THURSDAY, SEPTEMBER 4, 1873

THE TESTIMONIAL TO MR. COLE

AS was to be expected, the subscriptions for the well-deserved testimonial to Mr. Cole, to which we have already referred, have so far been thoroughly satisfactory, upwards of 2,000*l.* having already been subscribed. Among the names of the subscribers will be noticed the names of men eminent in nearly every department of human activity. Thus we see Dr. De La Rue, Mr. Brassey, Mr. Baines, M.P., Messrs. Clowes and Son, Elkington and Co., Prof. Ella, Mr. C. J. Freake, Lord Ronald L. Gower, Sir Francis Grant, Earl Granville, Messrs. S. C. Hall, Hawkshaw, Hawksley, Lord Houghton, Messrs. H. A. Hunt, C.B., Jackson and Graham, John Kelk, Longmans, J. E. Millais, Lord C. Paget, Sir A. de Rothschild, Sir Titus Salt, Duke of Sutherland, Messrs. G. Trollope and Sons, Sir Richard Wallace, Dr. J. F. Watson, Marquis of Westminster, Sir Joseph Whitworth, &c. &c. We may well hope that ere the list be closed many more names will be added, and such a sum subscribed as will render possible a testimonial worthy of the services performed by Mr. Cole to all the best interests of this country.

The earliest work which can be considered to have a connection with Science undertaken by Mr. Cole, was the reform of the Patent Laws, which he advocated in 1850, afterwards inducing the Society of Arts to take up the subject. He wrote three Reports, and the principles which he laid down have been generally adopted as the basis of the present law. He particularly insisted upon the principle of a moderate fee at the first registration of an invention, such payment to increase at the option of the inventor in after years. He denounced all "taxes on inventions," as such, and public opinion is now beginning to go with him. Successive Governments have received hundreds of thousands of pounds from this source, and still withhold all proper aid to the encouragement of Science. There is a spice of sarcasm in the adage which has been worked in Sgraffito on the back wall of the new Science Schools, "Scientia non habet inimicum nisi ignorantem."

In 1852 Mr. Cole reformed, or we may almost say, established, the system of Art Schools, making it possible for every locality to have its Art School if it pleased. In 1853 the Department of Art was made Department of Science and Art, and Dr. Playfair was appointed to organise the Science division; but he shortly afterwards resigned his post, and became Professor of Chemistry at Edinburgh. Mr. Cole then became sole Secretary for Science and Art. The late Marquis of Salisbury was the Lord President, and doubtless to the great interest which this nobleman took in all matters appertaining to Science is to be ascribed some of the success with which Mr. Lowe was enabled to ventilate and carry out his views. Captain Donnelly, R.E., was invited to enter the Department, and through the instrumentality of Lord Salisbury, Mr. Cole, and Captain Donnelly the present Government system of scientific instruction throughout the country, one of the things of which England has the greatest reason to be proud, was evolved; and through the admirable harmony existing between Major Donnelly and Mr. Cole the work has been brought to its present flourishing condition. In 1856 there were 16 Science schools, in 1872 there were 1,238. This is one part of the work which Mr. Cole has done fo English Science, and we blush to think that it has not been appreciated by men of Science as it ought to be and as it will be appreciated.

The Report which has just been issued by the Science and Art Department as to the attendance in the various classes connected with it, and the number of visitors to the various museums during 1872, will give some idea of the magnitude of the work accomplished by Mr. Cole.

The number of persons who have during the year 1872 attended the Schools and classes of Science and Art in connection with the Science and Art Department is as follows: viz. 36,783 attending Science Schools and Classes in 1872, as against 38,015 in 1871, and 244,134 receiving instruction in Art, showing an increase on the previous year of 31,633, or nearly 15 per cent. At the Royal School of Mines there were 20 regular and 148 occasional, students; at the Royal College of Chemistry, 212 students; at the Metallurgical Laboratory, 30; at the Royal School of Naval Architecture there were 35. At the Royal College of Science for Ireland there were 20 associate or regular students, and 19 occasional students. The lectures delivered in the lecture theatre of the South Kensington Museum were attended by 11,958 persons, or 2,927 more than in 1871. The evening lectures to working men at the Royal School of Mines were attended by 2,400 persons; and 186 Science teachers attended the special course of lectures provided for their instruction in the new Science Schools at South Kensington. The various courses of lectures delivered in connection with the Department in Dublin were attended by 2,577 persons; and at the evening popular lectures, which were given in the Edinburgh Museum of Science and Art during the Session of 1871-2, there was an attendance of 1,416. The total number of persons, therefore, who received direct instruction as students, or by means of lectures, in connection with the Science and Art Department in 1872, is nearly 299,000, showing an increase as compared with the number in the previous year of 28,000 or 10 per cent. The museums and collections under the superintendence of the Department in London, Dublin, and Edinburgh, were last year visited by upwards of 2,922,000 persons, showing the very considerable increase of 1,141,000, or about 63 per cent. on the number in 1871. The returns received of the number of visitors at the Local Art and Industrial Exhibitions, to which objects were contributed from the South Kensington Museum, show an attendance of upwards of 574,000. The total number of separate attendances during the year 1872, as shown by the returns of the different Institutions and Exhibitions, in connection with the Department, has been upwards of 3,795,000. This total, compared with that of the previous year, presents an increase of 1,117,000, or 53 per cent., not including the number of visitors at local exhibitions, which was exceptionally augmented last year by the attendance of 420,000 at the Dublin Exhibition of Art and Industry, and is necessarily liable to much fluctuation from year to year.

