "Siluridæ," by Dr. Günther. Some of the more remarkable points in the structure and life-history of the members of this group having been already noticed under the article "Ichthyology," in the present article we find only a notice of the chief sections into which the Siluroids have been divided; but though thus short, it gives a most useful *résumé* of what is known on the subject. A long and important article on "Snakes" is also from the pen of the same author. The article commences with an account of the classification and distribution of the members of this order, the number of known species being reckoned at from 1500 to 1800; next follow some details as to their general anatomy, especially as to their poison-fangs. A list of the sub-orders and families is given, and there are some excellent illustrations of some of the more important species. The various notices on birds, the snipe, stork, swan, &c., have been contributed by Prof. Alfred Newton, and, it is needless to say, embody all the most recent information possible in the small space allowed. The article on "Swine" is by Prof. Flower. A most excellent article on the "Skeleton" is by Mr. St. George Mivart. While we have nothing but praise for his treatment of the subject of the general skeletal conditions of the Vertebrata, we may venture to doubt whether the author could justify the assertion which occurs in the second paragraph of the article, to the effect that among plants the Desmidiæ clothe themselves with a horny coat. Making all due allowance for the rather loose way in which this word "horny" is used by some biologists, we think the botanists have not yet agreed to use it for any of the varieties of cellulose, and the Desmids are not even very exceptional in their clothing. The most important article from a zoological point of view in the volume is that on "Sponges," by Prof. Sollas. He takes notice of the great advance that has been made in our knowledge of this group during the last fifteen years, and gives one of the best accounts of the group in our language. Beginning with a sketch of the general structure and form of Sponges, he plunges into a disquisition on the characteristic spicules met with; and, though within very brief limits, ventures on a classification, with a detailed nomenclature of these protean forms. Whether the mass of the new names will meet with acceptance or not, time must decide; but there can be no doubt that the author deserves every commendation for his brilliant effort to reduce the various forms into an orderly sequence. Within the last few years the improvements in the methods of technique have opened new vistas into the histology of Sponges. The classification of the group is given in detail as far as the families: the Phylum being regarded as derived from the choanoflagellate Infusoria, but pursuing for a certain distance a course of development parallel with that of the Metazoa. The paragraph on the sponges of commerce is very interesting: we do not know of an equally accurate account in English, and yet no toilet article is in more universal use or more talked about. The little that is known as to the extent of the large trade in sponges may be judged of from the fact that the latest information the author was able to get on the subject dates from 1871, and that it only gives an account of the sponges sold in Trieste for that year. This article may be described as an excellent introduction to the history of the Sponges.

Although the "Encyclopædia Britannica" has reached its twenty-second volume, the editors are to be congratulated on the continued excellence of the articles generally, and it is evidently their intention to complete the series without lowering the quality of the work in the slightest degree. When completed, this edition will be a great addition to our literature, of which we may without hesitation be thoroughly proud.

THE MOTIVE POWERS OF THE MIND.

Psychology: The Motive Powers; Emotions, Conscience, Will. By James McCosh, D.D., LL.D., Litt.D., &c. (London: Macmillan and Co., 1887.)

THE first part of this volume, constituting more than two-thirds of the work, is a somewhat condensed and slightly modified reprint of the author's volume on "The Emotions," issued some seven years ago by the same publishers. It would, we think, have been well to have stated this fact. As it stands, there is nothing to show that this volume is not wholly new. It does not appear that the author's views, or the manner of their presentation, have undergone any material change.

Emotion is considered under four aspects, determined by four elements. First, there is the disposition, inclination, or "appetence," an innate or acquired principle of the mind; secondly, there is the idea or "phantasm" of an object or occurrence fitted to gratify or disappoint an appetence; thirdly, there is the conscious feeling or excitement, with attachment or repugnance, called forth by the phantasm; fourthly, there is an organic affection or bodily expression of the emotion.

A good deal of space is devoted to the appetences. Such an appetence is described as "simply a tendency in the mind to crave for an object for its own sake." It is difficult to see wherein it differs from a latent emotion. The possession of an appetence implies the possession of an emotional nature capable of responding in certain ways at the bidding of the appropriate idea or phantasm. But it is questionable whether it is very satisfactory to classify apart from the actual emotions these inherent possibilities of emotion. The appetences are divided into primary and secondary, or derivative. The account of the former begins with the love of pleasure and the aversion to pain. These, says the author, "do not need to be defined, for all sensitive beings know what they are. I rather think," he naïvely adds, "that all pain originates in a derangement of our organism. But it is not felt as pain till perceived by the conscious soul." The other primary appetences include, in the order named, the sympathetic instincts, attachment to relatives, native tastes and talents, the appetites, love of society, love of esteem and commendation, love of power, love of property, the æsthetic sentiment, and the moral sentiment. "The derivative appetences," we are told, "may and do assume an immense variety of forms, which run into and are mixed up with each other," and are "woven together in all sorts of ways, so that it is difficult to unravel the web." It is noteworthy that such unravelling as is to be found comes under the head of the classification of the emotions themselves.

Writing of "conflicting appetences," the author would almost seem for a moment to have fallen into the slough of determinism. "Passions," he says, "may contend in two ways. First, there may be the operation at one and the same time of two inconsistent propensities (*e.g.* duty and pleasure). Were the two equally balanced they might counteract each other, and inaction be the statical result. . . . But more frequently both passions act." (This we presume is a loose way of saying that they are not so absolutely and equally antagonistic as to produce inaction.) In this case "on the principle of the parallelogram of forces the man follows an intermediate course." Could any determinist have expressed his heresy more clearly? In the third part, however, dealing with the will or "optative power," we find a chapter with the orthodox heading, "The Will has Freedom." And though there is scarce any word therein with which the determinist will feel disposed to quarrel, we are led to suppose that Dr. McCosh would maintain that in the action chosen under volition the result is not always determined by the several "appetences" called into play by the "phantasm." Into this question, however, he does not enter: he merely contends for freedom in the popular sense, which no one denies.

Under the heading "The Organic Affection," and in the classification of the emotions, the modes of physical expression are set forth with quotations from Darwin, Bell, and Cogan. A short account of the anatomy of expression, by Prof. Osborn, has been added in this edition.

Regarded as a whole, Dr. McCosh's volume, notwithstanding a certain sketchiness and superficiality, shows not a little insight into the workings of the human mind. It is essentially descriptive. The author does not profess to dig down into origins. "I wish it to be distinctly understood," he says, "that in this treatise I undertake not to determine the origin of motives in the ages past and among the lower animals; I am satisfied if I can give an approximately correct account of them as they now act in the human mind." The promise to enter little into controversy is fairly redeemed. Even the few controversial passages there are had been better omitted, since they deal for the most part with questions of origin, that of the conscience for example, into which as we have just seen, Dr. McCosh wisely does not undertake to enter.

C. LL. M.

OUR BOOK SHELF.

Our New Zealand Cousins. By the Hon. James Inglis. (London: Sampson Low, 1887.)

THIS is an interesting little book, and at the present time, when so much is said about the relations between the colonies and the mother country, it ought to appeal to a wide circle of readers. Mr. Inglis had a pleasant tour in New Zealand in 1885, and as he had been there twenty years before, he was able to note the progress that had been made in the political and social development of the colony. The results of his observations are presented in a fresh, clear, and lively style, and he will no doubt communicate to a good many of his readers a little of his own enthusiasm about the condition and prospects of "the new Great Britain of the Southern Seas."

Pictorial Geography of the British Isles. By Mary E. Palgrave. (London: Society for Promoting Christian Knowledge, 1887.)

THIS volume, although it could not be used as a text-book, might be of considerable service to young students of geography. The pictures would probably excite their interest, and would certainly tend to give definiteness to some of their conceptions. The letterpress is, upon the whole, very good. Beginning with a chapter on how our scenery was made, the author gives what she calls "a summary of British scenery," and then proceeds to describe the coasts, the mountains and hills, the plains and rivers, and the lakes and islands of the British Isles. There are also chapters on historical scenery and industrial geography.

LETTERS TO THE EDITOR.

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

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

The *Spectator* and Science.

IN a recent number the *Spectator* discussed a rumour that an American inventor had discovered a compound which possessed the peculiar property of exploding "forward only." The matter was discussed quite seriously, and it was pointed out that if the report were correct the defence of the northern frontier of India would be facilitated, as it would be possible to substitute parchment for metal in the construction of guns. So enamoured was the writer with this idea that it was again referred to in a subsequent article on "The New Air-Cannon."

Upon this I ventured to address to the editor a short note, in which I pointed out that as it is improbable that the most ingenious inventor will now upset the law that "action and reaction are equal and opposite," the rumour might be safely discredited.

More than one number has since appeared, but no steps have been taken to remove the misconception which the serious discussion of an absurdity must have produced on the minds of many non-scientific readers.

It may be, of course, that the *Spectator* would consider it a useful exercise to discuss what would follow if perpetual motion were realized or the circle squared. If so, there is nothing more to be said, except that the grave application of such speculations to questions like the defence of India is apt to mislead. It may perhaps be added that such a habit is not likely to increase the respect with which the opinions of the paper are received when it plunges hotly into a controversy of practical importance on scientific methods, such as that on the utility and morality of vivisection.

It is, I believe, a subject of regret to others besides myself that a journal, the attitude of which on other matters we admire, should betray such obvious ignorance on matters scientific. Before the *Spectator* discusses yachts' bottoms, new air-cannons, and compounds which explode forward only, it would be well for the management to obtain the advice of someone who has a competent knowledge of the scientific problems involved.

October 10. ARTHUR W. RÜCKER.

"Toeing" and "Heeling" at Golf.

I WAS much interested in the "Unwritten Chapter on Golf" (NATURE, Sept. 22, p. 502), signed with the well-known initials of "P. G. T." The mechanical explanation of "toeing and heeling," is however incomplete, as it does not take into account the torsion of the head and shaft caused by the impact of the ball on one side or other of the centre of percussion. If the ball be "heeled" (that is, goes off any point of the club-face nearer to the heel than the centre of percussion), the impact on the club-head causes it and the shaft to twist horizontally from right to left, a movement that is plainly felt in the hands as a disagreeable jar. Even should the club-face approach the ball in a line perpendicular to the direction of the intended drive, it no longer remains so on meeting the ball.

In the best driving the club follows the ball nearly to the extent of the swing, so that before they part company, the elasticity of the shaft twists the club-face back to or beyond its normal position, which should be perpendicular to the line of drive. If the ball happens to be "toed," the reverse movement takes place. A curve to the right in the course of the ball so invariably follows "heeling," even with the best drivers, and a curve to the left (but not so frequently) "toeing," that they have become recognized by golfers as cause and effect. I have always looked upon the torsional movement described as the main cause of the horizontal rotation given to the ball, and still think that any explanation which leaves this unconsidered is incomplete.

T. MELLARD READE.

Park Corner, Blundellsands, September 24.

[THE cause spoken of by Mr. Reade has occasionally some little effect, and I was fully aware of this long before I wrote my article. But, as most golfers know to their disgust, a ball can be badly "heeled" or "toed" when driven by a club or a cleek with the most untwistable of shafts. I should thus have confused instead of enlightening the ordinary reader, had I entered upon such a subsidiary question as *this* effect of torsion. For my own part, I believe that the most serious effects of torsion are produced *before the club reaches the ball.* This is not alluded to by Mr. Reade.

Mr. Reade uses the word "heeling" in the literal sense of "striking with the heel of the club," and has thus been led to state the opposite of the facts. If he will think over the result of the impulsive rotation of the club-head, which is due to smallness of torsional rigidity in the shaft, he will see that (supposing the club-face at impact to be exactly perpendicular to the course desired) hitting off the heel tends to produce what is commonly called "toeing":—*i.e.* skewing to the *left!* Similarly, hitting off the toe will produce what is commonly called "heeling":—*i.e.* skewing to the *right!* Thus the torsion of the shaft tends to mitigate ordinary "heeling" if the heel of the club be used, and to intensify it if the toe be used. Surely this would not have been easily understood by the ordinary reader of newspapers, for whom my article was written.—P. G. T.]

The Fertilization of the Coffee Plant.

I SEND you the following notes on the fertilization of the coffee plant (*C. arabica*) which I made some time ago, and which may be interesting to those who study the subject.

Your readers are doubtless aware that coffee was cultivated some twelve years ago to a very large extent in Ceylon and South India, but owing to the attacks of leaf disease, the area has been rapidly reduced, except, I believe, in some parts of Coorg and Mysore, where the climate is drier, and the leaves suffer less from the fungus. It has now been largely replaced by tea.

The jasmine-like flowers of the coffee are borne in clusters in the axils of the leaves, and appear simultaneously all over the estates. After a prolonged drought of one or two months, or even more, at the beginning of the year, there is generally a heavy fall of rain, sometimes lasting only an hour or two, sometimes continuing for two or three days: the amount that falls must be enough to saturate the ground, and should not be less than one inch.

In from six to eight days from the time of the first shower, the flowers burst into full blossom, last for a day, and then drop off. On the evening before the blossom is fully out, if the flowers are examined it will be found that they are partially open, the stigma being protruded and receptive. During the

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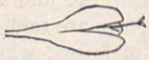

night the hum of insects can be distinctly heard, and I am of opinion that the flowers are largely fertilized by night-flying insects which carry pollen from those flowers which happen to be open rather before the others, as some are delayed. On the following morning all the flowers will be found open, and the field of coffee presents a sheet of white. These flowers are frequented by immense numbers of bees, of two kinds, one about three-quarters of an inch long and black, the other smaller and with white bands round its abdomen. The stigmas now are covered with pollen, and the anthers bursting, and the larger of these bees may be seen buzzing from flower to flower sweeping up the grains of pollen between its front legs, and rolling them into balls. Long before evening all the anthers are exhausted of pollen, and the insects have departed. Besides bees some butterflies visit coffee, such as *Hypolimnas bolina, Papilio Polymnestis*, and two or three *Danaidæ*.

The coffee plant by being proterogynous is intended by Nature to be cross-fertilized, but owing to all the plants in one clearing being usually grown from seed of a single estate, there must be a great deal of interbreeding, more especially as all the coffee of Ceylon and most of South India is supposed to be descended from a single plant introduced into Batavia about two centuries ago. This may have something to do with the manifest deterioration in stamina of the younger coffee.

While on this subject I may mention the curious alteration in the position of the organs of *Clerodendron infortunatum* when flowering. This plant is proterandrous: at first the style hangs

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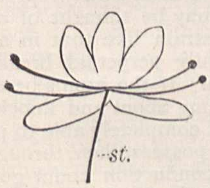

First position.

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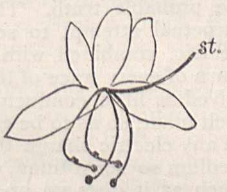

Second position.

down, while the stamens are erect: as soon as the pollen is shed the stamens drop, while the style rises, and the stigma becomes receptive. The chief carriers of pollen in this plant are small ants. T. F. BOURDILLON.

Quilon, S. Travancore, India, September 13.

Pearls of *Jasminum Sambac.*

DR. RIEDEL tells us in NATURE of September 15 (p. 461), that he possesses in his collection two melati pearls of *Jasminum Sambac.* I beg to say that, as in the case of tabasheer (see NATURE, vol. xxxvi. p. 30), and in that of cocoa-nut pearls (*ibid.* p. 158), Rumphius, in the almost inexhaustible treasure of his "Herbarium Amboinense," has already mentioned the pearls found also *in the flowers* of *Jasminum Sambac.* He gives in his fifth volume, in the 30th table, a good picture of that plant, and says in the description that a "dendrites" found in its flower in 1672 was sent to him two years after. It had the shape of a bud of the same vegetable, and was white-coloured and hard like silica or alabaster; moreover, it must have been without doubt a carbonate of calcium or some other alkaline earth, for Rumphius remarks that when the pearl was imprudently moistened with citric acid part of it was consumed by the acid. He also tells us that the common name given to all stone-concretions in fruits, wood, and animals by the Malayan people is "mestica," which corresponds well with Dr. Riedel's name of "mustica." ["In Celebe, ac præsertim in Macassara in *cunctis* sæpe fructibus dendrites quædam reperiuntur, ubi inter alia in hoc quoque frutice (Jasminum Sambac) talis detecta fuit, quæ loco floris inventa fuit anno 1672 in horto quodam Germani ibi habitantis, quæque mihi biennium post transmissa fuit. Formam habebat capituli, seu instar veri floris Bonga Manoor, nondum aperti, eratque alba et dura instar silicis seu alabastri; inventa autem fuit in tubo veri floris atque petiolum habebat ex ligno et lapide sensim compositum; quique hanc invenerat, imprudenter in mensa deposuerat, limonum succo commaculata, qui subito eius portionem consumserat."]

Frankfurt a. Oder. E. HUTH.

Action of River Ice.

IN the year 1854 the Yellow River burst through its left embankment near Kaifung-fu, and took a new course to the sea through the province of Shantung, occupying in its lower course the bed of the Tatsing-ho, which it scoured out and widened. Prior to the change the Tatsing-ho had been crossed at Tsiho-hien, about seventeen miles above Tsinan-fu, the provincial capital, by a stone bridge, seven arches of which remained standing in 1868 when Mr. Ney Elias visited the river (see Journal Roy. Geog. Soc. vol. xl. p. 6). Owing to the increased width of the channel, this bridge only reached about three-quarters of the distance across the river, and formed a serious impediment to the navigation.

Crossing the river myself at this site in April last, I made inquiries regarding the old bridge, but, as customary in China, could elicit nothing definite; the bridge had gone, and no visible obstruction existed in the channel.

When I arrived in Tientsin in July, the Yellow River was a frequent subject of conversation, and an old friend and well-known resident, Mr. J. G. Dunn, gave me the following account of a curious phenomenon witnessed by him when crossing the river in January 1883, on his way overland to Shanghai. The winter was a severe one, and the ice on the Yellow River at this spot was about three feet in thickness. Most of the ordinary traffic of the district was carried across the ice in carts and wheelbarrows; a space was, however, kept open for the ferry, by which usually the entire traffic of the high-road from the capital crosses the river, the ice being broken up every morning so as to leave a clear passage. Mr. Dunn preferred crossing the river by the ferry, as seeming to him more convenient and safer. From the boat he witnessed the extraordinary sight of a stone bridge floating on the upper surface of the ice; the piers had apparently been lifted bodily up, some of the arches were standing, still supported at one end by an abutment, but some had fallen, and were resting as they fell in order on the surface of the ice. The bridge had apparently floated some distance down; Mr. Dunn thought, from the confused answers of the people, a considerable distance, but from a comparison of the site it could scarcely have been more than a hundred yards or so. Strong westerly winds had been blowing for some time, and probably had, combined with other causes, induced a slight rise in the level of the water sufficient to break the connexion of the ice-sheet with the banks; the space kept open for the ferry had enabled it to move downwards by degrees under the influence of wind and current, and as the piers of bridges in China are usually built without cement they offered little obstruction to the movement.

