matter of satisfaction that Southport contains numerous public meeting-places close to each other. The scattered position of the Sections at the present meeting has been a very serious obstacle to members wishing to hear papers in different Sections on the same day. This has been especially the case in Section C, which, being half a mile from most of the other Sections, seldom obtained a good audience, and indeed was only filled when the popular subject of the Channel Tunnel was brought before the Section by Messrs. Boyd Dawkins and De Rance.

REPORTS

Report of the Committee consisting of Prof. Roscoe, Mr. Lockyer, Prof. Dewar, Prof. Liveing, Prof. Schuster, Capt. Abney, and Dr. Marshall Watts, appointed at the York Meeting to prepare a New Series of Wave-lengths Tables of the Spectra of the Elements.—This Committee report that they have lately obtained an instrument for the more exact performance of the process of graphical interpolation, constructed by Messrs. Cooke and Sons of York. And since this instrument has only been received within the last few weeks they are not in a position to make a detailed report to the Association.

The Report of the Committee consisting of Prof. Balfour Stewart, Thorpe, and Rücker, appointed at the York Meeting to Report on Methods of Calibrating Mercurial Thermometers was read by Prof. Rücker. Thermometer tubes are in general of unequal bore in different parts, and the indications of the instruments will thus be erroneous, unless these irregularities are allowed for. If a short column of mercury broken off from the main mass in the bulb and tube be measured in different parts of the tube, its length will be greater in the narrower, and less in the wider parts. By means of such measurements the correction for the inequalities in the bore can be applied in two different ways distinguished as methods of calibration and correction respectively. In the first the length of the column of mercury is measured in various parts of the tube before the scale is etched on it, and the lengths of the divisions are then so adjusted as to make equal differences of scale readings correspond to equal volumes. In the second the tube is in the first instance furnished with a uniform scale, and a table of corrections is afterwards drawn up, by means of which the same end is attained as before. In either case the measurements have to be made in some systematic manner, and a number of different methods of performing the observations and calculations have from time to time been proposed. That in use at the Kew Observatory is the simplest of all, while the more elaborate methods have for the most part been proposed by German writers. The report consisted of a minute discussion of the relative merits of these various methods, the chief of which had been applied by the Committee to the same thermometer, so that the results could be readily compared. The measurements for this purpose were made in the Physical Laboratory of the Yorkshire College. The methods chiefly investigated were Gay Lussac's, Hällström's, Thiessen's, Marek's, Rudberg's, and Bessel's, both as modified by von Oettingen, and also with further modifications introduced by Professors Thorpe and Rücker. As the result of a long theoretical and experimental investigation, the Committee conclude that labour is saved and equal accuracy secured by the repetition of the simplest method of correction (Gay Lussac's), instead of the employment of more elaborate and theoretically more perfect schemes.

Report of the Committee, consisting of Professors Odling, Huntington, and Hartley, appointed for the Purpose of investigating, by means of Photography, the Ultra-Violet Spark-Spectra emitted by Metallic Elements and their Combinations under Varying Conditions.—This report was drawn up by Prof. Hartley, and communicated to the Section by Prof. Huntington. The object of this investigation was to give, first, a means of readily identifying the metals by photographs of their line spectra; secondly, a knowledge of the alterations producible in the spectra of metallic salts by the presence of various non-metallic elements; thirdly, a knowledge of the alterations caused by the dilution of metallic solutions; fourthly, a possible means of performing rapid quantitative determination of metallic substances by the aid of photography, and obtaining permanent records of the results. These objects have been more or less completely attained, and the results obtained have been the subject of two communications to the Royal Society, which contain an account of the elucidation of the following points:—(1) The solution of the practical difficulty of obtaining photographs of spark spectra of metallic salts from their solutions; (2) the comparison of spectra yielded by metallic electrodes with those obtained from saline solutions; (3) the variations in the spectra caused by dilution of saline solutions; (4) the sensitiveness of spectrum reactions under certain conditions; (5) the variation in the spectra of metals caused by alterations in the intensity of the spark employed. A comparison of the spectra of solution of salts with those of metallic electrodes show that in almost all cases the lines of the metals were produced from the solutions. The non-metallic constituents of salts do not yield any marked series of lines. The spectrum of aluminium, as obtained from pure solutions, is free from a group of short or discontinuous lines, which the author has shown to be due to iron. In estimating the relative proportions of the constituents of alloys or minerals, only those methods are to be recommended in which solutions are used, as in this way the non-homogeneity of the substance under investigation can alone be obviated. With regard to the reversal of metallic lines, it is pointed out that over-exposure suffices to produce reversal without materially influencing the rest of the spectrum; and in order to obviate this result, it is recommended that comparative exposures should be methodically employed to confirm the accuracy of observations made entirely by the aid of photographic representations and of spectra. This is especially the case where gelatine or other dry plates containing organic matter are employed.

Report of the Committee on the Lunar Disturbance of Gravity, by G. H. Darwin.—Shortly after the reading of the first report last year at York, it was found that the instrument with which he and his brother had been working, had broken down, and this together with a series of unforseen circumstances, had prevented their continuing their observations. But he still had some remarks to make on the subject. From a remark made by Signor de Rossi on an observed connection between barometric storms and the disturbance of the vertical, he had been led to make some investigations on the mechanical effects caused by variations of pressure acting on an elastic surface. When a heavy body rests on the surface of the earth in the neighbourhood of a pendulum, the direction of the pendulum, or the vertical, appears to change, a change due to two causes: first, an actual change due to the attraction of the heavy body on the bob of the pendulum; and secondly, an apparent change due to an actual change of level caused by the elastic yielding of the surface. Sir W. Thomson had pointed out to him a very remarkable relation between those two effects. If a heavy mass of any form be placed on the surface of an elastic plate of great thickness, the deflection produced on a plumb-line suspended over any point of the plate by the attraction of the mass is proportional to the slope produced in the plate at the same point by the elastic yielding to the mass. Applying this to the case of variation of barometric pressure, and supposing the earth to have a rigidity between that of glass and copper, he found that the variation of slope between two places 1500 miles apart due to a difference of 5 cm. of barometric height would be 0″·0117, whilst if the attraction of the air be included, it would amount to 0″·0146. Thus, considering two cases of high pressure to right and left, there would be a difference in the position of the plumb-line relatively to the earth's surface of 0″·0292. The amplitude of oscillation at Cambridge due to lunar disturbance of gravity, as computed on the hypothesis that the earth is rigid, was in last year's report shown to be 0″·0216, whilst the instrument was capable of detecting changes of 0″·01. As these quantities were all of the same order of magnitude, he came to the conclusion that it was hopeless to expect determinations of the lunar effect by experiment based on the pendulum method. There was another effect due to change of barometric pressure, viz an alteration in the altitude of the surface. Under the same circumstances as above the difference in height at the two places would be 9 cms. The same reasoning applied to the tides would show that there would appear to be a greater rise and fall of tides that actually exists. This effect is in the opposite direction to that due to the elastic yielding of the earth on account of the tide-rising forces of the sun and moon. Near a coast line the apparent change of the vertical between high and low tides would be far more considerable than in the case of variation of barometric pressure. With a difference of true height of water between high and low tide of 40 cm., and with a tidal wave-length of 3900 miles, the change in slope at a distance of 1 kilometre from the water's edge would be 0″·076.—Sir W. Thomson pointed out a method by which the effect of the attraction of the

observer in Mr. Darwin's experiments might be determined independently of the deviation produced by the elastic yielding of the earth due to his weight. He also suggested that Mr. Darwin should apply the same reasoning to discuss the phenomena of seiches, such as have been observed by Forel on the Lake of Geneva.