We regret extremely to see that part of the great work done by Mr. Cole, in establishing the South Kensington Museum, runs some risk of being undone by the unintelligent intermeddling of Government. It would appear from statements recently made in the House of Commons that arrangements were being made for transferring the management of the South Kensington, Bethnal Green, and similar institutions to the trustees of the British Museum. It is difficult for an outsider to see what Government means by contemplating such a step; we believe no better means could be taken to cripple the efficiency of such institutions than by giving them over to the irresponsible management of the unpaid trustees of the British Museum, who have at present much work on their hands, which is the subject of constant Parliamentary inquiry. We cannot conceive that Mr. Cole would approve of any such step, a step which, we repeat, would be sure to mar the great work which, with untiring labour, all-conquering zeal, and advanced intelligence, he has accomplished. Report indeed has reached us that a National Committee is being formed to urge upon Mr. Gladstone's re-constituted Government the necessity of putting the British Museum, the National Gallery, and Institutions supported by Parliamentary funds, and now Trustee-muddled, under the direct control of a responsible Minister.

Sir Joseph Whitworth consulted Mr. Cole upon the establishment of Scholarships for Mechanical Science, to take place after his death. Mr. Cole recommended him to establish them during his life, so that he might have the enjoyment of watching the progress of them. Sir Joseph followed this recommendation, and presented the country with 3,000*l*. a year for these Scholarships.

Mr. Cole is now devoting special attention to the application of Science to Productive Industry in the yearly International Exhibitions, and we trust that he may long be spared to reap the honour which is his due and to help on the work of which he has laid the foundation.

The erection in Exhibition Road of the handsome Science Schools, one of the few buildings devoted to Science of which the country may be justly proud, which Mr. Cole has at length successfully achieved, is due solely to the persistency of his efforts, rendered more and more pertinacious by the obstinacy and penuriousness of the Treasury, which in the most niggardly spirit is still starving the work and preventing its proper development, simply because, we presume, it is a scientific work; and it was the intention of the recent Chancellor, Mr. Lowe, that in this particular England should be distanced by the smallest Continental or American state. It is fair to add that Mr. Cole was supported in this particular direction by the Duke of Buckingham, the Duke of Marlborough, and the Marquis of Ripon, who have successively been Lord Presidents since 1866.

ADVANCED TEXT-BOOK OF PHYSICAL GEOGRAPHY

Advanced Text-Book of Physical Geography. By David Page, LL.D., F.G.S., Professor of Geology in the College of Physical Science, Newcastle. Second and Enlarged Ed. (Edinburgh and London: Blackwood, 1873.)

PHYSICAL Geography is one of those branches of knowledge which, without being a science in itself, makes use of many of the Sciences to explain and illustrate the facts and phenomena with which it deals. So far as it is confined to the mere knowledge of facts and description of natural phenomena, no special acquaintance with any science is required; but when it comes to deal with the causes of phenomena and the deductions from geographical facts, it is essential that the teacher should himself possess a good general knowledge of several branches of modern Science. In particular it is necessary that he should clearly grasp the main principles of Physics, that he should have a good acquaintance with the distribution of animals and plants, and so much familiarity with arithmetic and mathematics as to be able to avoid making statements which are palpably incorrect.