From my own experience of the people in the district I can understand Mr. Dunn's mistake as to the distance the bridge was carried, and there can be no doubt that the bridge seen was the original one described by Mr. Elias.

The fact of a bridge lifted bodily off its piers by the floating power of river ice is probably unique, but in any case is sufficiently interesting to be worthy of record. I may add that the latitude of Tsiho is approximately 36° 40′ N., and the width of the river about 2000 feet. THOS. W. KINGSMILL.

Shanghai, August 26.

Unusual Rainbow.

A RAINBOW after sunset is probably a somewhat unusual occurrence, but on the evening of September 11 I witnessed a very beautiful one from the band-stand in the Alfred Park, which is about the highest ground in Allahabad. Just before sunset the sky was more or less covered with high cirro-stratus, and promised one of the very highly-coloured sunsets common in the rainy season, while at the same time a slight storm, heralded by distant thunder, was coming up from the east. After spending a few minutes in the Public Library near the band-stand, I came out, and found the sun had set behind a bank of what Abercromby calls "rocky cumulus," or some other lumpy form of cloud, and was sending long shafts of alternate light and shadow across the southern half of the sky, while towards the north and overhead the clouds were lighted up with the most gorgeous colours. On turning to the east to see whether the flutings of the cloud-shadows appeared to meet in that quarter, as they usually do, I saw on the approaching shower, which was towards east-south-east, a beautiful double rainbow, both arcs being some 20° long, but stopping short of the horizon by $1\frac{1}{2}°$ or 2°, to which height the earth-shadow already extended. Both bows seemed to the eye to be somewhat narrower than usual, and between and beyond them the fluted cloud-shadows appeared, by the illusion of perspective, to converge towards the anti-solar point. The bow must therefore have been produced by the light from a portion only of the sun's disk, shining through a hollow on the top of the western bank of cloud, and doubtless the same portion which illuminated the clouds directly overhead at the time of observation. The rainbow suffered no diminution of brightness where it was apparently crossed by the fluted shadows, the latter being far away in comparison with the bow-producing raindrops, which, of course, were in sunshine.

I regret that I am unable to send a photograph or sketch of the phenomenon, which was a most beautiful one, and must be of rare occurrence. I have never before seen anything similar, nor have I read anywhere a description of a rainbow after sunset.

Allahabad, India, September 18. S. A. HILL.

Occurrence of *Sterna anglica* in Belfast Lough.

IT may possibly interest some of your ornithological readers to know that towards the end of September a specimen of the gull-billed tern (*Sterna anglica*) was shot in Belfast Lough. The bird was placed in the hands of Mr. Darragh, of the Museum of that town, and brought by him to me for determination. On consulting the last edition of "Yarrell," I find that it does not appear to have been previously recorded from Ireland.

ROBERT O. CUNNINGHAM.

Queen's College, Belfast, October 8.

MODERN VIEWS OF ELECTRICITY.[1]

PART II.

III.

WE have now glanced through electro-static phenomena, and seen that they could be all comprehended and partially explained by supposing electricity to be a fluid of perfect incompressibility—in other words, a liquid—permeating everywhere and everything; and by further supposing that in conducting matter this liquid was capable of free locomotion, but that in insulators and general space it was as it were entangled in some elastic medium or jelly, to strains in which electrostatic actions are due. This medium might be burst, in a disruptive discharge, but easy flow could go on only through channels or holes in it, which therefore were taken to represent conductors; and it was obvious that all flow must take place in closed circuits.

To-day I want to consider the circumstances of this flow more particularly: to study, in fact, the second division of our subject (see classification on page 532), viz. *Electricity in locomotion*.

I use the term "locomotion" in order to eliminate rotation and vibration: it is translation only with which we intend now to concern ourselves.

Consider the modes in which *water* may be made to move from place to place; there are only two: it may be pumped along pipes, or it may be carried about in jugs. In other words, it may travel *through* matter, or it may travel *with* matter. Just so it is with *heat* also: heat can travel in two ways: it can flow *through* matter, by what is called "conduction," and it can travel *with* matter, by what is called "convection." There is no other mode of conveyance of heat. You frequently find it stated that there is a third method, viz. "radiation"; but this is not truly a conveyance of *heat* at all. Heat generates radiation at one place, and radiation reproduces heat at another; but it is radiation which travels, and not heat. Heat only naturally flows from hot bodies to cold, just as water only naturally flows down hill; but radiation spreads in all directions, without the least attention to where it is going. Heat can only flow one way at any given point, but radiation travels all ways at once. If water were dissociated on one planet into its constituent gases, and if these recombined on another planet, it would not be water which travelled from one to the other, neither would the substance obey the laws of motion of water—water would be destroyed in one place, and reproduced in another; just so is it with the relation between radiation and heat.

Heat, then, like water, has but two direct modes of conveyance from place to place. For *electricity* the same is true. Electricity can travel with matter, or it can travel through matter; by convection or by conduction, but in no other known way.

Conduction in Metals.

Consider, first, conduction. Connect the poles of a voltaic battery to the two ends of a copper wire, and think of what we call "the current." It is a true flow of electricity among the molecules of the wire. If electricity were a fluid, then it would be a transport of that fluid; if electricity is nothing material, then a current is no material transfer; but it is certainly a transfer of electricity, whatever electricity may be. Permitting ourselves again the analogy of a liquid, we can picture it flowing through, or among, the molecules of the metal. Does it flow through or between them? Or does it get handed on from one to the next continually? We do not quite know; but the last supposition is often believed to most nearly represent the probable truth. The flow may be thought of as a perpetual attempt to set up a strain like that in a dielectric, combined with an equally perpetual breaking down of every trace of that strain. If the atoms be conceived as little conductors vibrating about and knocking each other, so as to be easily and completely able to pass on any electric charge they may possess, then, through a medium so constituted, electric conduction could go on much as it does go on in a metal. Each atom would receive a charge from those behind it, and hand it on to those in front of it, and thus may electricity get conveyed along the wire. Do not, however, accept this picture as anything better than a *possible* mode of reducing conduction to a kind of electrostatics—an interchange of electric charges among a series of conductors. If such a series of vibrating and colliding particles existed, then certainly a charge given to any point would rapidly distribute itself over the whole, and the potential would quickly become uniform; but it by no means follows that the actual process of conduction is anything like this. Certainly it is not the simplest mode of picturing it for ordinary purposes. The easiest and crudest idea is to liken a wire conveying electricity to a pipe full of marbles or sand conveying water; and for many purposes, though not for all, this crude idea suffices.

Leaving the actual mode of conveyance as unknown, let us review how much is certainly known of the process called conduction.

This much is certainly known:—

(1) That the wire gets heated by the passage of a current.

(2) That no trace of a tendency to reverse discharge or spring back exists.

(3) That the electricity meets with a certain amount of resistance or friction-like obstruction.

(4) That this force of obstruction is accurately proportional to the speed with which the electricity travels through the metal—that is, to the intensity of the current per unit area.

About this last fact a word or two must be said. The amount of electricity conveyed per second across a unit area is called the intensity of current; and experiment proves, what Ohm originally guessed as probable from the analogy of heat conduction, that this intensity is accurately proportional to the slope of potential which causes the flow; or, in other words (since action and reaction are equal and opposite), that a current in a conductor meets with an obstructive electromotive force exactly proportional to itself. The particular ratio between the two depends upon the particular material of which the conductor is composed, and is one of the constants of the material, to be determined by direct

[1] Continued from p. 561.

measurement. It is called its "specific conductivity" or its "specific resistance" according to the way it is regarded. The law here stated is called Ohm's law, and and is one of the most accurately-known laws there are. Nevertheless it is an empirical relation; in other words, it has not yet been accounted for—it must be accepted as an experimental fact. Undoubtedly, it is one of vast and far-reaching importance: it asserts a connexion between electricity and ordinary matter of a definite and simple kind.

Now if we think of this opposing electromotive force as analogous to friction, it is very easy to think of heat being generated by the passage of a current, and to suppose that the rate of heat-production will be directly proportional to the opposing force and to the current driven against it—as in fact Joule experimentally proved it to be.

But if we are not satisfied with this vague analogy, and wish to penetrate into the ultimate nature of heat and the mode in which it can be generated, then we can return to the consideration of a multitude of oscillating and colliding particles moving with a certain average energy which determines what we call the temperature of the body. If now one or more of these bodies receives a knock, the energy of the blow is speedily shared among all the others, and they all begin to move rather more energetically than before: the body which the assemblage of particles constitutes is said to have risen in temperature. This illustrates the production of heat by a blow or other mechanical means. But now, instead of *striking* one of the balls, give it an electric charge; or, better still, put within its reach a constant reservoir of electricity from which it can receive a charge every time it strikes it, and at the same time put within the reach of some other of the assemblage of particles another reservoir of infinite capacity which shall be able to drain away all the electricity it may receive. In practice there is no need of infinite reservoirs: all that is wanted is to connect two finite reservoirs, or "electrodes," as one might now call them, with some constant means of propelling electricity from one to the other, *i.e.* with the poles of a voltaic battery or a Holtz machine.

What will be the result of thus passing a series of electric charges through the assemblage of particles? Plainly the act of receiving a charge and passing it on will tend to increase the original motion of each particle; it will tend to raise the temperature of the body. In this way, therefore, it is possible to picture the mode in which an electric current generates heat.

But although this process may be used as a possible analogy, it cannot be a true and complete statement of what occurs; for it is essentially the mode of propagation of *sound*. Sound travels at a definite and known velocity, being a mechanical disturbance handed on from particle to particle in the manner described. But heat, being some mode of motion, must also be handed on after some analogous fashion, so that when heat is supplied to one point of a mass it spreads or diffuses through it. It is difficult to suppose the conduction of heat to be other than the handing on of molecular quiverings from one to another, and yet it takes place according to laws altogether different from those of the propagation of the gross disturbance called sound. The exact mode of conduction of heat is unknown, but, whatever it is, it can hardly be doubted that the conduction of electricity through metals is not very unlike it, for the two processes obey the same laws of propagation: they are both of the nature of a diffusion, they both obey Ohm's law, and a metal which conducts heat well conducts electricity well also.

Conduction in Liquids.

Leaving the obscure subject of conduction in metals for the present, let us pass to the consideration of the way in which electricity flows through liquids. By "liquids," in the present connexion, one more particularly means definite chemical compounds, such as acids, alkalies, salt and water, and saline solutions generally. Some liquids there are, like alcohol, turpentine, bisulphide of carbon, and possibly water, which, when quite pure either wholly or very nearly decline to conduct electricity at all. Such liquids as these may be classed along with air and gases as more or less perfect dielectrics. Other liquids there are, like mercury and molten metals generally, which conduct after precisely the same fashion as they do when solid. These therefore are properly classed among metallic conductors.

But most chemical compounds, when liquefied either by heat or by solution, conduct in a way peculiarly their own; and these are called "electrolytes."

The present state of our knowledge enables us to make the following assertions with considerable confidence of their truth:—

(1) Electrolytic conduction is invariably accompanied by chemical decomposition, and in fact only occurs by means of it.

(2) The electricity does not flow *through*, but *with*, the atoms of matter, which travel along and convey their charges something after the manner of pith balls.

(3) The electric charge belonging to each atom of matter is a simple multiple of a definite quantity of electricity, which quantity is an absolute constant quite independent of the nature of the particular substance to which the atoms belong.

(4) Positive electricity is conveyed through a liquid by something equivalent to a procession of the electro-positive atoms of the compound in the direction called the direction of the current; and at the same time negative electricity is conveyed in the opposite direction by a similar procession of the electro-negative atoms.

(5) On any atom reaching an electrode it may be forced to get rid of its electric charge, and, combining with others of the same kind, escape in the free state: in which case visible decomposition results. Or it may find something else handy with which to combine—say on the electrode or in the solution; and in that case the decomposition, though real, is masked, and not apparent.

(6) But, on the other hand, the atom may cling to its electric charge with such tenacity as to stop the current: the opposition force exerted by these atoms upon the current being called polarization.

(7) No such opposition force, or tending to spring back, is experienced in the interior of a mass of fluid: it occurs only at the electrodes.

It would take too long to go into the evidence for these statements and to adduce examples: I will try and make the process of electrolytic conduction clearer by reverting to our mechanical analogies and models.

Looking back to Figs. 5 and 6 (p. 559), we see illustrations of metallic conduction and of dielectric induction. In each case an applied electromotive force causes some movement of electricity; but, whereas in the first case it is a continuous almost unresisted movement or steady flow through or among the atoms of matter, in the second case it is a momentary shift or displacement only, carrying the atoms of matter with it, and highly resisted in consequence:—resisted, not with a mere frictional rub which retards but does not check the motion, but by an active spring back force, which immediately checks all further current, produces what we call "insulation," and ultimately, when the propelling force is removed, causes a quick reverse motion or discharge. But the model is plainly an incomplete one: for what is it that the atoms are clinging to? What is it ought to take the place of the *beam* in the crude mechanical contrivance? Obviously another set of atoms, which are either kept still or urged in the opposite direction by a simultaneous opposite displacement of negative electricity. We are to picture two or any number of rows of beads, each row threaded on its appropriate cord; the cords alternately representing positive and negative electricity respectively, and being simultaneously displaced in opposite directions by any applied E.M.F. The beads threaded on any one cord have, in a dielectric, elastic attachments to those on some opposite cord, and thus continuous motion of the cords in opposite directions is prevented: only a slight displacement is permitted, followed by a spring back and oscillation after the fashion already described.

Very well; now picture the elastic connexions between the beads all dissolved, and once more apply a force to each cord, moving half of them one way and the alternate half the other way, and you have a model illustrating an electrolyte and electrolytic conduction. The atoms are no longer attached to each other, but they are attached to the cord. In the first respect, an electrolyte differs from a dielectric; in the second, it differs from a metal.

Moreover, electrolytic conduction is perceived to be scarcely of the nature of true conduction: the electricity does not slip through or among the molecules, it goes with them. The constituents of each molecule are free of each other, and while one set of atoms conveys positive electricity, the other set carries negative electricity in the opposite direction; and so it is by a procession of free atoms that the current is transmitted. The process is of the nature of convection: the atoms act as carriers. Free locomotion of charged atoms is essential to electrolysis.

In order to compare with Figs. 5 and 6, so as to bring out the points of difference, Fig. 13 is drawn. The beads representing one set of atoms of matter are tightly attached to the cord, no trace of slip between them being permitted, but otherwise they are free, and so are represented as supported merely by rings sliding freely on glass rods. The only resistance to the motion, beside the slight friction, is offered at the electrode, which is typified by the spring-backed knife-edge, Z. This is supposed to be able to release the beads from the cord when they are pressed against it with sufficient force. The cling between the bead and cord (*i.e.* between each atom and its charge) is great enough to cause a perceptible compression of the springs, and accordingly to bring out a recoil force in imitation of polarization.

The piece of cord accompanying each bead on its journey (*i.e.* the length between it and the next bead) represents the atomic charge, and is a perfectly constant quantity: the only variation permissible in it is that some kinds of atoms have twice as much, or are twice as far apart on their cord, and these are called by chemists dyad atoms; another kind has three times as much, another four, and so on; these being called triad, tetrad, &c.

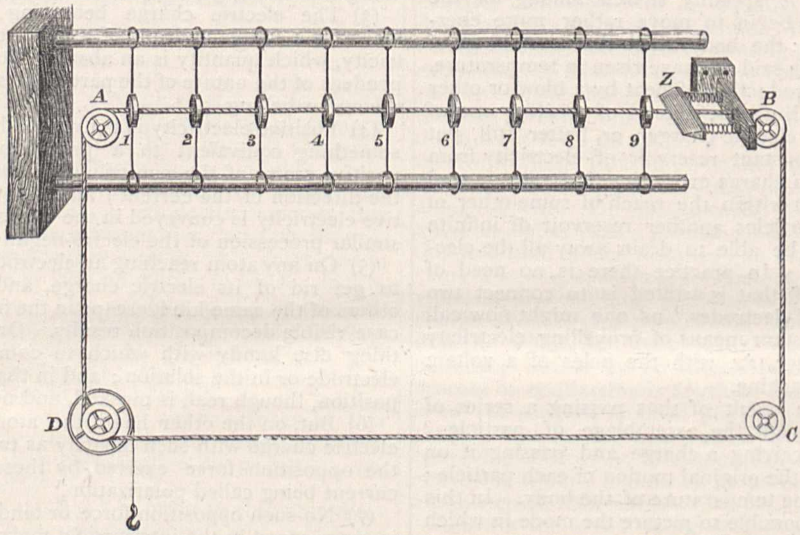

FIG. 13.—Crude mechanical analogy, illustrating a few points in a circuit partly *electrolytic*.

If the cord be taken to represent positive electricity, the beads on it may represent atoms of hydrogen, or other monad *cation*, travelling down stream to the cathode. Another cord representing negative electricity may be ranged alongside it, with its beads twice as far apart, to represent the atoms of a dyad *anion*, like oxygen. If the cords are so mechanically connected that they must move with equal pace in opposite directions, we have a model illustrating several important facts. The number of oxygen atoms liberated in a given time will be obviously half the number of hydrogen atoms set free in the same time, and will therefore in the gaseous state occupy but half the volume. For any element whatever, the number of atoms liberated in any time is equal to the number of atoms of hydrogen liberated in the same time, divided by the "valency" of the element as compared with hydrogen. This law was discovered by Faraday, and appears to be precisely true; and inasmuch as the relative weight of every element is known with fair accuracy, it is easy to calculate what weight of substance any given current will deposit or set free in an hour, if we once determine it experimentally for any one substance.

We may summarize thus:—

If we apply E.M.F. to a metal we get a continuous flow, and the result is heat.

If we apply it to a dielectric we get a momentary flow or displacement, and the result is the potential energy of "charge."

If we apply it to an electrolyte we again get a continuous flow, and the result is chemical decomposition.

There are a large number of important points to which I might direct your attention in the mode by which an electric current is conveyed through liquids, but I will specially select one, viz. that it is effected by a procession of positively charged atoms travelling one way, and a corresponding procession of negatively charged atoms the other way.

Whatever we understand by a positive charge and a negative charge, it is certain that the atoms of, say a water molecule, are charged, the hydrogen positively, the oxygen negatively; and it is almost certain that they hang together by reason of the attraction between their opposite charges. It is also certain that when an electromotive force—*i.e.* any force capable of propelling electricity—is brought to bear on the liquid, the hydrogen atoms travel on the whole in one direction, viz. down hill, and the oxygen atoms travel in the other direction, viz. up hill; using the idea of level as our analogue for electric potential in this case. The atoms may be said to be driven along by their electric charges just as charged pith balls would be driven along; and they thus act as conveyers of electricity, which otherwise would be unable to move through the liquid.