Report of the Committee on the Present State of Spectrum Analysis (drawn up by Dr. Schuster).—The report consists of three parts. In the first part the question is discussed whether any numerical relation between the different periods of vibration of one molecule can be traced. The result of several investigations seems to be that though the different vibrations are connected according to some unknown law, they are harmonics only in exceptional cases. The second part of the report considers the question whether a connection exists between the spectrum of a compound and the spectrum of the elements which make up the compound. The investigations of Dr. Gladstone are referred to, since confirmed in many instances, in which he has shown that coloured acids, as chromic acid, when combined with different bases retain their own absorbing properties. The same applies to coloured bases. But as Dr. Gladstone himself points out, the law is by no means a general one. The curious observations of Bunsen's on the absorption-spectra of didymium salts are discussed. Bunsen has shown that their spectra are all very nearly alike, but slightly displaced either towards one or towards the other end of the spectrum. Capt. Abney and Col. Festing's observations on the absorption in the infra-red are referred to at length, and the connection between the luminous spectra of such bodies as the chlorides, bromides, and iodides of the alkaline earths is discussed. In the last part of the report the similarity of the spectra of similar bodies is pointed out, but no numerical connection has as yet been found.

Report of the Committee, consisting of Lieut.-Col. Godwin Austen, Dr. G. Hartlaub, Sir J. Hooker, Dr. Günther, Mr. Seebohm, and Mr. Sclater, appointed for the purpose of investigating the Natural History of Socotra and the adjacent Highlands of Arabia and Somali Land.—The balance in hand from 1870-1 (61. 7*s*. 10*d*.), added to the 100*l*. granted at the York meeting, together with the amount received up to the present time by the sale of the duplicate specimens of birds and land shells, viz. 17*l*. 12*s* 4*d*., reduced by 7*s*. for postage, leaves a total balance in hand of 143*l*. 13*s*. 2*d*. for any future work on the Socotra or in the adjacent mainland.

Since the last report was presented Prof. J. Bailey Balfour has been working whenever his other duties permitted at the extensive botanical collection formed by him, to which must be added the plants collected by Schweinfurth, who has since visited the island, and who has placed the same most liberally at Mr. Balfour's disposal. Some of the preliminary diagnoses have been published, which show that the different groups are very rich, and that there is a very considerable amount of work in the collection which can only be brought out slowly. Prof. Balfour hopes to give a short report on what is completed at this meeting. Writing on June 17 he says:—"I have a lot more diagnoses in press just now, and hope in August or September to complete my work on the Botany. This *émeute* in Egypt will, however, interfere, as Schweinfurth will be unable to continue his communications, and I am waiting for a lot of notes by him on many species. I only hope his collections will not be destroyed, and as he has some of my specimens at present I am somewhat anxious regarding their fate." . . .

The rock-specimens collected by Prof. Balfour have been worked out by Prof. Bonney, whose report on the subject was read before the Royal Society at their last meeting of the present session. He states that the great limestone plateau, which forms so large a part of the upland district of the island, is found by the Foraminifera present in the rock to be of Miocene age. This is seen to rest in many places upon a floor of very ancient gneissic rock, bearing a general resemblance to the most ancient rocks of north-western Britain and other countries. The Haggier mountains, forming the highest ground in the island, consist, so far as is shown by the specimens brought, of granites poor in mica and rich in felspar, bearing often a considerable resemblance to those of Sinai. These are traversed by dykes of felsite and other igneous rocks. To the south-east of this range is a tract occupied by red felsites and rhyolites, with some agglomerates or conglomerates. The structure of some of the former rocks renders it in the highest degree probable that they are ancient lava flows. They are anterior in date to the Miocene limestones. These also are occasionally cut by basalts and perhaps trachytic rocks. In the northern part of the island, beneath the limestone, is an argillite of uncertain age, and there is probably some representative of the "Nubian sandstone." It is, however, almost certain that for a long period anterior to the Middle Tertiary, Socotra formed part of a land surface, and it is quite possible that the summits of the Haggier mountains may not have been even then submerged. If so, the flora, and perhaps the fauna, is likely to have an exceptional interest.

As to a renewal of explorations, the Committee fear that Eastern affairs make the outlook very unsatisfactory, and it would appear all through the East, in the vicinity of Aden especially, there is a very hostile spirit rampant against Europeans. It is hoped that there may soon be some definite settling of the excitement, but at present the Committee do not think that any plans for a future expedition can be made.

The results of the Socotran exploration have been so successful and so great, considering the small expenditure of money and time it entailed, that the Committee trust they may see the same kind of work extended. They trust that the opportunity will not be lost of sending properly trained naturalists into the mountainous regions of Eastern Africa, which the despatch of an expedition by the Geographical Society now presents. The scientific knowledge that would be accumulated by such explorers in such conditions as that lofty region offers would be of immense value, and not of secondary interest or importance to purely geographical information.

The Committee do not, therefore, ask for any further grant at present.

Report of the Committee, consisting of Mr. James Heywood, F.R.S., Mr. William Shaen, Mr. Stephen Bourne, Mr. Robert Wilkinson, the Rev. W. Deany, Prof. N. Story Maskelyne, M.P., F.R.S., Dr. Silvanus P. Thompson, Miss Lydia E. Becker, Sir John Lubbock, Bart., M.P., F.R.S., Prof. A. W. Williamson, F.R.S., Mrs. Augusta Webster, Rev. H. W. Crosskey, Prof. Roscoe, F.R.S., Prof. G. Carey Foster, F.R.S., and Dr. J. H. Gladstone, F.R.S. (Secretary), appointed to watch and report on the workings of the proposed revised New Code, and of other legislation affecting the teaching of Science in Elementary Schools.—When this Committee was re-appointed at York, it was with a special view to the important changes which it was expected the Government would make in the Education Code. In the postscript to their previous report, great satisfaction was expressed at the general scope of the "proposals" that had just been submitted to Parliament, but it was urged that the knowledge of nature should be more effectually encouraged as a class subject.

On assembling in the autumn, your Committee added to their number the Rev. H. W. Crosskey of Birmingham, and Prof. Roscoe of Manchester, and, subsequently, Prof. G. Carey Foster of London.

At the first meeting it was determined to enter into communication with Mr. Mundella, the Vice-President of the Committee of Council on Education, but the serious illness of that gentleman caused a delay. The Secretary, however, eventually saw him at his own house, and found him desirous of receiving the views of the Committee by deputation. As this was a step which your Committee felt themselves not justified in taking unless through the governing body of the Association itself, they drew up a series of resolutions, and submitted them to the Council, with the request that that body should appoint a deputation to urge their views.

These resolutions were passed by the Council, with the addition of that numbered VII. They were as follows:—

I. That Clauses 9 (3), 20, 26, and the Standard work in Geography (pp. 6 and 7) be approved.

II. That the arrangements involved in Clauses 18, 19, 21, 23, and 27 be subject to revision on the following grounds:—

a. That Clauses 19 and 21, read together, will practically exclude Elementary Science teaching in the Lower Division, as Geography will be almost always chosen by teachers as the second subject.

b. That placing Standard IV. in the Lower instead of the Upper Division will restrict the choice of Class-subjects to be taught in that Standard, and altogether exclude the teaching of any of the Specific subjects.

c. That, taking all these Clauses as they stand, there will practically be a cessation in the teaching of Elementary Science from the time of leaving the Infant School (Clause 9 (3)), till entering the Upper Division (Clauses 23 and 27).

It is therefore recommended that Clause 21 be left out; and that Clause 19 be so modified as to permit of the ordinary Class Grant being paid if the children pass in any one or two of the Class subjects, and an additional Grant if three be taken.

III. That the list of Specific subjects (Clause 25) should include Elementary Physics, and the fundamental facts of Chemistry; and the word "Geometry" should be used instead of "Euclid."