After a careful examination of the present volume, we are forced to conclude that the author is, on all the above-mentioned points, unfitted to teach this particular subject. It is with much regret that we say this, having expected something very different, not only from the popularity of Prof. Page as an author and a teacher, but also from the criticism of one of our first literary periodicals (used as an advertisement), that the work is "a thoroughly good text-book of Physical Geography." In order to justify this difference of opinion from so high an authority, it will be necessary to point out what are the most prominent errors and defects in the volume. Some of these defects may, it is true, be mere oversights; but most persons will be of opinion that, in the second edition of an educational work, the plea of "oversight" can hardly be allowed.

In the second chapter — on the figure, motion, and dimensions of the earth—we find a series of curious misconceptions, blunders, or obscurities. At page 19 we have the globe "revolving and rotating in obedience to the laws of gravitation and attraction," and in the next page these words are again used as implying distinct "forces." On page 21 occurs the following:—"But day and night are of unequal and varying length according to the *seasons;* and these seasonal successions are caused by the facts—first, that the orbit or path of the earth's revolution round the sun is not a perfect circle, but an ellipse; and second, that in performing this revolution her axis is not perpendicular, but inclined at an angle of 66° 27½′ to the plane of her orbit." This is simply absurd. The ellipticity of the earth's orbit has nothing whatever to do with the fact of there being seasons, which would occur exactly the same were the orbit a perfect circle. The actual effect of the elliptic orbit in slightly modifying the length and severity of winter in the two hemispheres, and which is of some importance as being an element in explanation of the cause of the glacial epoch, is never so much as alluded to. In a recent public examination some of the competitors gave this very account of the seasons, and received few or no marks in consequence. They had probably got up the subject from Dr. Page's volume. Three pages further we have a table of certain dimensions of the planets. This has no particular bearing on physical geography, but as it is given it should have been correct. It is, however, full of gross blunders, which can be detected by observation alone. We have in three columns—the diameter in miles, the cubic contents in miles, and the volume, earth being taken as 1. Now the "solid contents" and the "volume" being the same dimension expressed in different ways, must be proportionate in any two planets; yet we have Mercury, volume 0·06, solid contents 10·195; Venus, volume 0·96, solid contents 223·521, so that while the volume of Venus is 16 times that of Mercury, its solid content is 22 times! Again: Earth, volume 1·00, solid content 260·775; Mars, volume 0·14, solid content 48·723, the earth being over 7 times the volume of Mars, but only 5½ times its solid content. Almost any other two planets come out equally wrong. Again, from the diameters given the solid contents can be easily calculated, but here again is frequent error; and to add to the confusion, in at least two cases the diameters are seriously wrong (4,980 miles instead of 4,100 for Mars, for instance), so that it is very difficult to understand where so many mistakes could have come from. On the next page we have a contradiction as to the earth's internal structure. It is first stated positively that "the interior of the earth cannot be composed of the same materials that constitute its outer portion," and lower down, that "either the interior of the earth is composed of materials differing altogether from those known at the surface, or the compression must be counteracted," &c. At page 27 we have the atmosphere described as "mainly composed of two gases, nitrogen and oxygen—79 parts of the former to 21 of the latter—with a small percentage of carbonic acid and other extraneous impurities." Considering the importance of the carbonic acid gas in the atmosphere, it is hardly instructive to class it as an "extraneous impurity."

Passing over the mere description of the earth's surface, parts of which are very well done, we find other objectionable matter as soon as we have to deal with the explanation of phenomena. A mountain range is said at p. 75 to be "not a simple upheaval, the result of one paroxysmal outburst, but the work of innumerable volcanoes and earthquakes operating through ages and subsequently escarped and chiselled by rains, frosts," &c. Here gradual elevation without volcanoes or earthquakes, and possibly from altogether different causes, is ignored. On the next page, speaking of circumdenudation, we have:—"A mountain may thus consist of stratified rocks and be wholly unconnected with any forces of upheaval or ejection from below." Here ignoring that the strata must be upheaved before they can be circumdenuded. These are perhaps slight matters, but we think an introductory work should not adduce the almost exploded theory of Elie de Beaumont on the parallelism of mountain chains of the same age, "even when in opposite hemispheres," as if it were generally admitted, or Prof. Hopkins' explanation of central mountains with diverging spurs as the result of an upheaving force acting on a point, without stating that a very different explanation of the facts is adopted by most modern geologists.