Each of this pair of opposite processions goes on until it meets with some discontinuity—either some change of liquid, or some solid conductor. At a change of liquid another set of atoms continues the convection, and nothing very particular need be noticed at the junction; but at a solid conductor the stream of atoms must stop: you cannot have locomotion of the atoms of a solid. The obstruction so produced may stop the procession, and therefore the current, altogether; or on the other hand the force driving the charges forward may be so great as to wrench them free, to give the charges up to the electrode which conveys it away by common conduction, and to crowd the atoms together in such a way that they are glad to combine with each other and escape.

Now notice the fact of the two opposite processions. One cannot have a procession of positive atoms through a liquid without a corresponding procession of negative ones. In other words, an electric current in a liquid necessarily consists of a flow of positive electricity in one direction, combined with a flow of negative electricity in the opposite direction. And if this is thus proved to occur in a liquid, why should it not occur everywhere? It is at least well to bear the possibility in mind.

Another case is known where an electric current certainly consists of two opposite streams of electricity, viz. the case of the Holtz machine. While the machine is being turned, with its terminals somehow connected, the glass plate acts as a carrier conveying a charge from one collecting comb to the other at every half revolution; but, whereas it carries positive electricity for one half a rotation, it carries negative for the other half. The top of the Holtz disk is always, say, positively charged, and is travelling forward, while the bottom half, which is travelling backward at an equal rate, is negatively charged.

In the Holtz case the speeds are necessarily equal, but the charges are not. In the electrolytic case the charges are necessarily equal, but the speeds are not. Each atom has its own rate of motion in a given liquid, independently of what it may happen to have been combined with. This is a law discovered by Kohlrausch. Hydrogen travels faster than any other kind of atom; and on the sum of the speeds of the two opposite atoms in a compound the conductivity of the liquid depends. Acids therefore in general conduct better than their salts.

OLIVER J. LODGE.

(*To be continued.*)

JOSEPH BAXENDELL, F.R.S.

WE have already announced the death of Joseph Baxendell, an event which took place on Friday, the 7th inst., at the Observatory, Southport.

Born at Manchester in 1815, he had not the advantage of a thorough scientific training, such an education being much less frequent at that early period than it is at the present day. On the contrary, he had to make his way in the world, and went to sea when quite a youth. We are all of us moulded by circumstances, and while Baxendell no doubt inherited an aptitude for science, yet the particular bent which this took was unquestionably determined by the circumstances of his profession. An intelligent seaman cannot fail to be impressed with the importance of astronomy and meteorology, and it was in these two sciences that Baxendell especially distinguished himself in after life.

Meanwhile, notwithstanding the engrossing duties of a sailor, his energy and perseverance in the pursuit of science were such that he was enabled to supplement the deficiencies of his limited education, acquiring a knowledge of mathematics which was of great service to him in his investigations. A training of this kind is well qualified to produce a mature and thoughtful student of Nature, and it had this effect upon Baxendell. Owing to a retiring disposition, he was not much seen in general scientific society, but was, on the other hand, very highly esteemed by students like himself. A gathering of such students usually takes place once a fortnight during the winter months at the rooms of the Manchester Literary and Philosophical Society. At these meetings Baxendell was a most regular attendant, and he ultimately became Secretary of the Society as well as editor of its publications. It is in the Memoirs and Proceedings of this Society that most of his scientific contributions will be found, and in astronomy it is only necessary to notice his catalogue of variable stars, which is very highly esteemed by all observers.

Baxendell's contributions to meteorology are very important, and in one branch of this science he may claim to be the pioneer. In 1871, from an analysis of eleven years' observations of the Radcliffe Observatory, Oxford, he came to the conclusion that the forces which produce the movements of the atmosphere are more energetic in years of maximum than in years of minimum sun-spot activity. This conclusion has now been confirmed in various directions by other observers. We have heard it objected that Baxendell generalized from a comparatively small number of observations, but in a question like this such a procedure is essential to the pioneer. His task is to deduce with a mixture of boldness and prudence something of human interest out of the mass of observations already accumulated, and thus to stimulate meteorologists not only to go on with their labour, but to cover more ground in the future than they have covered in the past. Baxendell's procedure in this respect has been abundantly justified by the fact that many other men of science are now following in his footsteps.

It is believed that he was the first to propose the use of storm-signals which are now universally adopted by all maritime nations. He likewise foretold the long drought of 1868, and enabled Manchester to take precautionary measures which had the effect of rendering the inconvenience less severe. As an astronomer and meteorologist Baxendell was naturally interested in a study of the sun, and was an independent discoverer of the fact that the faculæ which accompany sun-spots are for the most part thrown behind them—the word *behind* having reference to the direction of rotation of our luminary. It was, we believe, his opinion that the behaviour of sun-spots is intimately connected with that of meteoric matter around the sun. Without asserting the exact nature of the bond between these two phenomena, we think that various students of the sun's surface are now inclined to be of this opinion.

He was a Fellow of the Royal Society and of the Royal Astronomical Society. He was likewise a corresponding member of the Royal Society of Königsberg, of the Scientific and Literary Academy of Palermo, and of the National Observatories of France, Germany, and Italy. For some years he enjoyed the use of his friend Mr. Robert Worthington's observatory at Crumpsall. On the death of the Rev. H. H. Jones, in 1859, he was appointed Astronomer to the Manchester Corporation. Latterly his health forced him to reside at Southport, in the neighbourhood of which he continued his observations until his death.

BALFOUR STEWART.

NOTES.

ONE of the most illustrious men of science of the present century, Prof. Gustav Kirchhoff, died at Berlin on Monday. He was sixty-three years of age. Next week we shall have something to say about his services to science.

THE *Gartenflora* for October announces the death of Dr. Robert Caspary, for many years Professor of Botany in the University of Königsberg. He was a native of Königsberg, where he was born in 1818, and the immediate cause of his death was a fall down stairs. The deceased was not a prolific writer, yet he was well known to botanists as a critical authority on the Nymphæaceæ. Local botany and the investigation of abnormal growths occupied much of his leisure time.

MR. ROBERT HUNT, F.R.S., died on Monday, at his residence in London. Mr. Hunt was born in 1807 at Devonport, was the Keeper of Mining Records at the Museum of Practical Geology, and was the first-appointed Professor of Mechanical Science to the Government School of Mines.

PROF. JOHANN KONRAD ULLHERR, a well-known mathematician, died at Kaufbeuren on September 28, aged sixty-seven.

THE last number of the Journal of the China Branch of the Royal Asiatic Society (vol. xxi. new series, Nos. 5 and 6) contains an obituary notice of the eminent Chinese scholar, Alexander Wylie, who died early in the present year. He was the author or translator of a considerable number of works of elementary science into Chinese. Amongst them were treatises on mechanics and arithmetic, translations of De Morgan's "Algebra," Loomis's "Geometry," Herschel's "Astronomy," "Euclid," and Main on the steam-engine. He also compiled a list of stars and astronomical terms in Chinese and English, and a paper on the Mongolian astronomical instruments in Pekin. It may be interesting also to notice that the same number of the Journal contains a sketch of the late Dr. Hance, of Canton and Whampoa, who was well known in Europe by his botanical writings, and whose death was noticed not long since in NATURE. The writer appends a complete list of Dr. Hance's papers on botanical subjects, beginning with the year 1848. There are in all 119 of these relating to Chinese botany.

ON the 9th inst. an interesting ceremony took place in the town of Le Mans (Sarthe). It was the unveiling of a statue erected to the memory of Pierre Belon, the celebrated zoologist and traveller of the sixteenth century. Pierre Belon was born in 1518. He was one of the first who established the homologies between the skeletons of different vertebrates. Over a century before the creation of the Jardin des Plantes in Paris, he had formed two botanical gardens. It was he who brought to France the first cedar planted there. It is a common tradition that the first specimen of this tree was brought by de Jussieu, but Belon had anticipated him by a century. The monument is very handsome. Belon is represented seated and holding a book. The expenses were covered by a public subscription.

THE Council of the Senate of the University of Cambridge report, respecting the site for the Geological Museum, that, as the price required by Downing College is £5390, the University do not proceed further with the proposal. They recommend that a syndicate be appointed to consider the plans, and, if necessary, to procure fresh plans for the erection of the Sedgwick Memorial Museum on the site to the east of the new chemical laboratory, and to present plans to the Senate for their approval before the division of the Lent Term, 1888. The plans are to be so arranged that a part of the building sufficient for the purposes of teaching and study might, with the consent of the Sedgwick Memorial Committee, be erected with the money now in their hands.

THE thirty-fourth annual meeting of the German Geological Society was held at Bonn on September 26, under the Presidency of Prof. Römer (Breslau). The following were among the papers read: on the dolerites of Londorf, near Giessen, by Prof. Streng (Giessen); on the basaltic rocks of the Vogelsberg, by the same; on the chalk of Umtamfuna, in Natal, the Upper Silurian Eurypterus dolomite of Gaaden, near Kiel, and on the mollusk fauna (fifty-four species) in the Central Oligocene of Itzehoe, by Dr. Gottsche (Hamburg); and on fossil footprints in the New Red Sandstone in Thuringia, by Dr. J. G. Bornemann (Eisenach).

A CORRESPONDENT in Trinidad writes:—"We have a Committee appointed here for the purpose of endeavouring to determine the influence the moon has upon vegetation. It arose in this way: I found that in cutting timber, bamboo, pruning cacao, sowing seeds, planting provisions, the phase of the moon was always considered, and in consequence much time was lost. In England, years ago, I heard the same idea and disproved it by experiment. Here it has such a hold upon the Spanish section of the community that it is no use endeavouring to combat it by speaking or writing, and therefore experiment has been authorized. The superstition is so infectious that the Hon. Director of Public Works, after many years' experience, was inclined to believe in it. But after perusing the works of Arago which I lent him, and Lardner's 'Astronomy,' he has refrained from asserting anything, but has devoted himself to the experiments to prove the truth or falsity of the theory. When you aver that no notice is taken of the moon in agricultural operations in England, you are met by the reply, 'Oh, the moon has more influence in the equatorial districts,' &c., &c."

AN Imperial Decree has been issued by the Mikado of Japan sanctioning regulations for the establishment of meteorological observatories, at the public expense, in the country. The regulations provide that the Central Observatory shall be situated in Tokio, and local observatories at such convenient places as may be designated by the Home Minister, without whose consent the local authorities may not establish observatories. The Central Observatory is to be under the Home Minister, while the local observatories are to be under the respective local Governments. The cost of maintaining local observatories is to be defrayed out of local taxation; they are to communicate and correspond with the Central Observatory according to departmental regulations which shall be made by the Home Minister.

THE Aristotelian Society has decided to print, at the close of each session, an abstract of its proceedings. The first number, edited by Prof. Dunstan, has just appeared. It represents the work done during the eighth session, which terminated last June, and contains lengthy abstracts of many papers of interest, among them being: the ultimate questions of philosophy, by Prof. Bain; the re-organisation of philosophy, by Mr. Shadworth Hodgson; Neo-Kantism in its relation to science, by Mr. Romanes and Mr. Bernard Bosanquet; recent psycho-physical researches, by Dr. Cattell. The ninth session will open on November 7 with an address by the President. Among the papers to be read is one by Mr. Romanes, on Darwinism in relation to design; and one by Prof. Bain, on the demarcations and definitions of the subject sciences.

A BOOK on tattooing, by Wilhelm Joest, will shortly be published by Messrs. A. Asher and Co., at Berlin. In this elaborate work, which will be fully illustrated, the author will present much information which he has collected during his extensive travels. He will also thoroughly discuss the question as to the motives which have led to the practice of tattooing.

A NEW periodical is being issued by Julius Springer, of Berlin, who has sent us a copy of the first number. The periodical is called *Zeitschrift für den Physikalischen und Chemischen Unterricht*, and is edited by Dr. Fritz Poske, with the aid of Dr. E. Mach and Dr. B. Schwalbe. The editor's principal object will be to provide an adequate exposition of the best ideas of the age as to the methods of instruction in chemistry and physics.

We have received the first number of the *Journal of Morphology*, edited by Mr. C. O. Whitman, with the co-operation of Mr. E. P. Allis, Junr., and published by Messrs. Ginn and Co., Boston, U.S.A. The journal is to be devoted principally to embryological, anatomical, and histological subjects. It will be published at irregular intervals, new numbers appearing "as often as the requisite material is furnished." The second number will be issued in November, and will complete the first volume.

Messrs. Macmillan have just issued a second edition of "The Growth of the Recruit and Young Soldier," by Sir W. Aitken. The work was originally published twenty-five years ago, and the writer's main object was to suggest a judicious selection of "growing lads" for the army and a regulated system of training recruits. In the present edition the subject-matter has been recast to meet the requirements of the time. Sir W. Aitken holds that the circumstances which justified the first publication are far more pronounced now than they were twenty-five years ago.

A seventh edition of Prof. H. Alleyne Nicholson's well-known "Manual of Zoology" (Blackwood), has just been issued. While the general plan of the original book has been retained, the work has been recast. A considerable number of fresh illustrations have also been added.

The Madras Literary Society has issued its Journal of Literature and Science for the session 1886-87. It contains, besides other good papers, notes on the cyclone of November 9, 1886, by C. Michie Smith; on a new method of finding the factors of any given number: a contribution to the theory of numbers, by J. K. Winter; on the reputed suicide of scorpions, by A. G. Bourne; the cosmogony of the Vedas, by the Rev. Maurice Phillips; and the pearl oyster of the Gulf of Manaar, by H. S. Thomas.

The second Annual Report of the City of London College Science Society has been sent to us. The Society has steadily grown during the past year; and it is claimed that in general interest and thoroughness of treatment the papers read at the evening meetings were fully up to the standard previously set.

The General Electric Apparatus Company have issued a third edition of their Illustrated Catalogue of Electric Lighting Plant and Material, and a sixth edition of their Illustrated Catalogue of Electric Bells. These catalogues present much interesting evidence as to the growth of a new and important industry.

A new tetrahydric alcohol, $C_{10}H_{20}O_4$, belonging to the series CnH_2nO_4, of which it is as yet the only known member, has been synthetically prepared in the laboratory of M. Friedel, by M. Combes (*Ann. de Chim. et Phys.*, October 1887). It is of special interest to organic chemists, as being the first tetrahydric alcohol which has been prepared by direct synthesis, and the discovery is but one of many exceptionally rich ones which have followed the application, by M. Combes, of the well-known aluminium-chloride reaction of MM. Friedel and Crafts, to the fatty series. While studying the action of chloride of aluminium upon acetyl chloride, it was found that a remarkable organo-metallic compound, $C_{12}H_{14}O_6Al_2Cl_8$, was formed, consisting of crystalline lamellæ showing strong colours in polarized light. These lamellæ dissolved in water with great violence, evolving carbonic and hydrochloric acid gases, and extraction with chloroform and subsequent distillation showed that the decomposition by water had resulted in the formation of a new ketone of the composition $C_5H_8O_2$ and constitution $CH_3—CO—CH_2—CO—CH_3$. To this ketone M. Combes gave the name acetyl-acetone, and it was by the hydrogenation of this substance that the new tetrahydric alcohol was obtained. The reduction was effected by means of hydrochloric acid and sodium amalgam, and, when the reaction was completed, a second extraction with chloroform and subsequent evaporation yielded a syrup consisting of a mixture of two compounds: one, boiling at 177°, being another new glycol of the composition $CH_3—CHOH—CH_2—CHOH—CH_3$; and the other, passing over at 270°, consisting of the anhydride of the tetrahydric alcohol, which appears to lose the elements of water very readily. The constitution of this alcohol is pretty conclusively shown to be

$$\begin{array}{l} CH_3—COH—CH_2—COH—CH_3. \\ \qquad\quad | \qquad\qquad\quad\; | \\ CH_3—COH—CH_2—COH—CH_3 \end{array}$$

It should be stated that the above are all general reactions, and open a wide field for further research; indeed, there can be little doubt that the richness of the results obtained through their first application by M. Combes will only prove an earnest of greater success in the future.

A correspondent of the *Nation* for October 6, "R. T. H.," writing from Arkadelphia, Ark., directs attention to what he calls a "scientific revival" in the Southern States of America. "In several of the States," he says, "the question of elementary physiology and hygiene in the public schools has come before the Legislature this year, and, though generally decided adversely, opinion in its favour is growing, and it is a most active leaven. In the Colleges there is a great advancement, and technical studies and natural history may be said to be enjoying a 'boom.' The University of North Carolina has a small but modern Natural History Department. The University of Tennessee is also waking up in this respect. The Mississippi State Agricultural College is exceptionally modern, and the Arkansas State Industrial University has recently added a competent naturalist to its faculty. Tulane University of New Orleans is also paying attention to biologic studies. The most interesting struggle, however, is in Texas, where, owing to an inexplicable tangle, we have the spectacle of the most progressive University in the South handicapped by the most unreasonable embarrassments—the rivalry of another State institution and many sectarian Colleges. But there is no room to doubt that in a few years the struggle will end in the University being unfettered, and becoming a centre from which will radiate much intelligent thought." The writer says that one great obstacle to biologic teaching in the South—opposition to the importation of teachers from the North—is being in part obviated by the fact that young Southerners are beginning to be found who have been abroad or North. For all those who are fitted, good places are made.

An earthquake is reported from Constantinople. It occurred at 10 a.m. on September 30, and lasted for seventeen seconds. Violent shocks were noticed on October 4 and 5 on the Greek mainland, the Ionian Islands, the Cyclades, and the Peloponnese.

Several earthquakes are reported from the south-east of Hungary, many having occurred during the last weeks of September. The most severe one was noticed at St. Peter's (Temesvar), one shock lasting for three seconds, and many houses being greatly damaged. The direction of the shock was from south-west to north-east.

A steamer which arrived lately at New York brought information from Navassa, an island lying between Hayti and Jamaica, that on September 23 an earthquake occurred there, which seemed to send a tremor through the whole island. No damage was done.

Prof. Hudson is giving a course of lectures in the Michaelmas Term of 1887 at King's College once a week, on Wednesdays, at 7 p.m., on "Elementary Applications of the Differential and Integral Calculus," beginning with applications to dynamics.

The additions to the Zoological Society's Gardens during the past week include a Crested Lark (*Alauda cristata* ♂) from India, presented by Colonel Verner; two Proteus (*Proteus *anguinus*) from the Caves of Adelsburg, presented respectively by Prof. W. H. Corfield, F.Z.S. and Dr. E. Rickards; a Spotted Salamander (*Salamandra maculosa*), European, presented by Mr. Alban Doran; a Gorilla (*Anthropopithecus gorilla* ♂), three Pluto Monkeys (*Cercopithecus pluto*), an Erxleben's Monkey (*Cercopithecus erxlebeni* ♀) from West Africa, deposited; two Coypus (*Myopotamus coypus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

NEW MINOR PLANET.—A new minor planet, No. 270, was discovered by Dr. Peters on October 13.