IV. That Clause 29 be left out, inasmuch as Domestic Economy includes the principles of alimentation, sanitation, &c.

V. That the teaching of Specific as well as Class-subjects in Night Schools should be provided for in Clause 30.

VI. That the Standard work in Elementary Science (pp. 6 and 7) needs re-arranging :—

The division (*a*) should generally include plants as well as animals.

The divisions (*b*) and (*c*) should be welded together, and more progressively arranged.

VII. That the Science programme should be regarded as a suggestion, but not necessarily as an inevitable arrangement.

VIII. That the Pupil Teachers' course (p. 11) shall provide for the study by them of Elementary Science, seeing that they will in all probability be required to give Object lessons, or to teach Elementary Science in the Schools, and to attend science classes at College.

A deputation was appointed to present the memorial, but so many other public bodies were approaching the Education Department on the subject of the New Code, that Lord Spencer was unable to find time to receive it, and the memorial was sent in the usual way. Dr. Gladstone, however, as one of a deputa- from from the London, Birmingham, and other School Boards had an opportunity of urging the claims of science, and mentioning the special wishes of the British Association. Nothing could be more distinct than the assurance of both Lord Spencer and Mr. Mundella as to their desire to introduce the teaching of Elementary Science as far as circumstances would permit.

Recommendations somewhat similar to those of the British Association were made, not only by the above School Boards, but also by a Conference of leading educationists on Code Reform, and by the British and Foreign School Society.

When the New Code was laid on the table of the House, on March 6, it appeared that some of these recommendations had been adopted, and that all the clauses in the "Proposals" which were approved by your committee had been retained.

The proposals thus retained are as follows :—

In infant schools the merit grant will be dependent upon the report of the Inspector, who will have to take into consideration the provision made for "simple lessons on objects, and on the phenomena of nature and of common life."

The leading facts of Physical Geography will be taught, not, as before, as an optional specific subject for the high standards, but as a part of Geography which is a class subject for the children in all the standards.

The teaching of the principles of Agriculture as a specific subject is, for the first time, recognised.

The recommendations adopted are as follows :—

"Chemistry" and "Physics" in the two branches of "sound, light, and heat," and of "electricity and magnetism," have been added to the list of sciences capable of being taken up as specific subjects by children in Standards V., VI., and VII.

The scientific specific subjects are admitted for the first time into the curriculum of evening schools.

The Department has considerably modified its scheme as to "Elementary Science" as a class subject; this "may be framed so as to lead the scholars in Standards I. to IV. up to one of the scientific specific subjects;" but a scheme is also given which "may be taken as a guide suggesting heads for a sufficient number of lessons in each standard." In the scheme, plants are recognised as fully as animals, and the inconsistencies that occurred in the original scheme are avoided.

The Department has not, however, acceded to other recommendations of your Committee. There are still retained such restrictions as will greatly hinder the introduction of this elementary science as a class subject. Domestic Economy has lost its preference as a specific subject in girls' schools. Euclid is still enforced as the handbook of geometry. There is no provision for the examination of pupil teachers by Her Majesty's Inspector in any branch of natural science, excepting that geography is made to include a good deal of physical knowledge.

Your Committee having been informed that Sir John Lubbock intended to move in parliament that it was desirable to allow children to be presented for examination in any of the recognised class subjects, passed a resolution offering him "their support in asking that the three class subjects of Schedule II. of the New Code, viz., English, Geography, and Elementary Science, should be placed on the same footing." Sir John Lubbock, in his speech, referred to the views of the British Association on this point; the debate which ensued was very favourable to the claims of elementary science, and the Vice-President promised to give the subject further consideration, and to "submit it to the Council of Her Majesty's Inspectors and the able men who assisted him in framing the Code, and, if it was possible, he should be happy to yield to the wishes which had been expressed (see *Times*, April 4, 1882).

Many of the Elementary Schools of this country are now working under the New Code, and before the month of May, 1883, they will all be in that condition. In that month also the Government inspection under this Code will commence, and it will be possible to ascertain many points of interest, such as (1) the quality of the object lessons in the infant schools; (2) how far the proposed improvements in the teaching of geography are carried out in practice; (3) to what extent elementary science is taken up as a class subject, and whether the teachers generally take it up as an introduction to the scientific specific subjects, or continue it as a class subject throughout the school; and if so, whether they have adopted some fuller scheme than that suggested in the Second Schedule; (4) whether the discontinuance of the teaching of specific subjects in Standard IV. is really a gain or a loss to science.

Your Committee, if reappointed, propose to obtain information on these points, and to draw the attention of the Council to any matters that may be necessary in connection with the working of the Code, or in respect of any future alterations.

Preliminary Report on the Flora of the Halifax Hard Bed Lower Coal-measures, by Prof. W. C. Williamson, F.R.S., and W. Cash.—The area examined is bounded by Bradford on the north, and Sheffield on the south, many of the coal-pits are now closed owing to low prices of coal, and to the iron-pyrites formerly worked being no longer used owing to the low rate at which foreign sulphur is now imported. Fossils were obtained from a bed of inferior coal 2 feet 6 inches in thickness, studded with "coal-balls," consisting of carbonate of lime and carbonate of magnesia, which are filled with fossils, which exhibit the most perfect condition of preservation, even to microscopical structure, surpassing even the well-known beds of Oldham. Much light has been thrown into the intimate structure of a large amount of vegetable forms, though some are still doubtful.

Tenth Report of the Committee, consisting of Prof. J. Prestwich, Prof. T. McK. Hughes, Prof. W. Boyd Dawkins, Prof. T. G. Bonney, the Rev. H. W. Crosskey, Dr. Deane, and Messrs. C. E. De Rance, D. Mackintosh, R. H. Tiddeman, J. E. Lee, James Plant, W. Pengelly, W. Molyneux, H. G. Fordham, and W. Terrill, appointed for the purpose of recording the position, height above the sea, lithological characters, size, and origin of the Erratic Blocks of England, Wales, and Ireland, reporting other matters of interest connected with the same, and taking measures for their preservation. Drawn up by the Rev. H. W. Crosskey, Secretary.—The Committee have received the following accounts of Erratic Blocks examined during the past year :—

Yorkshire.—Major Woodall has examined a number of boulders brought from the bottom of the North Sea north of Flamborough Head, and gives the following account of their position and character :—

North of Flamborough Head large numbers of boulders are found strewing the bottom of the North Sea; but they are arranged very much in a belt, which is generally parallel to the existing coast, at a distance of twenty to forty miles from the land. The outer or eastern edge of this belt is not well defined; but on the western side it would appear to have a sharper boundary, as the marks used by the trawlers to avoid the boulders show that the line is well marked.

While preserving a line parallel to the existing coast, it is curious to note that just opposite to the mouth of the Tees the inner edge of the "rough ground"—by which name this belt is known to the fishermen—makes a sharp bend to the eastward, coinciding almost exactly with a line drawn down the Tees Valley. I would venture to suggest that this large belt of

erratic blocks is connected with the history of the giant glacier which descended the Tees Valley, bringing, among other stones, masses of the well-known Shap Fell granite. The boulders that I have seen brought on shore—having been trawled up by the smacks—are either of Shap granite or carboniferous limestone, and of these I have examined from sixty to seventy specimens. The rough ground—as far as I am aware—extends from the coast of Northumberland to the mouth of the Humber. While the boulder clay on the coast line contains blocks of carboniferous limestone and Shap granite, the deposits of like date in the valley of the Rye and Derwent—south of the Cleveland Moor district—are composed of oolitic and liassic detritus, and are very different from those on the coast, though only a few miles distant from each other,

Warwickshire.—A remarkable group of Erratic Boulders has been exposed in some excavations made for building purposes in Icknield Street, Birmingham, between Key Hill and Hockley Hill. The section occurs on the north-west slope of the hill on which it is exposed, and consists of 7 feet or 8 feet of glacial drift (the height slightly varying at different points), which immediately rests on an irregular and broken surface of the new red sandstone of the district, and is composed of about 1 foot 6 inches of surface soil. The "drift" itself consists of erratic blocks, intermixed with numerous round and oval stones and pebbles, together with small gravel, sand and clay. In different parts of the section these various materials occur in varying proportions, a light clay gradually predominating. The erratic blocks, however, so pervade the whole bed, and so thoroughly constitute a component part of it, that they cannot have been dragged into it, either singly or by twos and threes. They must all have travelled together, for a certain distance, at any rate, and have been brought down together to the spot at which they are found.