When we come to the subject of the ocean, involving many nice problems in physics, our author is again altogether at fault. It seems hardly credible that he should not know the difference between salt and fresh water as regards the point of maximum density, on which much of the theory of oceanic circulation and temperature depends; yet such seems to be the case. At p. 123 we are told that "at 40° Fahr. water is at its minimum volume and maximum density," and again in the same page—"Its maximum density or minimum volume at 39½, its expansion as ice to one-ninth of its bulk at 32° for fresh water and at 28¼ or less for salt water." Again, at p. 131 we have—"As already mentioned, water acquires its minimum volume or greatest density at a temperature of 40°, and becomes lighter as it rises above or falls below this temperature. Owing to this property a perpetual interchange or circulation is kept up among the waters of the ocean," proving that sea-water also is supposed by the writer to have this property, instead of increasing in density down to about 27½°, as it actually does. Yet the author quotes Maury, who published this correction of the old notion in 1861, and the papers of Dr. Carpenter, who repeatedly refers to this fact as a most important one. Again, at p. 136 we have the obsolete theory of Sir James Ross as to deep-sea temperatures given in full, with a remark that it has recently "been materially interfered with" by the experiment of Drs. Carpenter and Wyville Thomson; but without, apparently, any acquaintance with the whole of the facts established by those gentlemen, as shown by again referring to the temperature of the bottom of the ocean as being 39° Fahr., "that of its maximum density."

It is perhaps a small matter that, in describing the Nile valley, Capt. Speke's account is quoted at length (p. 181), and the Victoria Nyanza given as the source, the Albert Nyanza not being once mentioned, or any allusion whatever made to the fact that Sir Samuel Baker claims it to be the true source of the Nile; but it is of great importance that the student should be impressed with clear and accurate ideas as to the cause of winds. Yet we find here the old school-book notion of a vaccum and an inrush to fill it up. "As air is expanded by heat and contracted by cold the warmer and lighter volumes will ascend, and the colder and denser rush in from all sides to supply the vacancy" (p. 205). "The air of the torrid zone becomes rarefied and ascends, while the colder and denser air sets in from either side to supply the deficiency" (p. 213). And the same words are repeated at p. 243. But every physicist knows that there is no "vacancy" and no "deficiency" in the case, but merely a disturbance of equilibrium; and unless this is clearly comprehended the causes and effects of atmospheric currents can never be understood. On the subject of light and heat the ideas of the author appear to be still more confused. At p. 205 he says—"As the atmosphere is the medium through which the sun's heat is conveyed to and disseminated over the earth, so also it is the medium of his light-giving rays." This sentence will certainly convey to the learner the false notion that the atmosphere is in some way essential to the "conveyance' of light and heat from the sun to the earth; and this is further dilated upon in the following vague and unintelligible, if not erroneous sentence:—"Heat and light are alike indispensable to plants and animals, and, from the peculiar constitution of the atmosphere, as regards its varying density, moisture, &c., both are reflected and diffused so as to become most available to vegetable and animal life." The learner must be very acute who can obtain any definite information from such oracular teaching as this. Again (at p. 207) we have a total misconception as to the cause of the decrease of temperature at increasing elevations—"The heat that falls on the land being partly absorbed and partly radiated into the atmosphere, the lowest aërial strata or those nearest the influence of this radiation will be warmer than those at higher elevations." But it is a thoroughly well-established fact that the atmosphere is scarcely at all warmed by radiant heat, except when charged with vapour, but almost wholly by contact with the heated earth, and that the diminution of temperature upwards is due to the cooling by expansion of the air which rises from below, and to its greater diathermacy, owing to the comparatively small amount of vapour at great elevations. In the whole of this part of the book there is no allusion to the effect of atmospheric vapour in checking radiation, so that the learner is left without a clue to the comprehension of some of the most important and interesting facts in climatology.