OLBERS'S COMET.—The following corrected elements and ephemeris for this object are by Herr O. Tetens (*Astr. Nachr.* No. 2806):—

T = 1887 October 8·4938 Berlin M.T.

$$\left.\begin{aligned} \pi &= 149^\circ\ 48'\ 7'' \\ \Omega &= 84\ 27\ 40 \\ i &= 44\ 32\ 53 \end{aligned}\right\}\text{Mean Eq. 1887·0}$$

$$\phi = 68\ 35\ 36$$

$$\log q = 0\ 078899$$

$$x = [9·854835]\, r \sin (v + 237^\circ\ 35'\ 31'')$$
$$y = [9·972351]\, r \sin (v + 168\ 39\ 22)$$
$$z = [9·891623]\, r \sin (v + 95\ 54\ 3)$$

Ephemeris for Berlin Midnight.

1887	R.A. h. m. s.	Decl. ° ′	log *r*.	log Δ.
Oct. 22	13 6 38	21 47·3 N.	0·0856	0·2795
24	13 15 8	20 43·7		
26	13 23 28	19 59·3	0·0898	0·2831
28	13 31 39	19 14·5		
30	13 39 39	18 29·4	0·0950	0·2875
Nov. 1	13 47 30	17 44·1		
3	13 55 10	16 58·8	0·1010	0·2924
5	14 2 41	16 13·5		
7	14 10 2	15 28·3	0·1077	0·2979
9	14 17 13	14 43·5		
11	14 24 15	13 59·0 N.	0·1152	0·3037

The brightness on October 26 will be 1·48, and on November 11, 1·20; that on August 27 being taken as unity.

SOUTHERN DOUBLE STARS.—A welcome addition to the still somewhat scanty supply of observations of southern double stars is contained in the *Monthly Notices* for June 1887, which furnishes a series of measures of stars in relative motion recently made at the Sydney Observatory, special attention having been paid to the binaries α Centauri and γ Coronæ Australis. The mean of eighteen measures of position-angle and distance of the components of α Centauri gives for the epoch 1886·47: angle = 202°·3, distance = 15″·10; whilst the mean of four measures of difference of R.A. and of declination of the components gives for 1886·55: angle = 201°·0, distance = 14″·87. Referring to *Monthly Notices*, vol. xlvi. p. 340, we find that for the former epoch the computed places are as follows:—

Downing-Elkin orbit-angle = 202°·6, distance = 15″·11.
Powell orbit-angle = 201·8, distance = 15·26.

These orbits give for the periodic time of α Centauri the values 76 years and 87 years respectively; it appears, however, that several more years' observation will be necessary to decide which of these is the more accurate. Of γ Coronæ Australis eight measures were made at Sydney in 1886. The most satisfactory orbit of this binary hitherto published is that computed by Mr. Gore (*Monthly Notices*, vol. xlvi. p. 104), and the errors of the computed quantities as compared with the observations which have been published since the computations were made are:—

Epoch.	Observed angle.	Error.	Observed distance.	Error.
	°	°	″	″
1881·72	225·5	+ 1·8	1·38	− 0·02
1883·62	217·8	− 1·3	1·62	− 0·33
1886·615	200·6	− 4·6	1·45	− 0·33

The first two of these observations were made at Cincinnati, and published in the *Observatory*, vol. ix. p. 234, the last at Sydney. Mr. Gore's orbit gives 1886·53 as the time of periastron passage; it is very desirable, therefore, that this pair should be repeatedly measured during the next few years in order that the small corrections to the elements which appear to be required may be accurately determined.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 OCTOBER 23-29.

(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 23

Sun rises, 6h. 39m.; souths, 11h. 44m. 26·2s.; sets, 16h. 50m.; decl. on meridian, 11° 24′ S.: Sidereal Time at Sunset, 18h. 57m.

Moon (at First Quarter October 23, 18h.) rises, 13h. 37m.; souths, 18h. 1m.; sets, 22h. 28m.; decl. on meridian, 18° 47′ S.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Decl. on meridian. ° ′
Mercury	9 7	13 14	17 21	21 14 S.
Venus	3 15	9 21	15 27	0 30 N.
Mars	1 25	8 25	15 25	10 57 N.
Jupiter	7 50	12 36	17 22	14 49 S.
Saturn	22 40*	6 28	14 16	19 6 N.

* Indicates that the rising is that of the preceding evening.

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. ° °
23	σ Capricorni	5½	20 18	21 29	113 327
24	θ Capricorni	4	16 32	17 52	78 277
26	70 Aquarii	6	19 50	21 7	88 323
28	B.A.C. 81	6½	23 32	0 21†	85 12
29	26 Ceti	6½	19 22	20 37	87 274
29	29 Ceti	6½	22 40	23 57	141 294

† Occurs on the following morning.

Oct.	h.	
27	3	Mercury at greatest elongation from the Sun, 24° east.
28	—	Venus at period of greatest morning brilliancy.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.
U Cephei	0 52·3	81 16 N.	Oct. 23,	3 51 *m*
			,, 28,	3 30 *m*
Algol	3 0·8	40 31 N.	,, 24,	2 32 *m*
			,, 26,	23 21 *m*
ζ Geminorum	6 57·4	20 44 N.	,, 25,	0 0 *M*
S Cancri	8 37·5	19 26 N.	,, 26,	2 10 *m*
S Ursæ Majoris	12 39·0	61 43 N.	,, 25,	*M*
U Coronæ	15 13·6	32 4 N.	,, 24,	1 58 *m*
T Ophiuchi	16 27·3	15 53 S.	,, 25,	*M*
U Ophiuchi	17 10·8	1 20 N.	,, 23,	0 51 *m*
			and at intervals of	20 8
η Aquilæ	19 46·7	0 43 N.	Oct. 24,	20 0 *m*
S Aquilæ	20 6·4	15 17 N.	,, 23,	*m*
δ Cephei	22 25·0	57 50 N.	,, 25,	1 0 *M*
			,, 28,	19 0 *m*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A.	Decl.	
Near β Tauri	78°	30° N.	Swift.
From Canis Minor	105	12 N.	Swift; streaks.
,, Cancer	135	20 N.	Very swift.

GEOGRAPHICAL NOTES.

MM. BONVALOT, CAPUS, AND PEPIN, who have just returned to France from an extensive journey in Central Asia, are credited with having been the first to cross the Pamir. They may certainly have been the first to take the particular north to south route traversed by them, but the Pamir has been crossed and very thoroughly explored in recent years by several Russian travellers, while Mr. Ney Elias has done much to make known its peculiar features. The three French travellers seem to have suffered much during their journey across this mountain mass, especially from the extreme cold and the rarefaction of the air. They had frequently to throw themselves down upon the snow from exhaustion. These enforced halts were taken advantage of by M. Capus to register the pulse-beats of himself and his companions; he found the mean number per minute rise to 170.

THE Danish Expedition to the coast of Northern Greenland has just returned to Copenhagen. It has been absent since the spring of 1886, and was directed by Herr C. Ryder. During the two summers it was enabled to proceed from lat. 72° to lat. 74½°. It investigated the Upernivik glacier during the winter. Many meteorological, magnetic, and astronomical observations were made, many anthropological measurements were taken, and botanical and zoological collections have been brought back. The investigations of the western coast of Greenland are not likely to be continued for the present.

THE Dutch Geographical Society has abandoned its plan of sending a scientific expedition to the Dutch part of New Guinea, but intends sending one to the Key Islands instead. The researches will not only be ethnographical and anthropological, but especially botanical.

AT the recent meeting of the French Association M. Schrader described the results of his ten years' study of the Pyrenees, which has led him seriously to modify previously accepted ideas upon the contour and structure of that range. According to the old descriptions the mass of the Pyrenean Chain was comparable to a fern-leaf with its transverse nerves, or to the backbone of a fish. In reality the Pyrenees consist of a long series of lines of elevations oblique to the imaginary axis of the chain, with which they often form an acute angle. It is impossible to look at the network exhibited in the map by the valleys and the ridges without being struck with the extreme precision of the meshes. These meshes are broken up in all directions, the slopes, however, presenting very different aspects. On the French side the crests are blunted. The incessant humidity of the atmosphere has used them up; mountains, ravines, crests, all are effaced to assume the form of juxtaposed cones or pyramids. On the Spanish side, again, the fractures have remained much fresher, the angles sharper, the forms rougher, due no doubt to the much drier climate of the south side. The slope on the Spanish side is very gradual, while on the French side the mountains rise like a wall.

To the *Zeitschrift* of the Berlin Geographical Society (Nos. 129-30), Herr Erich von Drygalski contributes an elaborate paper of over 100 pages on the deformations of the earth's form during the Glacial epoch. Dr. Oppel brings together much useful information on the religious conditions of Africa, his map showing very strikingly the distribution of the various forms. The whole of North Africa is covered with the Mohammedan tint (with the exception of Abyssinia and part of Algeria), coming down on the east to beyond the equator. Different shades of the tint show the oldest Mohammedan region as a narrow fringe along the Mediterranean. A lighter tint indicates the spread of Islam from the eleventh to the seventeenth centuries, and the lightest the broad belt in the south, which has been included during the present century.

THE HARVEIAN ORATION.

AT the Royal College of Physicians, on Tuesday afternoon, the Harveian Oration was delivered by Dr. William H. Stone. In the course of his remarks Dr. Stone sketched the lineaments of Harvey, self-revealed, as a scholar, a lecturer, a physicist, and as a man of genial, not to say humorous, disposition, and said:—"Perhaps the most important part of my prescribed task is to draw a practical conclusion from the essentially physical and mechanical character of Harvey's great discovery. That Harvey himself fully knew this, has been shown in his own words; it is also by his division of anatomy into three parts—*philosophica*, *medica*, and *mechanica*. Now, at the present time, investigation and research is carried on in the pathological, physiological, and therapeutical aspects of medicine, but the physical or mechanical side is somewhat neglected. For hundreds of ardent questioners of Nature who are labouring with the microscope in the biological and bacteriological laboratories, those who attack medicine from its physical side may be counted on the fingers of one hand. Nor, indeed, are the written treatises on this subject abundant, in this country at least. The 'Animal Mechanics' of the Rev. Dr. Haughton, of Trinity College, Dublin, is an exceptional work of great value, which has hardly received the attention it deserves from the medical profession, but it stands almost alone as the representative of its class. On the Continent, however, and in America the case is very different. The admirable 'Medical Physics' of Prof. Wundt, of Heidelberg, has been translated from the German into French, with valuable additions, by Dr. Ferdinand Monayer, who regularly lectures on medical physics at the Lyons Faculty of Medicine, and affords a storehouse of information of the highest value to the medical practitioner. Dr. John C. Draper, Professor of Chemistry and Physics in the Medical Department of the University of New York, has also made a valuable contribution to the literature of this subject in his text-book of 'Medical Physics,' published the year before last. There is, indeed, a small but scanty manual by Dr. Macgregor Robertson, the Muirhead Demonstrator of Physiology in the University of Glasgow, published in Cassell's Student's Series, but it is entirely unfit to compete with the two exhaustive treatises named before. As with the bibliography, so with the teaching. With the exception of a course of lectures which the present speaker has delivered since 1871 in St. Thomas's Hospital, I am not aware of any systematic attempt in London to teach the medical student the vast mass of physical facts which underlie the daily practice of medicine. This College, however, forms an honourable exception, for it has on two occasions kindly given me the opportunity to bring before my brother physicians some few of what our Harvey terms *nova vel noviter inventa*, respecting the physical basis of auscultation in the Croomian, and the electrical conditions of the human body in the Lumleian, lectures of a few years back. It is true that the University of London in its preliminary scientific examination for the degree of Bachelor of Medicine requires students to satisfy their examiners in physics by means of a written paper. But this paper is the same as that set to Bachelors of Science not medical. It is a terrible stumbling-block to the rising medical generation; it bristles with what the late genial Prof. De Morgan, himself a mathematician of the highest order, delighted to call mathematical conundrums. It is set by pure physicists, who know nothing and probably care little for the problems which interest us as medical men. It contributes a large percentage to the slaughter of innocent aspirants to the higher degrees in medicine, on which one of their most distinguished graduates, now Censor of this College, has feelingly and righteously commented. In the sixteen years during which I have carefully read the papers there set I have never once seen a question directly or indirectly bearing on the physics of medicine. The fact is that the large, difficult, and somewhat heterogeneous branch of knowledge connoted by the word physics is rapidly splitting into several independent portions. There are now distinctly molecular, mathematical, industrial, and physiological physics. It is the last of these with which we are concerned. The third or industrial branch has been enormously developed of late by the technical colleges at Bristol, Manchester, the City Guilds' at Kensington, and elsewhere. The mathematical branch is well cared for by the two old Universities of Oxford and Cambridge, but the physiological section has been hitherto hardly enough recognized by our teaching bodies. Surely an earnest student should be able somewhere to obtain information as to the natural laws on which the stethoscope, the microscope, the ophthalmoscope, and the sphygmograph are founded without having to wade through interminable problems on the C.G.S. system of units, or vortex theories of matter, or, chimera of chimeras, the possibility and advantages of four-dimensional space. It is to the promotion of this particular branch of study by means of experiment that it is this day my duty to exhort the College. An admirable opportunity exists, for in April of the present year the Committee of Delegates appointed by this College and the Royal College of Surgeons of England reported: (1) That it is desirable to utilize tha vacant ground adjoining Examination Hall for scientific purposes, under the control and management of the two Colleges. (2) That the 'scientific purposes' be, in the first place, the investigation and exposition of such branches of science connected with medicine and surgery as the two Colleges may from time to time determine. The College has subsequently adopted the report. Now I submit with the utmost respect, but with the greatest earnestness, to those here assembled, that a course of physiological physics to be delivered in the new College of Science would be a real boon to all students of medicine, whether they had succeeded in obtaining their diploma or not. The human body is a mass or congeries of separate machines, susceptible of mechanical explanation ; but, setting aside the heart and lungs, already named, how many students have their attention specially drawn to Donders's and Landolt's optical researches on the eye and eyesight, or to Helmholtz's account of the mechanism of the ear? Such a course, moreover, would in no way clash with other courses given elsewhere on different branches of the same subject, and it would eminently fulfil the exact purpose even to the very words of the great man whom we are to-day met to commemorate."

THE BRITISH ASSOCIATION.

Section C—Geology.

Preliminary Note on Traverses of the Western and of the Eastern Alps made during the summer of 1887, by Prof. T. G. Bonney, F.R.S.—The first traverse was made along the line of the Romanche from near Grenoble to the Col du Lautaret, and thence by Briançon over the Mont Genèvre and the Col de Sestrières to Pinerolo, at the edge of the Italian plain. The second went from Lienz, across the central range of the Tyrol to Kitzbühel, and the rocks of this range were also investigated at other places. During both traverses the author had the advantage of the assistance of the Rev. E. Hill, who had accompanied him on a similar journey in 1885. The results of their examination fully confirm the views already expressed by the author as to the nature and succession of the crystalline rocks of the Alps.

(1) The lowest group consists partly of modified igneous rocks (which indeed occur at all horizons), partly of gneisses of a very ancient (Laurentian) aspect.

(2) The next group, up to which there seems a gradual passage, consists mainly of more friable gneisses and moderately coarse mica-schists (Lepontine type). This group is commonly less fully developed in the above districts than in the Central Alps, having probably been removed by very ancient denudation.

(3) The third group has an enormous development. It forms a large part of the Cottian and Graian Alps, and it flanks the central axis of the Eastern Alps on both sides, often passing beneath the ranges of Secondary strata which here form the northern and southern ranges. It has been traced almost without interruption from east to west for more than 50 miles on the southern and 80 on the northern side of the central range. It has a very close resemblance in all respects to the uppermost group of schists in the Central Alps, found to some extent in the Lepontine and yet more largely in the Pennine Alps, and the author fully agrees with the Swiss and Austrian geologists in regarding it as in the main a prolongation of the same series. It is characterized especially by rather dark-coloured mica-schists, often calcareous, sometimes passing into fine-grained crystalline limestones, with occasional intercalated chloritic schists, especially in the lowest part and with (rarely) quartz schists.

(4) The Carboniferous and Secondary strata infolded or overlying in the Western Alps section, and the Palæozoic (? Silurian) and Secondary strata succeeding the metamorphic rocks in the Eastern Alps, are comparatively little altered and are each readily to be distinguished from the above.

(5) The succession of strata in the third group is inexplicable unless it be due to stratification ; in the second this explanation appears highly probable ; and in the first not more difficult than any other.

(6) As groups of rocks with marked lithological characters occur in like succession over a mountain chain measuring above 400 miles along the curve, and sometimes at distances of 40 miles across it ; and as these groups correspond with rocks recognized as Archæan elsewhere, which exhibit like characters and sometimes a like order of succession, the author thinks a classification of the Archæan rocks by their lithological characters (using the phrase in a wide sense) may ultimately prove to be possible.

(7) The views already expressed by the author as to the distinctness of cleavage-foliation and stratification-foliation have been fully confirmed by the examination of the above districts. He believes that the failure to recognize this distinction is the cause of the contradictory statements with regard to the relation of foliation and bedding which have been made by so many excellent observers, and lies at the root of much of the confusion which exists on the subject of the so-called metamorphic rocks.

The Origin of Banded Gneisses, by J. J. H. Teall.—The author first discussed the meaning of the term gneiss. This term was generally understood to denote a more or less foliated rock of granitic composition. Dr. Lehmann had proposed, however, that it should be used in a structural sense only, as meaning a more or less foliated plutonic rock. He would thus speak of granite-gneiss, diorite-gneiss, and gabbro-gneiss. The author called attention to specimens illustrating gneissic structures in acid and basic plutonic rocks. When various examples of gneissic rocks—that is, rocks of the composition of plutonic igneous rocks but possessing parallel structures—were compared, two types of parallel structure might be recognized ; the one characterized by a parallel arrangement of the constituents, the other by an arrangement of the constituents in bands of varying mineralogical composition ; thus, bands having the mineralogical composition of a diorite frequently alternated with others having the composition of granite. He proposed to discuss a possible mode of origin for the banded gneisses of the latter type. It was now admitted that those of the former type were largely due to the plastic deformation of masses of plutonic rock either during or subsequent to the final stages of consolidation.

Many observers were, however, still inclined to believe that those of the latter type conld only be accounted for by supposing that the original materials had accumulated by some process akin to sedimentary deposition. Now a possible mode of origin for these could be found if we could show : (1) that plutonic masses are liable to vary in composition, and (2) that such masses are occasionally deformed either during or subsequent to their consolidation. Scrope long ago proved that the laminated structure of certain volcanic rocks (liparites) is due to the plastic deformation of heterogeneous masses of acid lava. Any heterogeneous lump if deformed into a flat sheet will show laminated or banded structures, because each individual portion must of necessity take the form of the entire mass. Scrope not only proved this, but called attention to the similiarity between the structures of acid lavas and those of gneisses and schists. ("Geology of Ponza Isles.")