The felsites and the felspathic ashes are the most abundant, and the Llandovery sandstones are the rarest. No block of granite has been found in this group of erratics.

Some are sub-angular; a not inconsiderable proportion are well smoothed, although they can hardly be said to be highly polished; and on a few striæ may be traced.

Prof. C. Lapworth has examined the specimens, and recognises a large number as occurring *in situ* at the Berwyn Hills; others may be found in the Arenig range.

The condition of the new red sandstone rock on which the boulders rest is most remarkable. The sandstone rock is broken up, and large fragments of it have been lifted up out of their position and thrust into the middle of the drift. At one point in the section a part of the rock has been lifted up almost like an arm, and still remains united with the basement mass, while the drift fills the L-shaped hollow. A large erratic block is seen close to the extreme end of the uplifted arm of the basement.

The evidence of violence is complete. The breaking up of the sandstone rock, the uplifting of parts of it *en masse*, and the carrying away of fragments, are facts as patent as the presence of the erratic blocks themselves.

The Rev. W. Tuckwell has called the attention of the Committee to some very interesting boulders at Stockton, near Rugby, about equi-distant from Leamington, Rugby, and Coventry. One has been moved from the roadside, where it was in great danger of being injured, placed upon a bed of concrete, and protected by railings.

Leicestershire.—Mr. W. Jerome Harrison has sent the Committee the following note on a Leicestershire boulder which has travelled northwards:—

In the construction of the sewerage for the Clarendon Park Estate, near the Victoria Park, on the east side of the town of Leicester, some interesting sections of the drift were laid bare, which I examined in June, 1880. Much of the drift exposed was of a loamy nature, containing erratics of moderately large size, and overlying, though with no well-marked line of demarcation between, the well-known great chalky boulder clay which spreads so widely in this district.

Among the travelled rocks contained in this deposit I particularly noticed one angular block identical in appearance with the syenitic rock which forms Enderby Knoll (four miles south-west of Leicester), and Croft Hill (about two miles further in the same direction). These South Leicestershire syenites are well-characterised and somewhat abnormal rocks, and their identification is easy.

The surface of the Clarendon Park Estate is about 300 feet above sea-level, while Enderby Knoll is about 350 feet, and Croft Hill 450 feet (these heights are approximations only). The block which I saw on the Clarendon Park Estate measured about $3\frac{1}{2} \times 2 \times 1\frac{1}{2}$ feet, and would weigh about three-quarters of a ton; it was irregular in shape and very angular. As it did not interfere with the direct line of the sewer, it was not removed, but was covered in. I have examined a large number of the erratic blocks which stud the surface of Leicestershire, but this is the only instance I know of a boulder which has been carried to a distance several miles due north of its parent rock.[1]

Shropshire.—The Committee have received from Mr. Luff a valuable report upon the group of erratic blocks found in the neighbourhood of Clun, Shropshire.

Prof. Lapworth has examined a series of specimens, and describes them as lower Llandovery grits and shales belonging to the Plinlimmon group of Central Wales. The hills from which they have been derived are all south of Bala, and situated almost due west from their present position.

The following are the most remarkable among a large number of boulders:—The "*Great Boundary Stone*," marking the boundary of Clun and Treverward townships. It is on Rock Hill. Its dimensions are 6 feet × 6 feet × 2·5 feet. No striations can be detected, but it is angular and polished on one face. It is a cleaved flagstone, and has travelled from a point south of Machynlleth. It rests upon a bed of clay and rubble above the Upper Ludlow rock. Height above the sea, 1152 feet.

The "*Black Hill Boulder*," 52° 24′ 40″ N. L., 2° 59′ 50″ W. L. This boulder may be calculated to contain from 8 to 10 cubic feet, and is subangular. It is a pebble grit belonging to the Plinlimmon group, and may have come, according to Prof. Lapworth, from the neighbourhood of Rhadyr. So far as can be observed, it rests upon the same limit of bed as the Great Boundary Stone. Its elevation above the sea is 1327 feet, and it is the highest of all the boulders of the group.

The "*10-Feet Boulder*" is a pebbly grit of the Plinlimmon group. It lies on the Clun Hill, near Pen-y-wern, 52° 24′ 20″ N. L., 3° 0′ 30″ W. L., at an elevation of about 1160 feet above the sea. It measures 10 feet × 3 feet × 3 feet, and weighs, I should calculate, between 6 and 7 tons. It bears every evidence of having stood upright in the ground for a very long time. The base is tolerably angular and well preserved, but the sides and apex are much weathered. About 4 feet from the base it is deeply undercut, apparently all round, exactly as we should expect such a block to be where (on the ground-line) it had been much exposed to the combined influence of moisture and frost.

Report on the Conditions under which Ordinary Sedimentary Materials may be converted into Metamorphic Rocks, by Prof. W. J. Sollas, M.A., describes experiments on quartz and other minerals which have been subjected to a heat of 300° C. in an iron tube of $\frac{1}{2}$ inch diameter.

Report of the Committee for the purpose of carrying on Explorations in Caves in Carboniferous Limestone in the South of Ireland, consisting of the late Prof. A. Leith Adams, Prof. W. Boyd Dawkins, Dr. John Evans, Mr. G. H. Kinahan, and Mr. R. J. Ussher.—Within the past three months attempts have been made to effect an entrance from the face of the scarp into the series of caves discovered and reported on last year, in the rock called the Carrigmurrish, but after a careful survey had been made and levels taken from the several branches of the caves by Mr. Duffin, county surveyor, it was found that this means of access is not possible.

Eighth Report of the Committee, consisting of Prof. E. Hull, the Rev. H. W. Crosskey, Capt. Douglas Galton, Professors G. A. Lebour and J. Prestwich, and Messrs. James Glaisher, E. B. Marten, W. Molyneux, G. H. Morton, W. Pengelly, James Plant, James Parker, I. Roberts, Fox Strangways, Thos. S. Stooke, G. J. Symons, W. Topley, Tylden-Wright, E. Wethered, W. Whitaker, and C. E. De Rance, appointed for the purpose of investigating the Circulation of the Underground Waters in the Permeable Formations of England, and the Quality and Quantity of the Water supplied to various Towns

[1] It seems to the writer to show (1) that a submergence followed the retreat northwards of the great chalky boulder clay; (2) that when this submergence amounted to about 350 or 400 feet, the bosses of syenite which occur in South Leicestershire stood as little islands above the sea; (3) that "coast ice" forme on the margins of these islands, on which blocks of rock, detached by the frost, fell; and (4) that a current running northwards carried at least one of these blocks down the Soar Valley, and dropped it where it now lies, on the eastern brow of the Valley at Leicester.

and Districts from these Formations. Drawn up by C. E. De Rance, Secretary.—Eight years have elapsed since this Committee commenced to investigate the circulation of underground waters, and the quantity and character of water supplied to towns and districts so derived.

From 1874 to 1878 the Triassic and Permian formations were alone under consideration; in that year the Jurassic rocks were added to the scope of the inquiry, which at the York meeting was enlarged to include the whole of the permeable rocks in England and Wales.