The latter division of the volume treats of the distribution of life, but it deals chiefly in vague generalities, and shows little acquaintance with the large amount of research which has of late years been bestowed on this subject. The distribution of plants is illustrated by means of the eight zones, from equatorial to polar; and there is no hint to the student that this is not a natural system or that there are any other causes than climate, soil, and altitude that determine the flora of a region. Here, too, we are not free from absurd errors, such as rhododendron and azalea being given as characteristic of the "American Arctic zone," while "box, saxifrage, and gum" (!) are said to grow up to 4,200 ft. on the Pyrenees, and "rice and wheat" in "those provinces subject to the influence of tropical seasons!" (p. 257). Animal life is treated in an equally loose and obsolete fashion. We find such terms as "homoiozoic zones" and "latitudinal distribution" repeated *ad nauseam*, but in illustration of these the student is told that the opossum is peculiar to the north temperate zone, and the kangaroo to the southern, apparently in complete ignorance that opossums abound all through tropical South America, while kangaroos inhabit tropical Australia and equatorial New Guinea, as well as the more temperate regions. "The eagle and falcon" are also given as peculiar to the temperate zone, while "the wolf" is said to be peculiarly arctic (p. 261). We are next informed that—"it has been attempted to arrange the earth's surface into certain zoological kingdoms and provinces, but it must be confessed with much less precision and certainty than in the case of the vegetable world"—which is exactly the reverse of the fact,—and then we have the now obsolete arrangement of Edward Forbes put forth, without a word about the labours of Sclater, Günther, Murray, Blyth, Blandford, Huxley, and others, who have established what all agree are natural zoological divisions of the earth (which has not yet been done in botany), although they may still differ as to the comparative rank of those divisions. We are not therefore much surprised when (at p. 263) we are told that in the Moluccas and Timor "there is a great abundance of carnivora and other orders of animals (!)" or that we have (at p. 269) the entirely novel assertion that "on the introduction of some new exotic, animals hitherto unknown in that locality usually make their appearance." Having perhaps read or heard of Mr. Darwin's celebrated case of the heartsease, bees, mice, and cats ("Origin of Species," 6th ed., p. 57), Dr. Page holds forth as follows:—"Certain birds, for example, feed on certain insects, and these insects again find their chosen food in certain plants; remove the plants and you destroy the insects, and by the destruction of the insects you compel the birds to remove and find othe habitats, or if these supplies cannot be found the birds are extirpated." Mr. Darwin gives a possible and very probable case founded on careful observation, but here we have a very improbable, if not impossible case, founded on imagination; because no birds feed on "certain"—that is definite species of—insects only, and comparatively few insects again are restricted to certain definite species of plants, so that there is no reason to believe that any insectivorous bird could ever be extirpated, or even rendered scarce, by the destruction of a single species of plant with the insects that feed upon it.

Next we come to the subject of mankind with the inevitable five races of Blumenbach, no notice whatever being taken of more modern classifications. Thus, the hill-tribes of India are left with the Caucasians, and the New Zealanders, Papuans, Australians, and Malays, are all jumbled together as forming one race. In the concluding chapter, which is a kind of summary of the whole work, we find it stated that the new world is characterised by more "uniformity of vegetable and animal life" than Europe, the exact contrary being the case; that "the vegetation of Africa is much less varied than that of Europe or Asia," which is equally untrue as regards Europe; the Cape of Good Hope alone equalling it in the number of families and genera of plants, while the difference between its northern and southern extremities is far greater than any corresponding difference in Europe; and, that the Polynesians are "utterly uncivilised." Having now gone through the book, we find that several classes of earth-knowledge have been totally omitted. The great subjects of terrestrial magnetism and atmospheric electricity are altogether ignored, while such phenomena as the rainbow, the blue sky, and meteoric stones, are never once mentioned.

The great and radical defects which have now been pointed out are not however the only ones, although they are by far the most important. The work is carelessly written, and the author seems not to have thought it worth while, even in a second edition, to correct errors, erase repetitions, or make sentences intelligible. A passage is repeated word for word about the middle and near the bottom of p. 27. "Contour" and "vertical relief" are defined in almost the same words three times over at pp. 62, 66 and 72. The two first lines on p. 21 are unintelligible, owing to some omitted words; and the second line of p. 28 is palpably ungrammatical. These, however, are small matters, and would not have been noticed had the author carried out with any approach to completeness and accuracy his somewhat lofty pretensions. He tells us that it is his object to "present an outline of the science in its higher bearings," to rise above mere external appearances, and seek to explain the causes that produce them, and that "he has endeavoured to embrace all that is important in recent discovery and hypothesis." The numerous quotations and references now given will enable the reader to judge how far the opinion expressed at the commencement of this article is well founded, and, if they agree with that opinion, they will feel some indignation that periodicals of high standing should (through ignorance or something worse), mislead the public so far as to tell them that this is "a thoroughly good text-book of Physical Geography." (!) This is the more to be regretted, as there are two well-known works to which the epithet is fairly applicable, and which are at least free from such erroneous facts and false or exploded theories as have been pointed out in Dr. Page's volume.

ALFRED R. WALLACE

OUR BOOK SHELF

Half-hours in the Green Lanes: a Book for a Country Stroll. By J. E. Taylor. (Hardwicke.)