The author then proceeded to refer to illustrations of the fact that plutonic masses do vary in composition. He referred to the so-called contemporaneous veins, which are often more acid, and to the concretionary (?) patches which are often more basic, in composition than the main mass of the rock with which they are associated. He also referred to cases in which granite and diorite may be seen to vein each other in the most intricate manner, and especially drew attention to the photographs taken at the Lizard last year illustrating this feature. If complex masses of the kind referred to were deformed after the fashion of the acid lavas described by Scrope, then banded and puckered gneissic rocks would necessarily result. He then showed that in the Lizard district the banded rocks of Prof. Bonney's "granulitic series" were continuous with masses in which granitic and dioritic rocks could be seen to vein each other in the most intricate manner, and that the constituent bands of the granulitic series were composed of rocks petrologically identical with those of the igneous complex. He did not mean to imply that the deformation was connected with the intrusion of the plutonic masses. He was rather inclined to regard it as due in the majority of cases to mechanical forces acting posterior to consolidation. The uncertainty which might exist as to the precise conditions under which the deformation was affected did not invalidate the main conclusion, which was that a banded structure in rocks having the composition of plutonic igneous rocks was no proof that the latter were not of igneous origin.

On the Occurrence of Porphyritic Structures in some Rocks of the Lizard District, by Howard Fox and Alex. Somervail.—Prof. Bonney has described a porphyritic diabase which is seen on the shore at Polpeor ; it cuts, in an intricate manner, through micaceous and hornblendic schists. The authors have traced this rock further, and have recognized a porphyritic structure not only in many dykes and intrusions along the coast which cut through the serpentine, but also in the darker bands of Prof. Bonney's "granulitic group." Descriptions of these various localities are given, and illustrative specimens are exhibited. The crystals of feldspar are found to be most numerous in those rocks which lie in the closest proximity to the gabbros and serpentine. They have their long axes at various angles, and are mostly small except at Parn Voose, Cavouga, and Green Saddle. The feldspathic and hornblendic lines often circle round the crystals. Without discussing any theory as to the true nature and origin of the whole of the schists, the authors think that the porphyritic structure so prevalent in the dark bands of the "granulitic group," in many of the micaceous and other rocks, as also in the later intrusions cutting the serpentine, indicates an igneous origin for many rocks hitherto regarded as schists.

Preliminary Observations on the Geology of Wicklow and Wexford, by Prof. Sollas.—Of rocks older than the Cambrian, examples probably occur in the Carnsore district, but most of the presumed Archæan rocks are to be explained as crushed igneous dykes and flows. The Cambrian are certainly unconformably succeeded by the Ordovician. The main granite of the district is a truly intrusive rock, but at its junction with the Ordovician, which it penetrates, it possesses the characters of a true gneiss, the schistosity of which corresponds in direction with that of the adjoining schists, having resulted from earth-movements which took place after the Ordovician and before the Lower Carboniferous period.

Some Effects of Pressure on the Sedimentary Rocks of North Devon, by J. E. Marr.—The structures described in this paper are mainly seen in the Ilfracombe division of the Devonian system, as exposed near the bathing place at Ilfracombe. The rocks there consist of argillaceous beds, with thin bands of grit and crinoidal limestone; these harder beds are folded into a series of small sigmoidal folds, which form portions of similar larger folds. When the middle limb is replaced by a fault, the cores of the folds remain as "eyes" of limestone or grit, and these "eyes" have undergone further modification, having been pulled out into thin lenticular masses. In this way we have all the mechanical structures of a true schist produced (including the apparent false-bedding), the rock now consisting of clay-slate with alternating folia of grit or limestone, or both. Quartz veins are folded in a similar way to that described above, and the final result of this folding appears to be the production of a rock consisting of alternating clay-slate, limestone, and quartz-folia. Every stage of the process is seen in the case of the limestone "eyes." The cores of limestone, when not dragged out, have their compound crinoid stems pressed into polygons, which have been formed in the way described elsewhere by Dr. Sorby. When the limestone is pulled out the stems are separated, as in the case of the Belemnites figured by Heim, and the intervening portion is filled with calcite. In this neighbourhood, then, we find sedimentary rocks presenting all the mechanical peculiarities of normal schists, without any great amount of chemical change.

On the Organic Origin of the Chert in the Carboniferous Limestone Series of Ireland, and its Similarity to that in the Corresponding Strata in North Wales and Yorkshire, by Dr. George Jennings Hinde.—The author showed that this rock, which has hitherto been usually regarded as an inorganic deposit of silica direct from the sea-water, is in reality made up of the microscopic detached spicules of siliceous sponges. These sponges lived in successive generations over certain areas, and, after the death of the sponges themselves, the minute spicules forming their skeletons fell apart and were strewn over the bottom of the Carboniferous seas in countless numbers, so that by their accumulation beds of solid rock with a total thickness of from 150 to 350 feet have been formed. Sponges were thus more important as rock-formers in the Carboniferous than at any subsequent geological epoch.

On the Affinities of the so-called Torpedo (Cyclobatis, *Egerton*) *from the Cretaceous of Mount Lebanon*, by A. Smith Woodward.—Following Egerton's original determination, the fish seems to have been universally regarded up to the present time as referable to the Torpedinidæ, partly on account of its rounded shape, and partly on account of the supposed absence of dermal defences. The fine series of specimens now in the British Museum, however, appears to demonstrate conclusively that these generally-accepted views as to the affinities of *Cyclobatis* have no sure foundation in fact, but that the genus is truly referable to the Trygonidæ. There is thus no evidence, as yet, of the existence of "electric rays" of an earlier date than those made known by Volta and Baron de Zigno from the Eocene of Monte Bolca, near Verona, in Northern Italy.

The Pliocene Beds of St. Erth, Cornwall, by Robert George Bell.—The opinion expressed in the earlier reports upon this deposit, as to the southern facies of its fauna, has been amply justified by fresh researches. Had there been any connexion with northern seas or colder waters, it would be difficult to understand the entire absence of those forms of Pleurotoma (Bela) so abundant in the Boreal seas of the Crag period and the present age, as well as the equally characteristic bivalves, Astarte and Cyprina. Some conflict of opinion exists upon the depth of water in which the St. Erth clays were deposited. In a letter to NATURE, vol. xxxiv. p. 341, a very competent authority on Pliocene phenomena, Mr. Clement Reid, gave it as at least 40 or 50 fathoms, founding his view on the evident fact of its deposition in still water, which he maintains could not be found in a district exposed to Atlantic swells at less depth. To this the writer must take serious exception. Undoubtedly the clays exhibit an entire absence of such a disturbing cause as the influence of great wave action, but it remains to be proved that such a great depression as Mr. Reid describes did occur at the western end of Cornwall, and as far as the author's observations go there is little indication of such a fact. Some depression, of course, must have happened, sufficient to submerge the low-lying land near St. Erth, causing a strait or gulf, dividing the Land's End from the main eastern portion of the county. In this shallow strait the clays and sands were deposited, and just such an assemblage of Mollusca is found as will bear out this view. Scarcely any of the shells which are of living species are known to inhabit such deep water as Mr. Reid indicates, while the majority show the presence of a laminarian zone, extending to not more than 15 fathoms.

On a Starfish from the Yorkshire Lias, by Prof. J. F. Blake.—The specimen described was an external cast of the under side of a *Solaster*, which was sufficiently well preserved to afford both generic and specific characters. The only known species with which it is comparable is *Luidia murchisoni*. If this is truly described, and is in fact a *Luidia*, then the present specimen, which is certainly a *Solaster*, must belong to a different species. It was found at the base of the cliff at Huntcliff by the Rev. G. Crewdson, of Kendal.

The Classification of the Dinosauria, by Prof. Seeley, F.R.S.—The author discussed the structure of the animals named Dinosauria, and concluded that the group had no existence, the constituent animals belonging to two orders which have no near affinity; they are named Omosauria and Cetiosauria, the former with a sub-avian pubis and ischium, the latter with those bones sub-lacertilian. The *Omosauria* is defined as having the ventral border of the pubic bone notched out, so that one limb is directed backward parallel to the ischium, while the other is directed forward. The ilium has a slender prolongation in front of the acetabulum. The *Cetiosauria* is defined by having the pubes directed forward with a median symphysis, but with no posterior limb to the bone. The anterior prolongation of the ilium has a vertical expansion.

On the Reputed Clavicles and Interclavicles of Iguanodon, by Prof. H. G. Seeley, F.R.S.—The author showed, by superimposing a figure of the reputed clavicle upon the bone figured by Mr. Hulke as clavicle and interclavicle of Iguanodon (*Quart. Journ. Geol. Soc.*, vol. xli. plate xiv.), that the supposed sutures are fractures, and that the supposed interclavicle has no existence, except as an ossification posterior to the reputed clavicles. Then it was urged that these bones are unparalleled by any vertebrate clavicles, while the reputed pubes of crocodiles and prepubes of other animals offer a more probable analogy. The ossification in front of the pubis in Ornithosaurus is of similar form in several genera. And in crocodiles the ossification of the fibrous extension which connects the reputed pubes with the sternal ribs would produce a bone like the supposed interclavicle of Iguanodon. Hence it was urged that these bones in Iguanodon are pre-pelvic, and the author identified them with the pre pubic bones.

On the Permian Fauna of Bohemia, by Prof. Anton Fritsch (of Prague).—After having mentioned the seventy-three species of Labyrinthodonts of which he has given figures in his work ("Fauna der Gaskohle"), and of which he exhibited the electrotypes and restored models in the galleries of the Owens College, the author mentioned the discovery of a very peculiar genus *Naosaurus* (Cope). Then he explained some unpublished plates of Ctenodus, Orthacanthus, Ctenacanthus, and a new Ganoid Fish (Trissolepis), with three kinds of scales. Then he proved Acanthodes to be very near to the Selachians, and drew attention to the gigantic fish (Amblypterus), 113 cm. long, exhibited in the galleries.

SECTION D—BIOLOGY.

Proposed Contributions to the Theory of Variation, by Patrick Geddes.—The author argued that the variations which furnish the distinguishing characters of orders, genera, or species alike are seen to be not merely "spontaneous" or "indefinite," but parallel, or rather convergent; *i.e.* directed through the checking of vegetation by reproduction along a definite groove of progressive change. Passing from the study of the flower to the larger question of the classification of plants, an antagonism between nutrition and reproduction is seen to be general and constitutional, affording a constant factor in variability. In every natural alliance of flowering-plants, be it species or genus, order or class, we can distinguish the appearance of a predominantly floral, and of a predominantly leafy, or weedy, type; *i.e.* of a reproductive and vegetative one. What we figuratively call higher or lower species are thus essentially the leaders or the laggards along one or other of these two main lines of evolution—the representatives on one side or other of this or that stage in the rhythm between vegetative and reproductive changes which we know as the essential functions of organic life.

On the Structure of Haplodiscus piger, by W. F. R. Weldon.—This remarkable organism consists of an outer cuticle within which is a protoplasmic layer with interspersed nuclei; this protoplasmic layer is continuous with a network which ramifies through the body; in the middle of the body and towards the under surface the network is condensed into a solid mass which sends out pseudopodia-like processes and is evidently an organ of nutrition; the interstices of the network are occupied by the reproductive organs; there is a vesicula seminalis communicating with the exterior by an ejaculatory duct. The author compared this organism to a Foraminifer, such as *Haliphysema*, which had developed sexual organs.

On the Degeneration of the Olfactory Organ of certain Fishes, by Prof. Wiedersheim.—The author described a remarkable series of intermediate forms between a species of *Tetrodon* in which the olfactory organ was represented by a bifid tentacular outgrowth on each side, and another form in which these organs had degenerated into a simple flat plate.

On the Torpid State of Protopterus, by Prof. Wiedersheim.—In this paper the structure of the "cocoon" was described, and the author announced the startling discovery of a peculiar respiratory organ in the tail of the fish; the relations of this organ to the lungs during the torpid condition is not known.

The Larynx and Stomach of Cetacean Embryos, by Prof. D'Arcy Thompson.—The author pointed out that the divisions of the stomach in the Cetacea, do not really correspond to those of the Ruminants, with which they have been erroneously compared.

The Blood Corpuscles of the Cyclostomata, by Prof. D'Arcy Thompson.—The red blood corpuscles of *Myxine* are oval, as are also those of the larval lamprey. The adult lamprey has round corpuscles.

On the Luminous, Larviform Females of the Phengodini, by Prof. C. V. Riley.—Certain interesting phosphorescent Coleopterous larvæ, reaching from 2½ to 3 inches in length, have been well known to occur in America since 1862. Prof. Riley gave a minute description of these larvæ, calling attention to certain structural features of the head, and to other points.

The great interest attaching to these larvæ is not so much in their luminosity as in the fact that a portion of them are now known to be true and perfect females of Phengodini, which have until recently been represented in Coleopterological collections in the male sex only.

Prof. Riley has critically examined in all some thirty different sets of specimens. These all belong to *Phengodes* and *Zarhipis*, with the exception perhaps of one, which may be *Spathizus*. The differences between the larvæ proper and the adult female are so slight that it was difficult to separate them without some absolute index. Prof. Riley had obtained undoubted females, coupled with their males, of *Phengodes laticollis* and *Zarhipis riversii*, and in both genera there were absolutely no other structural differences than the somewhat shorter mandibles and tarsal claws in the adult. In reference to life-history, the food of Zarhipis is known to be Myriapods. The eggs in both genera are spherical, translucent, and laid in masses in the ground, the newly-hatched larvæ in both are structurally identical with the parent; and the female larva goes through a pseudo-pupal state prior to the final moult. Nothing is yet known of the male larva and pupa, and the author only conjectures that certain darker, more slender larvæ, structurally identical, belong to this sex. The author discussed the bearing of the facts on the theory of evolution. In these larviform females we get a glimpse, so to speak, into the remote past, from which has been handed down to us, with but little alteration, an archetypal form which prevailed before complete metamorphosis had originated; while on the other hand her male companion, during the same period, had developed wing-power and the most elaborate and complex sensorial organs, the eyes and antennæ in these beetles being among the most complex of their order. Whatever we believe of the origin of the female Phengodes, one thing is self-evident; viz. that there is direct relation between the phosphorescence and the remarkable differentiation of the sexes, and, further, that such relationship is explicable and full of meaning on evolutionary grounds.

A discussion upon *The Present Aspect of the Cell Question* was opened by Prof. Schäfer. After a brief historical *résumé* of the different conceptions of the cell, the speaker brought forward facts in support of his view that the essential part of the cell is not the reticular substance, but the interstitial substance. It was pointed out in the first place that the various materials produced in the cell by the activity of its protoplasm, *e.g.* fat, appeared in the interstitial substance; and that, in the second place, the *Amœba* presented no reticular substance whatever. The structure of the white blood-corpuscle was also quoted as an additional argument. These corpuscles have a reticulum like that of other cells, but the pseudopodia are prolongations of the interstitial matter; hence the activity of the cell for movement is lodged in this substance, and not in the reticulum.

Prof. Weismann contributed to the discussion an account of his views upon the nature and meaning of polar bodies, announcing at the same time the discovery of a single polar body in the parthenogenetic eggs of certain animals.

Prof. Lankester drew attention to a statement made by the President of the Association in his opening address. Sir H. Roscoe had stated that protoplasm was not a chemical compound, but a structure built up of compounds. This statement was indorsed as in harmony with the views of at any rate many biologists. The term *protoplasm* was originally applied by von Mohl to the whole of the slimy matter within the vegetable cell-wall. But nowadays biologists were more and more limiting the term protoplasm, and applying the term true protoplasm to the chemical substance of highest elaboration, which is the important living part of von Mohl's "protoplasm." Prof. Lankester suggested that the term "plasmogen" should be used for this substance. With regard to the structure of protoplasm, it was considered to be vesicular, the reticulum or walls of the vesicules being that part of the protoplasm in which the plasmogen resides which is not contained in the vesicular spaces. The idioplasm and germ-plasm of Prof. Weismann were probably varieties of plasmogen.

The discussion was continued by Profs. Krause, Carnoy, Marshall Ward, and Hartog, Mr. Gardiner, and Mr. Sedgwick.

Prof. Riley read a paper upon *Icerya purchasi, an Insect injurious to Fruit-Trees.*—It was stated that this species is the most polyphagous of Coccids, living on a great variety of fruit-trees. As it is capable of moving about at all stages of development after leaving the egg, and can survive for a long period without food, it is one of the most injurious of parasites. It is believed to have originated in Australia and to have been introduced into other parts of the world upon living plants. It is very hard to destroy the eggs by any insecticides because of the fluted waxy ovisac. In California these difficulties have, however, been largely overcome by the use of kerosene emulsions and of resin soaps, as well as by inclosing the tree in a portable tent, which is then filled with certain gases.

The Hessian Fly, by Prof. Fream.—The Hessian fly was discovered in Britain in barley-fields near Hertford in July 1886, previous to which date there is no record of its occurrence in this country.

During the present summer it has been traced over the greater part of England and Scotland, and the author found it on July 14 in fields of wheat and barley on the borders of South Wilts and South Hants. The theory that the fly was introduced into the United States by Hessian troops during the War of Independence is regarded as untenable. Packard, discussing Wagner's results, concludes that the Hessian fly had appeared in the Eastern States before the Revolutionary War, that it has never been known to inhabit England or Northern Europe, that it was not known even in Germany before 1857, that it has "from time immemorial" been an inhabitant of wheat-fields on the Mediterranean coasts, that it most likely originated in this region, or farther east (in the probable original habitat of wheat and other cereals), and that it was introduced thence into the United States before the war. How it reached Britain is not known, but it probably came as "flaxseeds" in straw used for packing or for litter. Wheat, barley, and rye are the cereals attacked; oats appear to escape. The "flaxseeds" or puparia have also been found upon timothy grass (*Phleum pratense*, L.), but there is no evidence of any other grass being attacked. American observations indicate that the fly flourishes best in warm, moist seasons, so that the hot, droughty character of the recent summer can hardly have specially favoured it; in fact, it seems to have made headway under rather adverse conditions, and with one of our usual moist summers the attack would probably have been more severe. Many precautions have been suggested for the use of agriculturists with the object of minimizing the attacks in future years. Several species of Hymenoptera are parasitic upon the Hessian fly. Specially useful in this way are *Semiotellus destructor*, Say, one of the Chalcididæ, which deposits its eggs in the pupa of the Hessian fly, and *Platygaster error*, Fitch, which places its eggs within those of the fly. These minute parasites have done splendid service in the American wheat and barley fields, where they are as active friends to the corn grower as are the aphis eating lady-birds in this country to the hop grower. It has been suggested that if the parasites have not accompanied the fly to Britain they should be colonized here. On August 11, however, from a "flaxseed" in the possession of the author there emerged a chalcis fly, and other observers have confirmed the presence in this country of insect parasites of this much-dreaded crop scourge.