The Triassic and Permian rocks of Devonshire are described in the first, fifth, and sixth reports; of Somersetshire in the first; of Leicestershire in the first, fourth, and fifth; of Warwick in the second, fourth, and seventh; of Nottingham in the second and sixth; of Cheshire in the second, fourth, and fifth; of Lancashire in the first, second, third, fourth, sixth, and seventh; of Yorkshire in the first, second, third, sixth, and seventh; of Shropshire in the sixth.[1]

Through the removal to South Africa of the member of the Committee taking charge of Staffordshire, this district is still incomplete, but some information as to the Burton-on-Trent area is given in the first report.

In Devonshire the inquiry was carried on by Mr. Pengelly, F.R.S., supplemented by details obtained by Mr. Stooke, C.E. The Triassic rocks of the district have been made the object of careful study by Mr. W. A. E. Ussher. From his investigations it would appear that the equence exhibited has more in common with the Trias of the French side of the English Channel than with that of the midland counties. In Devonshire and Somersetshire the sandstones and conglomerates appear to have been deposited in a distinct basin to that north of the Mendips, the Keuper marls being alone common to the two districts.

The basin south of the Mendips is remarkable for having a series of marls intercalated in its sandstones, called by Mr. Ussher the "Middle Marls"; these underlie sandstones beneath the Keuper marls. The conglomerates have a distinctly local character, and when present are plentifully water-bearing, as are the sandstones, though to a somewhat less extent.

Private supplies are obtained by wells at Torquay, where the water-level is 168 feet above the sea; at Teignmouth; at Dawlish, where the water-level is 71 feet above the sea; and at Bramford Speke, near Exeter.

Near Exeter the Lyons Holt spring issues at 126 feet above sea-level, yielding towards the town supply 47,000 gallons daily of very pure water, which is extensively used for drinking-fountains.

Higher up the valley of the Exe and its tributaries private supplies are obtained at Crediton.

North is the watershed separating the streams flowing into English and Bristol Channels.

At Wellington a well 230 feet above the sea is sunk to a depth of 48½ feet; only a small quantity of water is pumped from it.

At Taunton numerous private wells give a supply of rather hard water from the New Red Sandstone.

At Somerton hard water is obtained from a well 129½ feet deep; the White Lias is said to occur in it at 90 to 99 feet.

At Wembdon a private well in triassic conglomerate yields hard water at a well 30 feet deep, at 60 feet above the sea.

At Wookey, near Wells, 70 feet above the sea, a private well, 33 feet, yields a constant supply, uninfluenced by the seasons as to quantity, but decreases 9 feet in level after dry weather.

In Bristol the wells vary in depth from 60 to 300 feet, some only penetrating peat and gravel, others passing through triassic marls, whilst a few penetrate the Coal-measures.

At Braysdown Colliery, near Bath, a shaft 500 yards deep, passing through New Red Sandstone and Coal-measures, yielded water at the bottom of the pit containing 1008 grains of common salt, or 1440 parts per 100,000.

In the Tiverton Coal-pit, near Bath, 16,800 gallons per 24 hours are yielded by plastic shale in the Blue Lias, 130 feet above the White Lias, which is 12 feet thick, resting on 23 feet of Rhætics, lying on the New Red Marl; the water contains 112 parts per 100,000 of common salt.

The Tyning Pit, Radstock, intersected a spring yielding 864,000 gallons per day at 200 feet from the surface, at the bottom of the Red Marls.

[1] Report of British Association for 1875 (Bristol) contains first report; that for 1876 (Glasgow) the second; that for 1877 (Plymouth) the third; that for 1878 (Dublin) the fourth; that for 1879 (Sheffield) the fifth; that for 1880 (Swansea) the sixth; and that for 1881 (York) the seventh.

At Kilmersdon New Coal Shaft, Writhlington, a 10 feet shaft intersected a spring at 253½ feet. On cutting through a hard base of stone the water rose 99 feet in 24 hours, and stands at this level, yielding 98,400 gallons per day of hard water. The section passed through was liassic clay, black and blue marl 78 feet; 34 feet of "red ground," with bands of blue stone; conglomerate 5 feet; red beds 4 feet; then conglomerate again; the remainder of the section is not given. The late Mr. Charles Morre considered the last, 5 feet 4 inches of the Lias, in this section to belong to the Rhætic beds.

In reference to the information furnished by Mr. Taunton as to the Thames and Severn Canal, it may be well to state that the outcrop of the oolitic rocks has an average breadth on the dip of 25 miles. The base of the Oolites resting on the Lias reaches its highest point near Chipping Campden, 1032 feet above the sea, on the watershed between the Thames and Severn basins. This, south of the Severn Wells, the source of the Churn, runs somewhat east of the base of the Oolite, causing the surface drainage of the oolitic tract around Minchinhampton, Dursley, and Wotton-under-Edge to flow into the basin of the Severn. It is probable also that a portion of the underground drainage does so also, notwithstanding the general south-easterly dip, from the basement level of the Oolites, varying in the direction of the strike, owing to the denudation of the escarpment being unequal, the Oolite to the south having been worn back much further down the dip, and consequently to a lower elevation than at Chipping Campden, descending from 1030 at the latter place, to 212 feet in the Stroud Valley, or about 800 feet in 25 miles. South of this valley the level rises slightly, so that a partial discharge of underground drainage takes place in this valley, which is immediately west of the point in the Thames and Severn watershed which is penetrated by the canal connecting the two basins.

Of the 25 miles of average outcrop of oolitic rocks measured on the dip, only about 8 consist of impermeable depositions:—viz. the Fuller's Earth, the Oxford Clay, and the Kimmeridge Clay—so that two-thirds of the area may be considered to be of a permeable character.

Warwickshire information.—The southern and western portion of the Warwickshire coalfield is overlaid by Permian rocks consisting of reddish-brown and purple sandstones, intercalated with marls in lenticular beds, rising to a height of 622 feet at Cowley Hall, which forms part of the watershed between the tributaries of the Trent to the North, and those of the Avon on the south.

Though the surface-drainage of this Permian area flows in opposite directions, that portion of the rainfall percolating into the ground has a uniform gradient to the south, the base of the Permians, where they rest on the coal-measures west of Atherstone, being 470 feet above the sea, and 170 feet under the Mithurst Tunnel of the Midland Railway, being a fall of 50 feet per mile, while at Warwick the tops of the Permians are 186 feet above the sea, and as they are not less than 800 feet thick, their base is probably about 600 feet below the sea-level, giving a furtherr fall of 786 feet in 18 miles, or a fall of 43 miles.

Examining the district more minutely, it is seen that though the Permians do not always lie conformably on the coal-measures, yet there is a general conformity, and a synclinal flexure traversing the coal-measures from north to south is shared by the overlying Permians, which have synclinal dips towards the axis of an average amount of 3°, or about 270 feet per mile from the edges of the basin towards the axis, which occurs more to the eastern than the western margin.

The fault throwing in the coal measures of Arley Wood is believed to be connected with the fault throwing back the outcrop of the main part of the coal-field at Broomfield Park; but of this there is no evidence, and as the dips in the Permian show the flexures to be present on both sides of the supposed fault, its existence is very doubtful. If it occurred, and were a watertight barrier, the water percolating into the sandstones to the west of Atherstone and flowing south would be thrown out in a line of springs, which is not the case; and there is no doubt that the waters travelling in the porous portion of the system flow south to Leamington and Warwick, where a portion of the supply is utilised. South of this point the Permians are concealed by triassic, liassic, and oolitic rocks in the direction of Bambury. Southwards the Permians probably wedge out before the Trias, which continue into the Thames basin, the water travelling down the dip planes of the Permian, where that formation thins out, probably enters the overlying triassic sands,

and, prevented from rising higher by the Keuper marls, probably flows a considerable distance under the Thames basin, where its outlet being checked by the thinning out of the Lower Trias against the Palæozoic ridge, causes the subterranean Trias to be fully charged with water in a stationary condition, and thus limits the amounts of absorption in the area of absorption.

Between the base of the Permian and the *Spirorbis limestone* is a thickness of 150 feet, and between it and the first workable coal is a further 500 feet, of which a large portion consists of Permian sandstone fully charged with water, which was met with in sinking the Exhall Colliery.

The report also contains:—Appendix I.—Millstone Grit Wells. Appendix II.—Permian and Trias Wells, chiefly collected by Mr. E. B. Marten, C.E., Mr. S. Stooke, C.E., and Mr. H. T. Marten, C.E.. Appendix III.—Jurassic Wells.

Appendix IV., by Mr. E. Wethered, F.G.S., is on the porosity and density of rocks, and gives the results of a very elaborate investigation into the size of the grains, in decimals of an inch, making up the permeable rocks of England and Wales, of various geological ages, the specific gravity of these rocks, the specific gravity of the particles, the volume of water absorbed by 100 volumes of rock, the number of gallons of water absorbed per cubic foot of rock, and the number of gallons of water absorbed per square mile of rock three feet thick, and the relation of these volumes to the purity of the water obtained.

First Report of the Committee, consisting of Prof. Flower, Dr. Beddoe, Mr. Brabrook, Mr. F. Galton, Mr. J. Park Harrison (Secretary), Dr. Muirhead, General Pitt-Rivers, Mr. F. W. Rudler, and Mr. Charles Roberts, appointed for the purpose of obtaining Photographs of the Typical Races in the British Isles.—Owing to the accumulation of observations of height, weight, and other physical characteristics of the inhabitants of the British Isles, the discussion of which required the undivided attention of the Anthropometric Committee, the acquisition of photographs undertaken by them in 1876 was last year transferred to a Committee of the Anthropological Department.

The photographic portraits already collected have been handed over to the new Committee, and will assist materially in determining the values of crosses in different parts of the country. Some, obtained under exceptionally favourable circumstances, and especially seventeen portraits of Shetland Islanders, well illustrating the Scandinavian element in the population, and presented by Dr. Muirhead, may be safely termed typical.

The Scientific Bearing of the Subject.—A clear definition of racial features, illustrated by examples, will, the Committee believe, prove of considerable importance in connection with more than one social question.

1. First, as tending to allay national animosities springing from a belief in the preponderance of some one race, and, in connection with this, affording a safe basis for generalisation, in the place of deductions depending on doubtful traditions and insufficient historical data.

2. A correct description of the main racial types would also afford an opportunity of testing in a more complete manner than is now practicable the truth of views, believed to be extensively held, on the subject of racial tendencies and proclivities.

3. Indirectly, by indicating the way in which features, and more especially profiles, of human beings should be observed, it would lead to a more exact description of criminals and deserters, resulting, it cannot be doubted, in more frequent arrests. At present, so little attention is paid to the subject that photographs of prisoners are taken solely in full face, and the description of recruits for the military rolls is confined, so far as their features are concerned, to the colour of the hair and eyes.

Erroneous Views regarding the Possibility of a Survival of Racial Features at the Present Day.—Before proceeding further, the Committee think it will be well to notice an objection, not infrequently made, that European populations are now too much mixed to allow of racial types being recognised. This is not the belief of anthropologists generally. Prof. Rolleston—whose loss this Committee has especial reason to deplore—expressed no uncertain opinion on the subject in his address to the Anthropological Department at Bristol. "At once, upon the first inspection of a series of crania, or, indeed, of heads, from such a (mixed) race," he said it was evident that "some were referable to one, some to another, of one, two, or three typical forms;" also that intercrossing has left the originally distinct forms still in something like their original independence, "and in the possession of an overwhelming numerical representation;" and Prof. His was quoted as having arrived at a similar conclusion from an investigatfon of the ethnology of Switzerland (Brit. Assoc. Rep., 1875, p. 148).

Prof. Kollmann, too, of Bale, believes that it is quite possible to distinguish original or main racial characteristics in a mixed population, owing to a capacity in skulls and facial skeletons to preserve their pristine types long after the colour of the hair and eyes have changed by crossing. A complete fusion of component elements, the distinguished Professor is convinced, never absolutely occurs.

Reversion to Original Types.—Besides, however, these composite forms, eminent anthropologists admit a natural law, through the operation of which a complete reversion takes place, under favourable circumstances, to original types. Drs. Beddoe, Barnard Davis, Flower, Rolleston, Thurnam, and Turner, in this country, and Morton, Broca, Quatrefages, Retzius, and Virchow, abroad, have satisfied themselves, from craniological evidence, that prehistoric characteristics exist at the present day; Prof. Quatrefages, than whom the Committee believe there could not be a safer authority, even affirming that representatives of the fossil types of man are still to be found amongst us ("Crania Ethnica," p. 28).

Height and Colour of the Hair and Eyes insufficient as Evidence of Race.—Assuming the correctness of Prof. Kollmann's deductions that hair and eyes (permanent in a pure race) change by crossing more easily than skull forms; dark tints, except under conditions of intensity, joined with diminutive stature and complete dolichocephalism, such as unmistakably point to the race styled Iberian, simply indicate, according to the index of nigrescence established by Dr. Beddoe, more or less mixture in blood. Where, however, hair and eyes are light, and the stature tall, in the absence of information respecting the features generally, it would be impossible to pronounce any individual to be Celt or Saxon, Dane or Swede.

Birth of Parents and Grandparents in the same Locality no Proof of Race.—An experiment made for the purpose of ascertaining how far the birth of parents and the grandparents, on both sides, in certain districts would assist in the selection of pure local types, resulted in the conclusion that the requirement mentioned, though securing the absence, of recent foreign admixture, failed as a sufficient test, by affording no evidence that movements had not occurred in the population at an earlier date.

Photographic portraits obtained under the above-mentioned conditions do not, as a fact, assist materially in the definition of racial characteristics; the features exhibit more than one type even in districts supposed to have been peopled by a given race; though, owing to the law already alluded to, pure types may be sought for, and would more frequently be found amongst such populations than elsewhere.

This, and other considerations, led a sub-Committee, in 1880, to collect in preference, from different localities, a certain number of portraits, all of which exhibited similar features; and then an equal number distinguished by characteristics in all respects different from the first series, but equally homogeneous. They presented contrasts which appeared to be racial.

Method of Identification of Types adopted by the Committee.—Approaching the subject from the standpoint of comparative physiognomy alluded to in the last paragraph, but experimenting in the first instance on the facial skeletons of skulls obtained from ancient tumuli and cemeteries in different parts of the British Isles, it was found on superimposing tracings of the skeleton profiles of the three main types figured in the "Crania Britannica," that the brows of the Brachycephalic, round-barrow types were more prominent, and the nasal bones more angular and sharply projecting, than those of the Dolichocephalic, long-barrow type; whilst brows and nasals in the Teutonic skulls (and especially those of the Saxons proper) were respectively smooth and little prominent. The main characteristics in the profiles of the Round-barrow man and the Teuton would clearly have been the high-bridge of the nose of the former, and the entire absence of an arched nose in the Saxon.

Similar results were obtained from measurements of skulls in the Anatomical Museum at Cambridge, purchased from Dr. Thurnam by Prof. Humphry, and presented by him to that University. Also some skulls in the Museum of the Royal College of Surgeons, and the Greenwell collection at Oxford, have been measured and found to exhibit the same contrasts. Mr. Harrison, who obtained the measurements for the information of the Committee, found that the mean difference in pro-

jection of the nasal bones in skulls from the round-barrows, as measured from the basion to fixed points on the dorsum and the nasion, or root of the nasal bones, is about twice that observed in purely Teutonic crania. In the fine collection of true Saxon skulls from Wiltshire, obtained by General Pitt-Rivers, the principal characteristics are a rounded forehead and smooth brow, and but little projection in the nasals; and this in the male as well as the female skulls.