Recent Researches on Earthworms.—Mr. W. B. Benham gave a general account of his own researches into the structure of this group, as well as those of Beddard, Horst, Perrier, and others. One object of the paper was to compare the facts already known about this group and to deduce therefrom the mutual affinities of the different genera. *Perichæte* was regarded as being an ancient form, while *Criodrilus* was referred to as a degenerate form.

A Luminous Oligochæte.—Prof. Harker described a species of *Enchytræus* which he had noticed gave off a brilliant phosphorescent light.

Mr. F. E. Beddard communicated a paper *On the Structure of Fratercula arctica*. The point of the paper was to record the fact that the "oblique septa" of this bird, like those of the duck, were covered with a layer of muscular fibres; in this respect these two birds agree more closely than any other birds with the crocodile, in which animal, according to Prof. Huxley, the homologues of the oblique septa are largely muscular.

On Cramer's Gemma borne by Trichomanes alata.—Prof. Bower described peculiar developments on a plant of *Trichomanes alata* from the Royal Botanic Garden in Edinburgh. From the tips of the pinnæ are produced flattened outgrowths of an apparently prothalloid character; these produce spindle-formed gemmæ, which are recognized as corresponding to those previously described by Cramer. These are thus shown to be genetically connected with a plant of Trichomanes, and the opinion of Cramer is thus now confirmed; but, further, if the flattened outgrowth on which they are produced be truly prothalloid in its character, there is here a further example of that direct transition from the fern plant to the prothallus which has been described under the name of apospory.

On Bennettites, the Type of a New Group between Angiosperms and Gymnosperms.—Count Solms-Laubach described a genus of fossil plants, *Bennettites*, the type of a new group between Angiosperms and Gymnosperms. The plants in question accord with the Cycadeæ in their vegetative structure, but possess fruits which exhibit the true structure of the Gymnosperms.

The Secretion of Pure Aqueous Formic Acid by Lepidopterous Larvæ for the Purposes of Defence, by E. B. Poulton.—It has long been known that the larvæ of the genus Cerura (Dicranura) have the power of ejecting a colourless fluid from the mouth of a gland which opens on the prothoracic segment. The latter segment is dilated when the larva is irritated, so that the fluid is thrown in a forward direction, and for a distance of several inches. When the larva is touched, the head and anterior part are immediately turned towards the source of irritation, and the fluid is thrown in this direction. In 1885 I found that the secretion was strongly acid to test-paper, and that it caused very strong effervescence when placed upon sodium bicarbonate; while a little later I showed the fluid to Prof. Wyndham Dunstan, who told me that the characteristic smell of formic acid could be plainly detected. This opinion was further confirmed when it was found that silver nitrate was readily reduced by the secretion (Trans. Ent. Soc. Lond. 1886, part ii., June, pp. 156–57). In 1886 I obtained a larger number of larvæ, and with the kind help of Mr. J. P. Laws, I was enabled to show that the secretion contains about 33 per cent. of anhydrous acid. All the well-known qualitative tests were applied to the secretion and to the alkaline salts obtained by neutralizing with standard alkali. Among other tests, the secretion was found to dissolve the oxide of lead, a white crystalline salt being deposited. Although only a very minute weight of this was obtained, Prof. Meldola kindly offered to estimate the amount of lead present in the salt. The weight was found to correspond to one of the basic formates of this metal formed by the action of the normal formate upon the excess of oxide. During the past summer I have had a very large number of these larvæ, and the investigation has been continued with larger amounts of secretion. The pipette has been applied for the removal of secretion between 500 and 600 times, and between twenty and thirty volumetric determinations have been made. A mature larva which has not been previously irritated will eject ·050 gramme of secretion containing about 40 per cent. of anhydrous acid. Half-grown larvæ eject nearly as much, but the fluid is weaker, containing about 33–35 per cent. of acid. The rate of secretion is comparatively slow—*e.g.* two days and a half after ejection, two large larvæ only yielded together ·025 gramme of secretion. Two captured larvæ, to which the eggs of parasitic Ichneumonidæ had been affixed, only ejected ·035 and ·045 gramme of secretion; having incompletely made up the amount lost during the attack of the Hymenopterous insect. Starvation lessens the amount of secretion, and also decreases the proportion of acid; but probably both these effects are due to general health, and do not imply the direct formation of the acid from the food. The different food-plants—poplar and willow—do not make any difference in the amount or strength of the secretion. About half the total quantity of secretion obtained was made use of in preparing a relatively large amount of the normal formate, which is now in Prof. Meldola's possession. The weights of the constituent elements will be determined by combustion. The rest of the secretion has been used for other exact methods of estimation and analysis under the kind direction of Mr. A. G. Vernon Harcourt, the work having been conducted in his laboratory at Christ Church. Mr. Harcourt suggested that it was most important to prove that the amount of acid shown to be present by volumetric analysis is formic acid, and nothing else. This proof was obtained in two ways: (1) a certain weight of the secretion was divided into two parts; the amount of acid in one of these was determined by the volumetric method, while the other was decomposed by strong sulphuric acid, and the carbon monoxide which was evolved was exactly measured in the apparatus for gas-analysis, and the amount of formic acid present was calculated from the data thus obtained. The two percentages nearly corresponded, and, as the latter was the higher, it was obvious that no other acid could be present. (2) A certain weight (·186 gramme) of secretion was heated in a tube over a water-bath, and, after drying at 100° C., only ·0004 gramme of solid residue remained, and this was probably accidental. The rest of the fluid was distilled into a tube containing carbonate of lead, and this was afterwards heated to 100° C., and the water collected in drying-tubes. As a result, the increase in weight of the latter, and the tube containing lead carbonate, the weight of formate of lead obtained from the latter, and of sulphate of lead obtained from the formate, all corresponded almost exactly to the weights which would have been given by pure aqueous formic acid having this composition: water, 62·5 per cent.; formic acid, 37·5 per cent.

Since writing the above I have received the results of Prof. Meldola's analysis, from which he concludes that the secretion consists of aqueous formic acid almost in a state of purity.

Further Experiments upon the Colour-Relation between Phytophagous Larvæ and their surroundings, by E. B. Poulton.—From the instance of the larval *Smerinthus ocellatus*, I have shown that certain Lepidopterous larvæ are susceptible to the influence of surrounding colours, so that the larvæ themselves gain a corresponding appearance.[1] This larva varies from bright yellowish-green to a dull whitish or bluish-green, and either variety can be produced by the use of a food-plant, with the appropriate colour on the under side of the leaves. Although the difference between the two varieties is very great when they are placed together, so great in fact that I can readily distinguish three intermediate stages of variation between the extremes—yet it is not nearly so well marked as in the case of the green and brown varieties of many dimorphic larvæ. I was therefore anxious to test one of these latter, and to ascertain whether either variety can be produced at will by surrounding the larva with the appropriate colour. Lord Walsingham had previously called my attention to the variable larvæ of *Rumia cratægata*, some of which are brown, some green, while many are intermediate. The larva exactly resembles the twigs of its food-plant, and always rests upon the branches in a twig-like attitude, and this habit rendered the species very favourable for the purpose of this inquiry, which was conducted as follows:—A glass cylinder was provided with a black paper roof, and a similar floor, and a small quantity of the food-plant—hawthorn—the rest of the space being entirely filled with dark twigs. Owing to their habit, the larvæ always rested upon these latter, and after reaching maturity in two such cylinders, forty dark varieties were produced. Three other cylinders were roofed and floored with green paper, and green shoots bearing leaves were introduced as food, nothing brown being allowed inside the cylinder. In these cylinders twenty-eight green varieties were produced. The young larvæ were obtained from the eggs of three captured females. After hatching, the larvæ were thoroughly mixed and introduced into the cylinders when quite small. Some of the dark varieties were greenish, and some of the green larvæ brownish, but the greenest in the dark cylinders was browner than the brownest in the green cylinders. The larvæ were compared by placing the sets side by side upon white paper, and the contrast between the larvæ brought up in different surroundings was very marked. In this case the larvæ ate precisely the same kind of leaf, so that it is clear that the effects follow from the surrounding colours, and not from the action of food. The instance recorded above is the best among the many cases of adjustable colour-relation which are now known in Lepidopterous larvæ. It is now extremely probable that all dimorphic species will show more or less of this susceptibility to the colours of their environment.

Further Experiments upon the Protective Value of Colour and Markings in Insects, by E. B. Poulton.—The experiments undertaken in 1886, of which a short account was given in a paper read before Section D, at Birmingham, led to such interesting results that I determined to renew the investigation during the present year.[2] At the same time the range of the inquiry has been widened, and for the first time a mammal has been included in the list of insect-eating vertebrates used in the experiments. For this purpose a marmoset has been employed, and this animal appears to be highly insectivorous. With the kind help of Mr. A. G. Butler I have been able to add largely to the number of experiments made with birds, and these results have been especially needed. In addition to the species of lizards and frogs made use of last year, I have also experimented with a chamæleon and a salamander. The comparison of the results obtained from these different groups of insect-eaters is extremely interesting. In nearly all cases there is complete concurrence in their treatment of highly-coloured nauseous insects. But there are great differences in the relative ease with which the different groups can be induced by hunger to eat distasteful insect food.

The frogs and the birds appear to be the least scrupulous in this respect. It seems probable that the superficial skin of the frog is more delicate than the lining of the oral cavity. Thus the Hymenopterous larvæ, *Crœsus septentrionalis* and *C. varus*, were eaten in considerable numbers, but the face was carefully wiped by the paw after being touched by the everted glands of the larvæ. I am inclined to think that lizards are less unscrupulous in this respect than the most completely insect-eating birds. Mammalia (*i.e.* the marmoset), appear to be far more difficult to please than any of the other groups. The above arrangement accords well with what is known on other grounds of the development of the sense of taste in the vertebrate classes.

I will now bring forward a few of the instances which support the above-mentioned conclusions. The marmoset would never touch a hairy or spinous larva of any kind; this was because of the presence of the structures themselves, for the same species was always eaten in the pupal stage. All the other vertebrates will sometimes eat hairy larvæ. Birds have a special advantage in their power of getting rid of unpleasant appendages—such as hairs or wings. Large lizards will eat unpalatable insects which are often refused by smaller ones, probably because the former can swallow their prey without so much biting, and thus without tasting it so much. Lady-birds were eaten by the nightingale, and by frogs when very hungry; hitherto they have been invariably refused by the other vertebrates. The green larva of *Pieris rapæ* was eaten, but disliked by the marmoset, relished by the lizards. The hairy larva of *Orgyia antiqua* was eaten by birds but refused by lizards, except on one occasion, when two lizards fought over the larva, and in the struggle tore out the hairs incidentally. An experiment with this latter larva gave a very probable interpretation of the meaning of the hairy tufts on many Bombyx larvæ. A lizard seized the larva by one of these tufts, which immediately came out, leaving the lizard with a mouthful of hairs. After this it did not again touch the larva. These tufts are placed on the back, in the part where larvæ are nearly always seized; being formed of very closely approximated fine hairs of the same height, the whole tuft suggests a solid part of the animal rather than a mass of loosely fixed hairs.

The following conspicuous nauseous forms have been eaten, when the vertebrates have been hungry:—

Euchelia jacobææ, larva, by lizard.
Pygæra bucephala, larva, by lizard.
Porthesia auriflua, larva, by lizard.
Zygæna filipendulæ, imago, by lizard.
Zygæna trifolii, imago, by frog.
Diloba cæruleocephala, larva, by lizard.
Liparis salicis, larva, by lizard.
Liparis salicis, imago, by lizard and marmoset.
Abraxas grossulariata, imago, by lizard.

L. salicis (imago) is evidently very distasteful, but the very similar (although smaller) *P. auriflua* (imago) is palatable, and the latter probably benefits by the reputation of the former. Thus the marmoset when very hungry ate the former, although it was much disliked; immediately afterwards the mammal refused the latter, although on other occasions he ate as many as four of these moths with evident relish. Highly-gilded pupæ of *Vanessa urticæ* were eaten with relish by birds and the marmoset, and it is clear that the appearance does not in this case indicate an unpleasant taste, as has been suggested. The spider-like larva of *Stauropus fagi*, in its terrifying attitude, somewhat impressed a lizard and the marmoset, but not to such an extent as to prevent the larva from being eaten. This was to be expected, for both animals will eagerly devour spiders. Such effect as was produced was due to the suggestion of no ordinary English spider, but one of much greater size, and with the terrific aspect highly idealized. The terrifying larva of *Cerura vinula* certainly frightened the marmoset, and either its appearance or the secretion of formic acid greatly affected the lizards. The terrifying but quite harmless larva of *Chærocampa elpenor*, which is known to frighten all but the boldest of birds (as Weismann has shown) was offered to a large lizard. The latter examined the larva most cautiously and many times before touching it; then it bit the larva gently, and retired to watch the effect, repeating this process several times. Finally, finding that nothing happened, it seized the larva, and soon swallowed it. The effect produced by this serpent-like larva was not due to its size, for the equally large larvæ of *Smerinthus ocellatus* were seized at once. The imagines of *Sesia bembeciformis* and *S. apiformis*, resembling hornets, were offered to lizards. On the first occasion the moth was approached with the greatest caution, examined carefully, and seized by the head and thorax,

[1] An account of these experiments will be found in Proc. Roy. Soc., No. 237, 1885, p. 269, and No. 243, 1886, p. 135.

[2] For the complete account of the experiments in 1886 see a paper by the author in Proc. Zool. Soc., Lond., March 1, 1887, pp 191–274.

just as though it possessed a sting. At the same time the lizard evidently doubted whether it was a really dangerous insect at first sight. When, a few days later, a second moth was offered to the same lizard, it was immediately seized without any caution or hesitation. The lizard had learnt its lesson. Instances of this kind support the belief that insect-eating animals have no instinctive knowledge of the palatable, or unpalatable, or dangerous character of their prey, but that they learn by experience. Thus the chamæleon was offered a bee, which was caught at once with the tongue; as the organ was withdrawn, the chamæleon was stung, and shook the bee off; after this it would never touch a bee again. Similarly with many conspicuous nauseous insects, they were generally caught once, but rarely a second time. Now if such instinctive knowledge existed, the chamæleon above all might be expected to possess it, because of the manner in which it catches insects. Shooting its prey from a considerable distance, it can rarely gain any knowledge of a new insect without, so to speak, committing itself, whereas other lizards can make use of the tactile sense in their tongues, while their sense of smell must be more delicate because of their greater proximity before capture. It appears, however, that the chamæleon brought among the insects of a new country relies solely upon a good memory and powerful sight, and these are so efficient that a single instance of each species of insect is sufficient for a thorough education. If the chamæleon possessed an instinctive knowledge of the dangerous or unpalatable insects by which it is normally surrounded, it is most probable that it would also shun the insects of other countries which are protected by similar "warning" colours.

All the species of the genus Zygæna hitherto tested are nauseous, and all are conspicuous and strikingly similar, so that it is probable that we have here an instance of divergence checked by the advantages which follow from simplifying the education of enemies, by setting them one pattern to learn instead of several. Instances of this are well known in other countries, but this is the first example in our own fauna. Among all the experiments previously recorded there occurred no instance of an unpalatable imago which had been palatable in earlier stages. I have paid especial attention to working through many histories in this way, and as a result I have found one such instance. The larva of *Arctia caja* is unpalatable because of the presence of hairs, but apparently not otherwise; the pupa is palatable, while the imago is highly conspicuous and extremely nauseous.

Section E—Geography.

Dr. Ludwig Wolf, who accompanied Wissmann in his exploration of the southern tributaries of the Congo, gave some account of his journeys on the Upper Kasai and the Sankuru, the leading results of which have already appeared in our "Geographical Notes." The point of his discovery was that the Sankuru, which hitherto had been supposed to fall into the Congo, joined first with the Kasai. He described the nature of the country and the habits of the people, giving an account of many personal adventures. The people are superstitious and offer human sacrifices. He did not think Central Africa would ever become a country for European emigration. At the same time Europeans of good constitution could not only live there, but do several hours' manual labour every day. He wished the Congo Free State all success in its efforts to civilize the natives.

A paper by Capt. Coquilhat on the Bangala, a tribe of the Upper Congo, was read. The Bangala are in some cases given to cannibalism, suicide is not unusual, and certain games of chance are popular. European spirits are unknown, and the most popular drink is a kind of beer made from the sugar-cane. The tribe is intelligent and ambitious.

A sociological study on the tribes of the Lower Congo was contributed by Mr. R. C. Phillips, for many years a trader there. His opinion was that these natives had degenerated from a higher standard. They believed in witchcraft, charms, and fetishes. They recognized a something in the sky as a god, but no form of worship followed upon this recognition; it was simply a matter of knowledge. The family relations were fairly developed, and there were fair principles of public justice in operation. The rise of legitimate trade on the Congo had to some extent deprived the chiefs of their wealth, and in this way the lower classes had been benefited.

A discussion followed on the climate of West Africa and its adaptability to European colonization, the general opinion being that European families could not be reared, at least on the coast regions of tropical Africa. Mr. R. C. Phillips, in answer to a question as to the fitness of the Congo districts for emigration, said that during the sixteen years he had known the river (he spoke of it from the mouth up to Vivi) he had seen only three or four white ladies there, and they had either died or been invalided home. At St. Paul de Loanda and other places on the coast the white ladies looked very sallow, and their children did not seem healthy. The population had to be kept up by importation from Europe. His opinion was that the Congo in general was no place for Europeans.

Account of a recent Visit to the ancient Porphyry Quarries of Egypt, by W. Brindley.—Egyptian porphyry has been sought after from the earliest times, as one of the most precious building stones. Ancient writers differed as to the whereabouts of the quarries from which that stone was obtained, and in modern times they were literally rediscovered by Burton and Wilkinson in 1823, and subsequently visited by Lepsius in 1845. The information published by these visitors proving of no immediately practical value, the author determined to follow in the footsteps of Wilkinson, and, accompanied by his wife, he came to Cairo in February last. Having examined the ancient granite quarries at the first cataract, which supplied deep red, rose, and dark grey stone, which was quarried by metal wedges, and not wood (as is generally supposed), the author started from Keneh with a small caravan and supplies calculated to last three weeks. Passing the remains of several Roman stations, the author, on the fifth day, reached an excellent well in the charming Wadi Kitar, hemmed in on three sides by precipitous mountains. Soon after leaving this valley he crossed the watershed (2400 feet above the Nile), and then travelled along the flank of the immense porphyry mountain of Gebel Dukhan as far as the old Roman station with an old fort. The morning after his arrival the author ascended to the top of a pass (3100 feet), without having found even a fragment of porphyry; but espying by the aid of a good field-glass porphyry colouring on the opposite mountain he resolved to go there, and his delight knew no bounds when he found the ground there strewn with pieces of the most sumptuous porphyry, and discovered a pitched way or slide, 16 feet wide, down which the blocks were lowered. Further examination led him to the locality where the Romans had extracted their grandest masses, and he found that these quarries had yielded not only the usual spotted variety but also the brecciated sorts and green-greys The great quarry was at an altitude of 3650 feet above the sea, and a road led down to it to an ancient town with workshops. A path led hence to the old town in the valley, further up which are the ruins of a Roman temple. The blocks were formerly carried to the Nile, a distance of 96 miles, but they will in future be conveyed by a gentle incline to the Red Sea, which is about 25 miles distant. On his return to Cairo the author secured a concession to rework the quarries, the terms of which have since been ratified.