The points of contrast in the skeleton features of the two races were noticed by Dr. B. Davis; but owing to Saxons and Angles being at the time he wrote considered equally Teutonic, the differences observed in some of the examples selected by him to illustrate types, are not so strongly marked as in others. Dr. Beddoe and Mr. David Mackintosh, it should be mentioned, both consider the Anglian features to have been more prominent than the Saxon.—When proceeding to define tribal differences and crosses, the nasal forms will, with other features, be subjected by the Committee to more minute examination.[1]

The above facts having been sufficiently ascertained, it was easy to compare the skeleton features of the two main types—viz., the Round-barrow man and the Saxon—with profiles of living subjects in this and neighbouring countries presumably inhabited by similar populations. Whenever the osseous and other features were found to correspond, at the same time that they differed entirely from other equally well-marked types, it was assumed that the characteristics belonged to distinct races.

In the following definitions the main types are designated by capital letters, intended to be used as symbols when dicussing racial crosses:—

The First or Dolichocephalic Dark Type, A.—The definition of the short, narrow-headed race shown by Dr. Thurnam and Prof. B. Dawkins to have preceded the so-called Celts, and termed by them Iberian (=the Silurian of Prof. Rolleston), is at present incomplete. The forehead, however, appears to have been fairly vertical, the brows prominent, the nasal bones long and straight, the lower jaw weak (Rolleston), and the hair and eyes dark. Statistics of the colour of the hair and eyes, collected by Dr. Beddoe, show that the race exerted a much wider influence on the population than is usually supposed. A number of photographs, which, it is believed, represent varieties of the type, have been placed on cards.

The Second or Brachicephalic Fair Type, B.—The principal characteristics of this race consist in the prominence of brow and supra-nasal ridges; a slightly receding forehead; sharply projecting nasal bones, causing a high-bridged or arched nose, without undulation; a long, oval face; high cheek-bones; and a prominent fine chin. From Mr. Park Harrison's observations the lips of this type appear to be thin, and the ear pear-shaped, with no proper lobe, the fossa being continuous.

The above features are found associated with light hair and eyes, and a stature above the average.

This type includes Belgic, Cymric, and Danish varieties, which, further observation, the Committee believe, will by-and-bye enable them to differentiate; as also the Anglian, Jutish, and Frisian types. They have selected several portraits, which present common characteristics.

The definition of Type B agrees in all the main points with descriptions given some years ago by Dr. Beddoe, Mr. David Mackintosh, and Mr. Hector Maclean, as well as with Dr. Rolleston's deductions in the appendix to "British Barrows."

The Third or Sub-Dolichocephalic Fair Type, C.—The Committee believe that the following is a correct definition of true Saxon features. Brows smooth; forehead rounded and vertical; nasal bones short and straight; nose not arched, ending in more or less of a bulb; face elliptical, rounded; cheek-bones broad; chin rounded; lower part of face wide; eyes prominent, in colour blue or bluish-grey; lips moulded; ears flat, with formed lobes; face and frame well covered. Height about the average.

The definition accords with Schadow's pure German (Teutonic) type, and with the Saxon type of Beddoe and Mackintosh.

Photographs conforming in all respects to the above characteristics have been obtained from Sussex and several other English counties; and from Scotland, Sweden,[2] Germany, and France. Specimens have been arranged upon cards.

[1] Prof Flower, speaking of the racial value of the nasal bone, when describing the cranial characters of the natives of the Fiji Islands, says: "The nose is one of the most important of the features as a characteristic of race, and its form is very accurately indicated by its bony framework" (*Jour. Anthrop. Inst.*, vol x. p. 160) Dr. Broca defines six forms.

[2] The Dolichocephalic Swedish race of Retzius was believed by him to be closely allied to the Saxon.

No photographs have as yet been taken specially to illustrate the three types, the Committee thinking it best to proceed before doing so with the definitions of racial varieties.

New Designation of the Committee.—If re-appointed, they suggest that it should be "for the purpose of defining the facial characteristics of the races and principal crosses in the British Isles, and obtaining illustrative photographs with a view to their publication."

Constitution of the Committee.—Prof. Flower having been unable to take an active part in the proceedings of the Committee owing to pressure of other work, and having expressed a wish that another chairman should be appointed, they hope that General Pitt-Rivers will undertake the duties.

Photographs.—Mr. Barraud, who was asked to act as an Associate, has presented some cabinet photographs of well-known persons for exhibition. The Committee have also received from Dr. Beddoe a portrait in full face and profile, taken at his expense, of a native of Montgomeryshire. It is a good example of the Silurian type. Other photographs have been received in illustration of Types B and C.

The Committee ask for a renewal of the grant of 10*l.*, with an addition sufficient to procure the requisite negatives, and also photographs from different counties to illustrate crossing.

Report of the Committee, consisting of Dr. M. Foster, Dr. Pye-Smith, Prof. Huxley, Dr. Carpenter, Dr. Gwyn Jeffreys, the late Prof. F. M. Balfour, the late Sir C. Wyville Thomson, Prof. Ray Lankester, Prof. Allman, and Mr. Percy Sladen (Secretary), appointed for the purpose of aiding in the maintenance of the Scottish Zoological Station.—The Committee beg to report that, with the aid of the sum of 40*l.* voted last year, further investigations have been made by Mr. Romanes, F.R.S., and Prof. Cossar Ewart on the "Locomotor System of the Echinodermata." The work of the station was carried on at Oban, where, in addition to the ordinary forms abundant on the east coast, *Antedon* was plentifully obtained for examination. The investigators directed their attention—1. To completing their observations on (*a*) the internal nervous system of *Echinus;* (*b*) the external nervous system of *Asterias;* and (*c*) the nature of the nervous system of *Antedon*. 2. To the effects of rotation on inverted echini. 3. To the effects of poisons on echini and other invertebrates. 4. To the natural movements of *Antedon*, and to the influence on these movements of partial destruction of the nervous system. The publication of the results obtained at Oban is reserved until the further researches now in progress are completed this year. It may be added that a fine specimen of the rare compound Ascidian, *Diagona violacea*, was dredged in the Sound of Mull. During the present autumn Mr. Romanes and Professors Ewart and Schäfer are at work on the Ross-shire coast. The Committee again beg respectfully to request that a sum of 50*l.* be voted to assist in meeting the expenses of the station.

Report on the Progress of the International Geological Map of Europe, by W. Topley, F.G.S.—A committee was appointed by the Geological Congress of Bologna to prepare a map of Europe. An account of the proceedings of this Congress has already appeared in NATURE. The present Report deals chiefly with the progress since made. Arrangements have been made with Reimer and Co. of Berlin, for the engraving and publication of the map. MM. Beyrieh and Hancherverne are the directors for the map. The topography of the British Isles is already engraved; a proof was exhibited to the meeting.