Matabeleland and the Country between the Zambesi and the Limpopo, by Capt. C. E. Haynes, R.E.—The Matabele are the near kinsmen of the Zulus, and have nearly identical customs. They were driven out of Zululand about the beginning of the century, and under their chief Umselikazi, they became a terror to all the Bechuana tribes living north of the Vaal River. Attacked by the Voortrek Boers, and by the Zulus under Panda, they were forced to retire north of the Limpopo, and finally settled down in the midst of the Makalaka and Mashona tribes. About the same period the Gaza kingdom was established by Manikuza, one of Chaka's generals, to the east of the Sabi River. The invasion of the Matabele has caused the annihilation or disruption of the tribes with whom they came into conflict. There are only fragments of the aboriginal people now, who still carry on in a furtive manner some of their old industries, such as gold-digging, iron-working, and weaving. The climate of Matabeleland resembles that of the Transvaal, and the high veldt which ranges from the Nata River to the vicinity of the Zambesi near Tete, is well fitted for European settlers, and promises to become a prosperous agricultural region, with numerous local markets at hand in the mining districts. Care should be taken to protect the forests there. Their wholesale destruction has already begun. The Gaza country and the low veldt is not so salubrious, and, generally speaking, the Zambesi valley is malarious. Agriculture at present is in a depressed state. There is plenty of arable land on the high veldt, and excellent wheat, as all English vegetables alongside the banana and orange can be grown. The high and middle veldts are more suitable for stock-farming. Facilities for irrigation abound. The tzetze does not exist on the high veldt. The mineral wealth of the country still awaits development. The Tati gold-field is now being worked by an English company, but a nod from the Matabele king may at any time put an end to this.

From a scientific point of view Monday was the most interesting day in this Section, the greater part of the time having been devoted to what was practically a discussion of the legitimate field of geography. The first paper, which was more of the nature of a lecture, was by Prof. Boyd Dawkins, on *The Beginning of the Geography of Great Britain.* He said that the surface of the earth was being given up to geographers, and in a few years it would all have been explored. Besides the geography in space, however, there was a geography in time, a field hardly yet touched. It seemed to him that in the field which was open to geographers in recording those ancient changes by which the earth's surface had come to be what it is, in bringing before us boldly and clearly those various geographical outlines at various geological periods presented by the science of geology, they would do as good and as true geographical work as any of those facts which were brought from the interior of Africa or from the inclement regions of the poles. He wished to put before them in outline the method he hoped to follow out in some detail in the course of a few years—a method opened by the results mainly of the various deep-sea exploring parties. The stratified rocks forming the crust of this earth as we know them were all of them deposited in waters which were none of them very deep, and were formed along the margin of a land which was in every degree of the same general sort as the margins of the present ocean. After describing the maps put before the Section, and stating the reasons for supposing Great Britain was originally part of a continent not Europe, which he called Archaia, Prof. Dawkins said that when he looked at the distribution of land and water in the British Isles, from the infinitely remote Upper Silurian period up to the present time, he was bound to believe that some part of the highlands remained dry lands, while the various rocks which occupied the greater part of England, and especially south-eastern England, were accumulated as represented on the map. In conclusion he said he considered that hitherto geologists had devoted themselves so much to the study of fossils and the construction of rocks, and the coining of names which shocked them all, that they had hardly seen that if the knowledge of the ancient life of the earth was to be of any practical use it must be in terms of geographical expression.

Mr. H. J. Mackinder, the recently appointed Reader in Geography at Oxford, opened a discussion on the teaching of geography as applicable to the Universities. To give a practical value to the discussion, he expounded his programme for the coming academical year. There will be two courses of lectures: Course A, on the principles of geography; Course B, on the geography of Central Europe. In these lectures no definition of geography will for the present be attempted. But, to prevent geography becoming a discussion of things in general, a distinct line of argument will be kept steadily in view. This we may indicate thus: the basis—a descriptive analysis of the earth's surface, including in that term the atmosphere, the hydrosphere, the form of the lithosphere, and the material of its surface. From this we shall reason backwards to the causes, and forwards to the effects—the causes largely geological, the effects mainly on man; in other words, in the former stage we answer the question "Why?" for physical, in the latter for political geography. Course A is intended to be annually repeated, subject of course to improvements. It will deal with the methods and principles of geographical observation, reasoning, and exposition, with the great circulations in air and water, with the various types of features, with the broad facts of distribution of animals and plants, and, lastly, with the dependence of man on geographical surroundings and the distribution of his social attributes. The classification will not be topographical, and the examples will be drawn from all parts of the world. Course B will vary in subject from year to year, but will always be an analysis of a particular region. Mr. Mackinder selects Central Europe to begin with, because it best fulfils the necessary conditions: good topographical surveys give us with precision the form of the earth; geological surveys are available for causal reasoning; and a long history gives us abundant scope for the exhibition of effects. It is impossible to foretell the nature of the classes, but he trusts to see at Course B historical students, at Course A those who intend becoming masters in our great public schools, and at both a few who intend being geographical professors, politicians, &c. As regards examinations, Mr. Mackinder is inclined to doubt the ultimate advantage of the too speedy introduction of examinations. We shall lose perhaps in the number of our students at first, but on the other hand we require time to train teachers, time to begin the tradition of a school, and as in this time we are bound to make experiments and mistakes, let us at least make them with our hands untied by a syllabus. One method of stimulating exertion is, however, not open to the same objection. Let us have a prize, but a prize under special conditions. Provisionally, he would suggest the following:—Make a list of, say, twenty small regions, carefully selected, not too distant from England, regions of historical and physical interest. Let the student select one of them at will: let him read up the literature on the subject, and then write an essay. Award the prize by the essays, and then let the winner use the money in visiting the region he has treated theoretically. There let him revise his essay on the spot, or, as he will more probably do, re-write it. Then let it be published. Thus he hopes we might help high training, and at the same time produce a valuable set of monographs. He would also add as a preliminary qualification attendance at the Reader's lectures. As regards diagram-maps, Mr. Mackinder advocates many similar outline-maps, each coloured to represent one set of features, hung side by side. Lastly, as to the relation of physiography to geography. It is impossible to teach rational geography without postulating an elementary but sound knowledge of certain physical and chemical laws and facts, chiefly relating to air and water. This training, it is true, is required for other scientific studies, and even for the intelligent newspaper reader, but it is indispensable to the geographer, and until the schools send us boys so trained, or until the Universities supply such a course for their students generally, the geographical lecturer will have to deal much with physiography. But physiography is not geography; it lacks the topography, which is the essential element in geography.

In the discussion which took place on Prof. Boyd Dawkin's paper it was maintained that he dealt with what was pure geology, or the geography of the past, which was not geography at all in the rational acceptance of the term. Geography should deal strictly with the present, and use only so much of geology as will enable it to understand the conditions of the existing surface. Geography begins where geology ends. In spite of a somewhat humorous diatribe by Canon Tristram on what seemed to him the all-comprehensiveness of the new geography, the meeting was distinctly in favour of Mr. Mackinder's interpretation of the subject.

A paper on *The Ruby Mines of Burmah* was read by Mr. G. Skelton Streeter. The ruby mine district which lies to the north of Mandalay, between the Irrawaddy and the Shan States, bordering on Yunnan. The ruby mine tract, he said, was a large valley some twelve miles long by eight broad, composed of several small valleys, or rather basins. It lay on the slope of the Sibwee Doung, dividing the Irrawaddy and Salween Rivers. The valley bore signs of volcanic origin. The ruby mines were of three distinct kinds. The first was furnished by the metamorphic rock, whose mass was traversed in all directions by huge fissures, caused probably in the past by shrinkage. These fissures were filled with a soft reddish clayey earth, generally containing rubies. At present they were worked in a superficial manner. The second variety of mine was on the sides of these rocky hills where diversified strata of clayey consistency had been upheaved. This earth the natives washed away slowly by hydraulic mining. The last system of mining was by sinking pits in the lower or plain parts of the valley and washing the earth extracted by hand.

The Valley of the Rio Dôce (*Brazil*), by Wm. J. Steains.—The author in 1881 left England for Brazil for the construction of a railway in the flourishing little province of Alagôs. On the completion of this railway, the author, at his own expense, undertook an exploration of the Rio Dôce and of its northern tributaries. The valley of the Rio Dôce is one of the most fertile regions of the empire. Virgin forests cover nearly the whole of it. Gold is found in Cuithé, a district of Minas Geraes, close to the right bank of the Dôce, as also on the head-waters of the Rio Tambaquary, a tributary of the Sussuhy Grande. Most of the basin of the Rio Dôce is inhabited by wild Botocudo Indians, who possess an inborn hatred of the white man, who, on his side, looks upon these "Bugres" with feelings of intense horror and dread. Until these wild Indians shall at least have been partially civilized, the valley of the Rio Dôce must necessarily remain a sealed paradise. The few attempts made hitherto in this direction have hopelessly failed, perhaps because of the gross mismanagement on the part of those to whom the task was intrusted. The author's arduous explorations have resulted in a carefully plotted map of the Rio Dôce and of its tributaries, based upon over 4000 magnetic bearings and careful dead reckonings.

On some Defects in the Ordnance Survey, by Mr. H. S. Wilkinson.—The author gave a brief sketch of the various methods used by cartographers in the delineation of the irregularities of the ground, illustrating the several styles by specimen sheets of foreign topographical surveys, and he explained that while the English 1-inch hill-shaded Ordnance map is for the mountainous districts unsurpassed by anything published in the world, the same map utterly fails in the representation of the less elevated and therefore less sloping ground. Mr. Wilkinson complained that the contours given on both the 6-inch and the 1-inch map are not sufficiently numerous and strongly-drawn to be of practical value. He suggested that the Ordnance Survey might produce a physical map of Great Britain on some such scale as 1 : 500,000 or 1 : 300,000, so as to relieve English students from the necessity of buying their maps abroad. In conclusion, Mr. Wilkinson urged that the Ordnance Survey should form a high ideal of the scope of its work, and should aim at assisting the eye and imagination of the student to realize "the nature of the earth's surface as the arena of the development of mankind."

Sir Charles Wilson said that the reader of the paper appeared to be under some misconception with regard to the nature and character of the Ordnance Survey. It differed in some respects from those of foreign countries, which were made for purely military purposes. It was true that our Ordnance Survey in its conception was military in character, but its military character was soon lost, and it was now a cadastral survey. The reader of the paper had complained of the crowded detail on the Ordnance maps, but it was to be borne in mind that England was much more crowded than any foreign country. He was acquainted with most of the gentlemen who superintended the foreign surveys, and he knew that our 1-inch map was looked upon as one of the most beautiful pieces of work that had been published. With regard to contours, he said they were tied down by Parliament, but he would like to say that the contours on the Ordnance Survey were instrumental contours, and all strictly accurate. The Ordnance Survey maps indeed were acknowledged to be the most mathematically accurate maps in Europe.

A paper on *The Utilization of the Ordnance Survey* was read by Sir Charles Wilson, who showed a number of Ordnance maps on various scales. He contended that in England as in Ireland the unit of area should be the same for all local purposes. The Ordnance maps had not been much used so far for educational purposes, though they were admirably adapted therefor. He suggested that in the elementary schools a commencement should be made with the immediate neighbourhood around them, which could be done with the 25-inch map. That showed roads, ditches, houses, and isolated trees, and conveyed to the child an idea of how objects were represented in plan. From the place with which they were familiar an advance might be made to the county, then to the whole country, the Continent, and so on. This plan was already in use in France, and he would like to see elementary schools supplied with maps such as he had suggested.

Dr. H. R. Mill gave some account of a new bathy-orographical map of the Clyde basin, embodying the results of the researches which he and others have been carrying on for some time. He described the peculiarities of some of the lochs on the west coast of Scotland, and pointing out the Wyville Thomson ridge, off the north-west coast of Scotland, stated that it was owing to this ridge that the Arctic waters did not descend to our shores, and give us a semi-Arctic climate.

A Plea for the Metre, by E. G. Ravenstein.—The author pointed out the great advantages of the metre as a universal international standard of length. There were at present in use three international measures of length, viz. the English foot, in countries covering 18,188,112 square miles, with 471,000,000 inhabitants, [the metre (12,671,200 square miles, 347,091,000 inhabitants), and the Castilian foot (752,901 square miles, 5,905,000 inhabitants). The English foot, at present in use throughout the British and Russian Empires, in the United States, and in some other countries, appeared to gain no new adherents, while the metre was still engaged upon a career of conquest. Denmark and Russia were the only countries in Europe which had not as yet adopted it. The metrical system appeared to him to present great advantages to business men, and in 1885 nearly one-half the commercial transactions of the country were carried on with countries using the metre. The time at present expended in our schools upon acquiring a knowledge of an absurdly complicated system of weights and measures might be devoted to more useful objects. To geographers and statisticians the universal acceptance of the metre would prove an immense boon. Scientific men in other departments had freely adopted the metre, and geographers should follow this laudable example. Owing, however, to the intimate connexion of geography with the common affairs of life, he despaired of the general acceptance of the metre until it should have become the legal standard of length.

Section H—Anthropology.

The Primitive Seat of the Aryans, by Canon Isaac Taylor.—The author discussed recent theories as to the region in which the Aryan race originated. The pre-scientific Japhetian theory and the Caucasian theory of Blumenbach have long been abandoned. A few years ago the theory advocated by Pott, Lassen, and Max Müller, which made the highlands of Central Asia the cradle of the Aryans, was received with general acquiescence, the only protest of note coming from Dr. Latham, who urged that the Asiatic hypothesis was mere assumption based on no shadow of proof. The recent investigations of Geiger, Cuno, Penka, and Schrader have brought about an increasing conviction that the origin of the Aryan race must be sought not in Central Asia, but in Northern Europe. These writers have urged that the evidence of language shows that the primitive Aryans must have inhabited a forest-clad country in the neighbourhood of the sea, covered during a prolonged winter with snow, the vegetation consisting largely of the fir, the birch, the beech, the oak, the elm, the willow, and the hazel; while the fauna comprised the beaver, the wolf, the fox, the hare, the deer, the eel, and the salmon—conditions which restrict us to a region north of the Alps and west of a line drawn from Dantzic to the Black Sea.

It has also been urged that the primitive Aryan type was that of the Scandinavian and North German peoples—dolichocephalic, tall, with white skin, fair hair, and blue eyes—and that those darker and shorter races of Eastern and Southern Europe who speak Aryan languages are mainly of Iberian or Turanian blood, having acquired their Aryan speech from Aryan conquerors. It has been urged that the tendency in historic times has been to migration from north to south, and that in Central Asia we find no vestiges of any people of the pure Aryan type, while the primitive Aryan vocabulary points to the fauna and flora of Northern Europe rather than to that of Central Asia.

But the Aryans must have had forefathers from whom they were developed; and the inquiry suggests itself, What could have been the race from which the Aryans might have been evolved? A Semitic, an Iberian, an Egyptian, a Chinese, a Turkic, or a Mongolian parentage is out of the question; and the author proposed to show that both from the anthropological and the linguistic point of view the Finnic people come closest to the Aryans, and are the only existing family of mankind from which the Aryans could have been evolved. The Tchudic branch of the Finnic family approaches very nearly to what we must assume to have been the primitive Aryan type.

The only argument for deriving the proto-Aryan from Central Asia was the belief that Sanskrit comes the nearest to the primitive Aryan speech. It is now believed that the Lithuanian, a Baltic language, represents a more primitive form of Aryan speech than Sanskrit, and hence the argument formerly adduced in support of the hypothesis that the Aryans originated in Central Asia becomes an argument in favour of Northern Europe.

If this hypothesis as to the primitive identity of the Aryan and Finnic races be established, a world of light is thrown upon many difficulties as to the primitive significances of many Aryan roots, and the nature of the primitive Aryan grammar. We are furnished, in fact, with a new and powerful instrument of philological investigation, which can hardly fail to yield important results. Comparative philology must henceforward take account of the Finnic languages as affording the oldest materials which are available for comparison.

The Non-Aryan and Non-Semitic White Races, and their place in the History of Civilization, by J. S. Stuart Glennie.—The general thesis of this paper may be thus stated. The first civilizations of Chaldea and of Egypt appear to have been founded by the action on dark races of white races, neither Aryan nor Semitic. The combined results of a great variety of recent researches show that such white races are an important, and hitherto quite inadequately recognized, element in the ethnology of Asia, and of Oceania, of Africa, of Europe, and of America; and not only in Chaldea and in Egypt, but throughout the world, the civilizations of Semites and of Aryans have been founded on civilizations initiated by some one of these non-Aryan and non-Semitic, or, as in one word they may, perhaps, fitly be called, Archaian white races.

The three great divisions of this paper are indicated by this statement of its thesis:—

First, classification and summary of the facts which seem to lead to the conclusion that the imitators of the Chaldean and Egyptian civilizations belonged to a white stock different from both the Aryan and the Semitic white stock.

Secondly, an endeavour to give an approximately complete indication at least, if not statement, of the facts only partially stated by Quatrefages ("Hommes fossils et hommes sauvages") with respect to the white races which he names *Allophyllian*, and for which the term *Archaian* is proposed.

Thirdly, classification and summary of the facts which—the wide dispersion of an Archaian stock of white races being established—seem to indicate that the vexed questions with respect to the Hittites, the Pelasgians, the Tyrrhenians, the Iberians, the Picts, &c., and with respect also, in part, to the origin of the Chinese, the Mexican, and the Peruvian civilizations; the facts which indicate that these questions may be solved by reference to the general facts with regard to the migrations and characteristics of the Archaian white races.

The bearing of these results on the questions raised by the essential identity of the varying forms of folk-lore tales all over the world were also pointed out.

On the Picture Origin of the Characters of the Assyrian Syllabary, by the Rev. W. Houghton. — All written language probably originated in pictures representing objects or ideas, as in Chinese and Egyptian. At first the characters were rude figures of animal or other objects. In time the resemblance would be fainter, till at length all similarity between the character and the object represented would disappear. The process may be expressed by the term "pictorial evanescence." Of the 522 characters of the Assyrian syllabary, as given in Prof. Sayce's "Grammar," very few of the simple characters exhibit their primitive form, but the composite characters often clearly reveal themselves. We must look to the older forms of the characters for evidences of their pictorial origin. Thus, the character for a "fish" in the modern Assyrian may be traced back through the hieratic Assyrian, the hieratic Babylonian, and the linear Babylonian, to a figure of a fish, with head, body, fins, and tail. The ideograph for a "month" is, in its ancient form, a figure of a square with 3 × 10 inside it—*i.e.* thirty days within the sun's circle. The ancient forms of the character denoting a "man" are rude figures of a man with head, neck, shoulders, body, and legs—such a picture as a schoolboy would draw on his slate, or the North American Indians depict.