Report on the Earthquake Phenomena of Japan, by Prof. J. Milne, F.G.S.—This paper was illustrated by diagrams showing the effect of earthquake waves at the Palazzo Palmieri, Polla, in the Neapolitan earthquake, and in the earthquake traversing Tokio Bay on February 22, 1880, in which the centres of origin of the waves are indicated, in another the manner of interference of earthquake waves, in the ground underlying Yokohama. Earthquakes of the north-east of Japan do not spread south-west, owing to the tract of high ridges lying in their path, which form a barrier to their movement, while to the south-east, east of the central mountain axis, there is a flat district, which invariably receives the shocks. The author is preparing a seismological atlas, which shows the large number of seismic centres in which the earthquakes originate, and the relative intensity of the waves and the areas affected. Outside the island occur several seismic centres in the open sea. The waves propelled from these centres breaking against the mass of the mountain, are either reflected or absorbed by the mass. In regard to the velocity of earth-

quake waves, the author described the "time-take," which is a clock which is an automatic arrangement causing dots to be made and the time of wave-motion to be indicated without stopping the clock. He describes shocks observed by him in Japan as travelling at 10,000 feet per second, decreasing as it went on to 4500 feet, getting slower and slower as it went on. The waves last from thirty seconds to four minutes. The author describes the result of experiments carried out by himself and Mr. Gray as to artificial earthquakes, explosions of 2 lbs. to 5 lbs. of dynamite in bore-holes 10 feet in depth, fired by electricity, and the effect of letting a heavy iron ball fall on the ground to a depth of 20 to 30 feet in height. The effect of shocks is communicated along the surface, gradually decreasing as it proceeded from the point of propagation, but at a less rate as the distance increases.

SECTION A—MATHEMATICAL AND PHYSICAL

On the Absolute Measurement of Electric Currents, by Prof. Lord Rayleigh.—The absolute measurement of current is more difficult than that of resistance. All the methods hitherto employed require either accurate measurements of the horizontal intensity of the earth's magnetism or of coils of small radius and many turns. This latter is difficult to evaluate, as it is impossible to measure the length of the wire wound, as the tension necessary to make the wire lie evenly, stretches it very considerably, whilst it is most important to determine the mean radius accurately, as an error therein doubles itself in the final result. The method of Kohlrausch is free from this objection, but it requires a knowledge of the moment of inertia, a quantity not easy accurately to determine. When the electromagnetic action is a simple force, it can be determined directly. In Mascart's recent determination, a large solenoid is suspended vertically in a balance, and is acted on by a flat co-axal coil of much larger radius. This is simple to think about, but not calculated to secure precise results. The appearance of accuracy is illusory, unless it can be assumed that the distribution of wire is absolutely uniform. It would appear that all the turns of the suspended coil should operate as much as possible, that is, that the suspended coil should be compact, and should be placed in the position of maximum effect. There is a further incidental advantage in this arrangement. The expression for the attraction involves as factors the product of the number of turns, the square of the current, and a function of the mean radii of the two coils, and of the distance between their mean planes. This function is of no dimensions. When the position is such that the function for two given coils is a maximum, the result is practically dependent only on the two mean radii, and the function being of no dimensions, can involve these mean radii only in the form of a ratio. This can be obtained electrically with full precision by dividing a current between them in such a way that no effect is produced on a small magnet at their common centre. In practice it will be desirable to duplicate the fixed coil, placing the suspended coil midway between two similar fixed ones, through which the current passes in opposite directions.

On the Duration of Free Electric Currents in a Conducting Cylinder, by Lord Rayleigh.—This paper was devoted to considering the rate of decay of currents of electricity circulating round a conducting cylinder. The time in which the intensity sinks from e to 1 is called the "time of subsidence." For a copper cylinder of r centimetres radius, this is equal to $r^2/800$. That this may be one second, the diameter of the cylinder must be two feet.

On the Equilibrium of Liquid-conducting Surfaces charged with Electricity, by Lord Rayleigh.—This was a mathematical paper in which was investigated the condition of stability of a sphere of fluid charged with electricity. If Q be the charge, T the surface tension of the fluid, and a the radius of the sphere, then the condition of stability is that $T > Q^2/16\pi a^3$.

Preliminary Account of Results obtained during the late Total Solar Eclipse, by Prof. Schuster and Capt. Abney.—Three photographs of the corona were obtained with different exposures. The comet Tewfik, discovered during the eclipse, appears on the photographs, and the change of its position in successive plates shows that it was moving away from the sun. The corona is seen to extend over a solar diameter away from the sun. A plate exposed in a camera which had a prism in front of the lens shows the spectra of different prominences, which are not found to be identical, but in every case the lines H and K are the strongest. A photograph obtained in a complete spectroscope shows (1) a complicated prominence spectrum; (2) a strong continuous spectrum in the lower parts of the corona; (3) a reversal of the solar line G in the upper regions; (4) a series of coronal lines, different from the prominence lines.

Some Matters relating to the Sun, by Prof. Schuster.—Observations of the shape assumed by the solar corona in successive eclipses during the last fifteen years have shown remarkable changes coincident with the sun-spot period. The corona of sun-spot minimum is characterised by a certain symmetry about an axis not far removed from the sun's axis of rotation, but very likely not quite coincident either with it or with the perpendicular to the ecliptic plane. Some apparent irregularities in the symmetry seem to be due to differences in the position of the earth in its annual orbit. Changes in the spectroscopic and polariscopic properties of the corona which are coincident and connected with the changes of form seem to point to partly meteoric origin of the corona.

On a Misprint in the Tidal Report for 1872, by Mr. G. H. Darwin.—Mr. Darwin has recently been carrying out a laborious reduction, by the Method of Least Squares, of the observations of the tides of long period at a number of stations. The results, which seem to have an important bearing on the question of the rigidity of the earth's mass, will appear as § 848 in the new edition of Thomson and Tait's Natural Philosophy, now in the press. Subsequently to the completion of the calculations, Prof. J. C. Adams discovered a misprint in the Tidal Report of 1872, which forms the basis for the method of harmonic analysis, which has been applied to the tidal observations. On inquiry of Mr. Roberts, who has superintended the original computations, Prof. Adams learnt that the erroneous formula has been used in all the reductions of the long period tides. The erroneous formula occurs near the middle of p. 471 of the Report of the British Association for 1872, in the instructions for clearing the diurnal means from the undue influence of the short period tides; in the first of the two formulæ for that purpose, the factor $\sin 12\,n/\sin \frac{1}{2}\,n$ should obviously be replaced by $\sin 24\,n/\sin n$. The tides of long period are evaluated by the following process:—A mean is taken of the twenty-four heights of the water above the datum line at each mean solar hour during the twenty-four hours. The 365 diurnal means form the results of tidal observation for the whole year, and these are to be treated by harmonic analysis; but the continuous integrals which arise in Fourier's method are of course replaced by finite integrals. This method of procedure introduces an undue influence of the short period tides on the values deduced for the long tides, and a correction to each diurnal mean is necessary to get rid of this influence. It is in the formula for the correction to be applied in the case of the semi-diurnal tides that the error occurs. This paper is an evaluation of the maximum effect which can have been exercised on the results by the error. The analysis shows that all the values assigned to the long period tides in the Tidal Reports and Tide Tables must have been more or less vitiated. The lunar fortnightly declinational tide, the semi-annual and the annual tide have suffered comparatively little. The montly elliptic tide has suffered more, and the synodic fortnightly tide will in many years have been utterly worthless. The paper contains suggestions of a new method of procedure in the harmonic analysis of the tides of long period, and also discusses a remarkable result of the procedure by diurnal means in consequence of which there is an exaggeration of the undue influence exercised by the short-period tides on those of long period, in which either the sum or difference of the speeds is exactly 15° or 30° per mean solar hour.

On the Velocity of White and Coloured Light, by Mr. G. Forbes.—The author gave an account of experiments made by him in conjunction with Dr. James Young, F.R.S., with a view to determining the velocity of light. This research has been published in the *Transactions* of the Royal Society. The chief point of interest is that it appears that the velocity of blue light is greater than that of red, the difference being between 1 and 2 per cent. of the whole velocity.

Lord Rayleigh could give no other possible explanation of the phenomena described by Mr. Forbes, but he had great hesitation in accepting them from considerations on other sides. Michelson altogether repudiated them, and Lord Rayleigh thought that Foucault's method, that used by Michelson, was better suited to bring out results, if such existed, than Fizeau's, for it would produce a spectrum of considerable length. He would refer to some other points which he noticed in a letter to NATURE about twelve months ago, especially as to what is