Mr. George St. Clair contributed a paper on *Boat-shaped Graves in Syria.*—In passing through the Anti-Lebanon lately, from Damascus to Baalbec, the writer noticed that the graves at the hamlet of El Fijeh have the form of a flat-bottomed boat; those at Ain Hawar are formed like long narrow boats, with an ark or house occupying the middle part; and the graves at the village of Yafufeh are built in three tiers, of which the upper one may be representative of the ark, while the head- and foot-stones are almost certainly the conventional reproduction of the head and stern of the boat. The author asks the question, What led these people in the mountains to build their graves in the model of a boat? Authors are quoted to show that arks or ships were carried in procession by the Phœnicians, as also were sacred boats in the funeral processions of the ancient Egyptians. The Egyptians conveyed the body across a lake, and both the lake and the boat were symbolical, typifying the voyage of the soul in the under-world. The system passed into Greece, where we have Charon and his boat. Charon's boat is sculptured on a funeral monument in the Ceramicon at Athens—a recently uncovered cemetery; and the bas-relief of a ship appears on a tomb at Pompeii. From these facts and others the writer of the paper would infer that the boat-shaped graves of Syria are fashioned by traditional custom in perpetuation of a practice which appears to have originated with the ancient Egyptians. As a supplementary conclusion, it is suggested that the head stones and foot-stones of modern graves may be the surviving representatives of the prow and poop of the sacred boat of the dead.

The Effect of Town Life upon the Human Body, by J. Milner Fothergill, M.D.—It is generally recognized that the effect of town life upon the physique is not beneficial, and as the population of boroughs has now exceeded that of the country, the fact becomes one worthy of our attention. The great and rapid increase of large towns at the present time adds to the importance of the subject and deepens its gravity. Of old there were but few large towns, in our modern sense of a "large" town; but Lugol, the great French authority on "scrofula," noted how the population of Paris deteriorated, and how scrofulous were the third generations of persons who came in from the country perfectly healthy. Other observers have noticed the bad effect of town life elsewhere. And the recent researches of Mr. James Cantlie have demonstrated the rarity of a pure-bred Cockney of the fourth generation. Of old the baron lived in his castle, while the populace lived around in villages of limited size. For men of all conditions of life the one thing to be coveted above all others was physical prowess. For work, for war, for games which were largely mimic war, bodily strength was essential. No courage, no skill, could effectually compensate for the want of thews and sinews. Work, war, sports, revels, all too were conducted in the open air. But civilization brought about changes profoundly influencing the life of the individual. The development of commerce entailed the growth of towns; and then it was found that in the new struggle for existence the battle went rather to the man with the active brain than to the man with a massive framework. The active brain became now the one great thing to be coveted rather than physical prowess. The tendency of town populations is to dwindle, and this dwindling is seen markedly in the feeble digestive capacity of town dwellers. They cannot eat the pastry, the pie-crust, the cakes, which form so large a portion of the dietary of their country cousins. If they attempt these articles of food they give themselves the stomach-ache. Consequently they live on such food as they can digest without suffering—bread, and fish, and meat; above all the last—the sapid, tasty flesh of animals, which sits lightly on the stomach, and gives an acceptable feeling of satiety, so pleasant to experience. The town dweller, in his selection of food, is guided by his feelings; he avoids what is repugnant to him. Such selection is natural and intelligible, but it is fraught with danger all the same. Pulmonary phthisis and Bright's disease seem Dame Nature's means of weeding out degenerating town dwellers. The offspring of urban residents are another race from their cousins who remain in the country. The latter are large-limbed, stalwart, fair-haired Anglo-Danes, while their urban cousins are smaller, slighter, darker beings, of an earlier and lowlier ethnic form, and resembling the Celto-Iberian race. And amidst this general reversion we can recognize a distinct liver-reversion to the early primitive uric acid formation of the bird and reptile. A recognition of these facts must lead to such modifications of the food customs of town dwellers as are indicated. The spread of teetotalism and vegetarianism tells of a dark groping in the right direction in blind obedience to the law of self-preservation. There must also follow some modification of the existing system of education, for it is by the imperfectly nourished town child that the weight of the burden of education is most acutely felt.

On the Bosjes Pelvis, by Prof. Cleland, F.R.S.—The embroadened brim found in certain savage tribes is a retention of a feature of adolescence. This is seen well in the Bosjes, and the peculiarity may be correlated with others which have escaped attention. There is feeble development of the iliac blades, especially at the back part, probably owing to early anchylosis of the epiphysis of the crest. Connected with this the post-auricular levers of the ilia are very feeble, as they also are in early life in Europeans, causing shallowness of the post-sacral fossa occupied by the strongest part of the multifidus spinæ muscle, a most important muscle for erecting the lumbar part of the column on the pelvis. The action of the iliac levers in broadening the brim in the European is recognized. Their shortness, and the lightness of the superincumbent weight of the body, are circumstances which account for the brim failing to broaden out in the Bosjes.

The Experimental Production of Chest types in Man, by G. W. Hambleton.—The author contended that the type of man after birth was produced solely by the conditions to which he is subjected, and that hence a wide and most important field is open for our investigation, for if we can ascertain what the conditions are that produce those changes in each part of man that together form a class or type, we may produce the type that is most suitable for different places and occupations, and then we shall have a true Science of Man.

The Scientific Treatment of Consumption, by G. W. Hambleton.—At the last meeting of the Association the author read a paper on that part of his research that referred to the prevention of consumption, and he now completed the subject by giving an explanation of the mode in which the disease is produced, and by laying down the principles that must guide us in its successful treatment. These principles are four in number, and may be stated as follows: to establish an equilibrium between the amount of interchange required to be effected and that effected; to enable the other organs of the body to perform their ordinary functions; to restore to the lungs the power of adjustment to their external conditions; and to effect the above without producing indications of friction. The effect of this method of treatment is to arrest the process of irritation, to gradually restore the general health, and to develop the lungs. This is shown by a gradual cessation of chest symptoms, a healthy appearance, and a greatly increased vital capacity, range of expansion and size of chest-girth. The author has invariably obtained these results in his experiments, and also in the few cases he has had an opportunity of treating. Sydenham undoubtedly cured consumption by ordering continuous horse exercise in the country till the patient recovered. And the author is satisfied that if we carefully treat consumption—before the disease has been permitted to become too extensive—on the principles advocated in this paper we shall be able to secure complete recovery.

Tattooing, by Miss A. W. Buckland.—The object of this paper was to show that although tattooing seems to have been almost universal among savages, yet the mode of performing the operation varies so much, and the various methods in use seem to have such definite limits, as to make them anthropologically valuable, as showing either racial connexion or some intercourse formerly subsisting between races long isolated.

The Early Ages of Metal in South-East Spain, by Henri and Louis Siret.—The authors explored a coast region, about 75 kilometres in length, between Cartagena and Almeria. They investigated some forty stations belonging to three prehistoric epochs: (1) the Neolithic, (2) Transition between Stone and Metal, (3) the Metal Age. In the Neolithic period man employed instruments of bone, stone, and flint; and ornaments made of bone, stone, and shells were used. The dead were buried in polygonal spaces, surrounded by stones. In the Transition period bronze bracelets and beads were used; and cremation of the dead was practised. These new customs were probably introduced by some foreign people; but at the same time there is evidence of the first attempts at a native metallurgy, utilizing the ores of the country; arms and utensils are found cast in metal, and imitating the form of those in bone and stone. During the Metal epoch, copper and bronze were employed simultaneously, as in the preceding age; but copper predominates, and stone implements are still common. MM. Siret also found several silver ornaments, and this is a new fact in the early Bronze Age; in this region prehistoric man found and utilized the native silver gathered on the surface of the soil. No less than 1300 sepultures were explored by the authors; all the bodies were interred, and not cremated, the bodies being usually placed, doubled up, in large terra-cotta vases. An enormous number of copper and bronze arms and utensils were found, together with vases in pottery; also bracelets, rings, and earrings in copper, bronze, gold, and silver; and necklace beads in bone, ivory, serpentine, bronze, copper, silver, and gold.

The Origin of Totemism, by C. Staniland Wake.—The fundamental basis of totemism is to be found in the phase of human thought, which supposes spirits "to inhabit trees and groves, and to move in the winds and stars," and which personifies almost every phase of Nature. The problem of totemism receives its solution in the fact that the totem is the *re-incarnated form of the legendary ancestor of the gens or family group allied to the totem.* The totem is thus something more than a "badge of fraternity" or "device of a gens." It is regarded as having actual vitality, as the embodiment of an ancestral spirit. Any object is fitted for this spirit re-incarnation, and therefore totemism may be looked upon as the expression of Nature-worship and ancestor-worship in combination.

Certain Degenerations of Design in Papuan Art, by S. J. Hickson.—(1) On a prau figure-head is a design which, although considerably modified, can readily be recognized as a design of the human figure. The long crimpled hair of the Papuan, two tufts of which are coloured red, in imitation of the red mud with which the Papuans complete their *coiffure*, the eyes, nose, and mouth of the face are clearly indicated, but the rest of the body is degenerated into a mere conventional sign. (2) Upon the same prau figure-head, as in (1), there is a figure of an animal (probably a gecko), fairly good and complete as a work of art, but upon the same is a design, evidently degenerated, of this, in which all that remains of this unconventionalized is the anterior pair of legs. The designs are wrought by the old men or priests of the villages, and are made for the purpose of keeping off spirits of storm, sickness, &c. Modifications are produced by the artist by want of time, ability, or inclination, and these modifications become permanent by being copied by subsequent artists, and thus in some cases mere conventional signs take the place of figures of men, birds, and other animals.

Gypsies, and an Ancient Hebrew Race in Sus and the Sahara, by R. G. Haliburton.—The province of Sus, as respects the customs of its people, is, and always has been, a *terra incognita.* Excepting a few lines by Herodotus on the subject of these people, nothing has yet been written, and this paper is the first attempt to describe them. The people of Morocco are divided into the Riffs and the Susis: the first light-haired, and large men, living in the mountains; the latter smaller, darker, and generally nomadic. The Susis speak a dialect of the Berber, and are most of them Gypsies of different descriptions. They are famous for their skill as artificers. Most of them tell fortunes—some by sand, others by beads; others, again, by a flower, and some by watching a fowl after its head has been struck off. The women, in some tribes, tell fortunes by the hand, but the men never do so. These people have been for many centuries connected with the Timbuctoo gold trade; and have secret signs and passes, called the words of the Kafila (tent or lodge), which is probably the same word as the well-known "Cabala" of the Jews. The author showed that there are vestiges of the Osirian cult lingering among these people. The author described an ancient Hebrew race inhabiting the Sahara, and pointed out that the Jews and the Gypsies must have been cast in the same mould, but must have been made of very different material. That mould, he believed, was the life in common in North Africa for thousands of years, in connexion with the gold trade and the caravans of that country.

Colour-Names amongst the English Gypsies, by W. E. A. Axon.—Considerable discussion has taken place as to the development of the colour-sense within the historic period. The colour-vocabulary of the English gypsies is limited to "green," "black," "red," and "white," so that we have the notable fact that "blue," on which so much stress has been laid in the discussion of the colour-sense, is entirely absent from the English gypsy vocabulary. This is emphasized by the fact that the gypsies sometimes use the word *blue-asar*, the suffix being that which is generally added in Romany to disguise a borrowed word. So their word for "toadstools" is *blue-leggi*, because the *Agaricus personata*, which they regard as a delicacy, has blue stalks. Clearly, if they had now in Romany a word for "blue," they would not appropriate that of *Gaujo.* And if any evidence were needed that the Romanies are not colour-blind, it is afforded by their appropriation of the English word for "blue." It only remains to add that *Yack* and *Erescare* are both given by Pott as gypsy equivalents for "blue." If these words are genuine—which may be open to doubt—it is apparently possible for a race to possess and to lose a colour-name. This brief investigation of the English gypsy colour-vocabulary will show the danger of accepting the negative testimony of philology as conclusive. The positive evidence of linguistics no one need doubt. It is clear that there is no relation between the colour-perception and the colour-nomenclature of the English gypsies.

On the Migrations of Pre-glacial Man, by Henry Hicks, F.R.S.—Referring to the further researches carried on this summer at Cae-Gwyn Cave, North Wales, the author stated that the additional evidence obtained proved most conclusively that the flint implement found there last year in association with the remains of Pleistocene animals was under entirely undisturbed glacial deposits. He maintained also that the evidence is equally clear in regard to the implements found within the caverns, which he said must have been introduced before the glacial deposits blocked up and covered over the caverns. The question as to the direction from which pre-glacial man reached this country is an exceedingly interesting one, and seems now to be fairly open to discussion. It is admittedly fraught with difficulties, but the facts recently obtained seem to require that an attempt should be made. The evidence, so far as it goes, points to a migration to this country from some northern source, as the human relics found in the caverns, and also in the older river gravels (which Prof. Prestwich is now disposed to assign also to the early part of the Glacial epoch, when the ice-sheet was advancing), occur in association with the remains of animals of northern origin, such as the mammoth, rhinoceros, and reindeer. Up to the present no human relics have been found in this country (and it is very doubtful whether they have been found in any other part of Europe) in deposits older than those containing the remains of these northern animals. If man arrived in this country from some eastern area, it is but natural to think that he would have arrived when the genial Pliocene climate tempted numerous species of deer of southern origin, and other animals suitable as food for man, to roam about in the south-east of England. Hitherto, however, not a relic has been found to show that man had arrived in this country at that time. But in the immediately succeeding period, with the advent of cold conditions and of the northern animals, evidences of the presence of man become abundant. Whether man at an earlier period migrated northward from some tropical or sub-tropical area, and that he then lived on fruit and such-like food, there is no evidence at present to show; but it seems certain that the man of the Glacial period in this country had to live mainly on animal food, and that he found the reindeer to be the most suitable to supply his wants. He followed the reindeer in their compulsory migrations during the gradually increasing glacial conditions, and kept mainly with them near the edge of the advancing ice.

Observations on Recent Explorations made by General Pitt-Rivers at Rushmore, by J. G. Garson.—Dr. Garson began his paper by defining the early British races; he then proceeded to describe the discoveries of General Pitt-Rivers at Rushmore, near Salisbury, where he has found the remains of no less than four British villages of the Roman period, besides many tumuli and cists. The human remains are extremely interesting, and throw much light on the characters of the people to whom they belonged. The chief point of interest which they show is the small stature of the people, the average of the males being 5 feet 4 inches, and of the females 4 feet 11·8 inches, in the village of Woodcuts; while in that of Rotherly, the other village excavated this year, the heights are 5 feet 1 inch and 4 feet 10 inches respectively. The skulls are of a long, narrow, oval form, with one or two exceptions, when they are of rounder form; these were found associated with longer limb bones, showing them to be of different race from the majority of the inhabitants. Two forms of skull are frequently met with in long barrows, both of a long narrow shape, but differing from each other in one having a regular oval outline, while the other broadens out from a narrow forehead, and, having attained its greatest width, terminates rapidly behind. The skulls found in these villages correspond exactly to the first type. It is therefore probable that there were two distinct races of the long-headed people which will have to be distinguished in future.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 10.—M. Hervé Mangon in the chair.—On the theory of outflow between narrow walls at a low or a high level, by M. J. Boussinesq. The problem here discussed deals with the discharge of water into a basin, which is subjected from below to a constant pressure either less or greater than that exercised by the atmosphere from above.—On the grading of tubes intended for gasometric measurements, by M. Berthelot. The author here studies some of the difficult problems presented by the different forms of graduation in tubes employed for the measurement of gaseous volumes.—On the mechanical labour expended by the gull in its horizontal flight, by M. Marey.—On M. G. A. Zanon's memoir entitled "La Cinetica combattuta e vinta da G. A. Hirn," by M. H. Faye. M. Zanon, Professor of Naval Construction at Venice, here intervenes on the side of M. Hirn in the controversy between that physicist and M. Clausius on the subject of the modern theory of kinetics.—Remarks accompanying the presentation of M. Rouvier's seventeen charts of the Congo region, by M. Bouquet de la Grye. These charts, prepared with the co operation of Capt. Pleigneur, of the French Marines, comprise a general map of the French possessions in the Congo basin, and special maps of the lower course of the main stream and of its affluents on the right bank. They embody the results of the first exact surveys made in this extensive region over which the French protectorate has recently been extended.—Observations of Palisa's new planet, No. 269, made at the Observatory of Algiers with the 0·50 m. telescope, by MM. Rambaud and Sy. The observations include the positions of the comparison-stars and the apparent positions of the planet on September 23 and 24.—Apparent positions of Olbers's comet (Brooks's, August 24, 1887), measured with the 8-inch equatorial at the Observatory of Besançon, by M. Gruey. The observations cover the period from September 14 to October 1.—A new solar eruption, by M. E. L. Trouvelot. A description is given of a protuberance of unusual size and brilliancy observed by the author on June 24, 1887, at 267° on the western edge of the solar disk.—Action of carbonic acid on some alkalies, by M. A. Ditte. It is shown that under pressure carbonic acid and aniline unite at equal equivalents, yielding a crystallized carbonate below + 8° C., liquid, or at least in permanent superfusion, at 10° C. This carbonate, soluble in the aniline, does not dissolve the carbonic acid, but dissociates when the pressure is lowered.—On a new source of capric acid, by MM. A. and P. Buisine.—The tactile rays of *Bathypteroïs*, Günther, by M. Léon Vaillant. The specialized organs of touch resulting in certain fishes from a modification of the pectoral and ventral fins, are shown to acquire quite an unusual degree of perfection in the *Bathypteroïs* captured during the *Talisman* Expedition, from depths of 400 to 1000 fathoms.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

The Sailor's Sky Interpreter: S. R. Elson (Thacker).—Class-Book of Algebra Examples, part 2: John Cook (Madras).—Dix Années dans L'Histoire d'une Théorie: J. H. Van 't Hoff (Bazendijk, Rotterdam).—Report of the Voyage of H.M.S. *Challenger*: Zoology, vol. xxii. (Eyre and Spottiswoode).—Other Suns than Ours: R. A. Proctor (Allen).—Madras Journal of Literature and Science.—Journal and Proceedings of the Royal Society of New South Wales, vol. xxi. (Trübner).—Transactions of the Edinburgh Geological Society, vol. v. part 3 (Maclachlan and Stewart).—Boletin de la Academia Nacional de Ciencias en Cordoba (Buenos Aires).

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