THERE are two ways at least in which the first principles of Natural Science may be taught to the youthful mind, as well as to "intelligent people who have not had time to enter into the technicalities of scientific questions." One which, if we may judge from the number of elementary works on Physics in which it is adopted, has many arguments in its favour, consists in the careful and logical working out in detail of a few of the most important principles of the Science, together with the different steps by which they were arrived at; the knowledge of minutiæ being left for future observation and study, on the foundation supplied: and the other is little more than a compilation of disconnected facts, of unequal importance, arranged with an endeavour to make them impressive from their almost endless number, and strung together with teleological argument. The tenants of the "tarns and green lanes being the objects treated of, there is an expanded field for the 300 or so short pages, in which the fishes, molluscs, and reptiles of the former, as well as the birds, insects, and plants of the latter, are rapidly passed in review. Several excellent figures illustrate the work, Mr. Wood and Mr. Keulemans contributing to the ornithological section; however, we are surprised to see so many on subjects of comparatively little importance, as the 14 on the slight variations in the shape and marking of cycloid scales, and the 32 on the different species of snails. Turning to the letterpress, many of the descriptions will be found to be accurate and clear, and a few sufficiently long to enable the uninitiated to form a fair idea of the subject. Many however are so short and incomplete that but little can be made of them without extraneous assistance, and in some the carelessness in the choice of words adds to the difficulty, as where the Vapourer Moth (*Orgyia antiqua*) is said to derive its name "from the habit of the winged males rising and falling simultaneously in their flight." A fact is sometimes stretched to make a *simile*, as when we are inaccurately told that "the generic name of the Kingfisher (*Halcyon*) is derived from the ancient belief that when it was hatching its eggs, the water was always calm and still." The genus *Turdus* is more than once called *Tardus*, and several other mistakes show that the author's knowledge of the subject is not of the deepest, as when the hind wing of the Clifden Nonpareil (*Catocala fraxini*) is said to be black and red, and the wide geographical distribution of the Kingfisher is given as a reason for supposing that it has a comparatively high geological antiquity. Notwithstanding its faults, however, there are many points in this small work which will make it of more than ordinary interest to the general reader.

The Royal Readers. Nos. 1 to 6. (Nelson and Sons. London and Edinburgh.)

THE excellence of these reading books and their adaptation to the broader culture of the present day demand from us some notice. The editor of the series, who has done his work with unusual ability, tells us in the preface that his aim has been to cultivate the *love* of reading. So far as we are able to judge, this aim he has successfully carried out by presenting interesting subjects in an attractive way. Opening any one of these Readers, we are struck with the air of freshness and interest it possesses. An intelligent child, instead of closing the book with relief, is far more likely to leave it with regret. And added to the happy way in which the lessons have been prepared, the pages abound with capital woodcuts, some of which are of real beauty. There are none of the stereotyped cuts of stale children in old-fashioned dresses and hair in pig-tails, primly grouped at play, and supposed to illustrate the story of the goody-goody girl, or the naughty-naughty boy. Our children are mercifully spared from these haunting ghosts of our childhood and have their Royal Readers instead. But these books have a wider scope than mere reading lessons. In the fifth and sixth books we find a large amount of sound scientific knowledge conveyed in a course of lessons carefully prepared by the editor. Then there are articles on physical geography, the bed of the sea, the various ocean routes, and lessons on useful inventions, besides some other novel features which we have not room to detail. The employment of these reading books will certainly tend to create a love for healthy reading, and at the same time they seem likely to be of the highest service in training and furnishing the minds of children.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Atoms and Ether

I AM not enough of a metaphysician to say whether a substance which can be compressed and expanded *necessarily* contains void spaces.

If so, the idea of air, furnished to a beginner by instruction in "Boyle's Law," is self-contradictory; and any molecular theory afterwards developed in order to account for "Boyle's Law," may claim not only ingenuity but necessity in order to abate a crying grievance to all right-minded persons.

I do not myself believe in Prof. Challis's æther, but at the same time I do not believe in the power of the human mind to pronounce that a continuous medium capable of being compressed is an impossibility.

But, on the other hand, I am sure that a medium consisting of molecules is essentially viscous; that is, any motions on a large scale which exist in it are always being converted into molecular agitation, otherwise called heat, so that every molecular medium is the seat of the dissipation of energy, and is getting hotter at the expense of the motions which it transmits. Hence no perfect fluid can be molecular. So far as I can see, Prof. Challis intends his æther to be a perfect fluid, and therefore continuous (see p. 16 of his Essay), though he does not himself pronounce upon its intimate constitution.

Hansemann* makes his æther molecular, and in fact a gas with the molecules immensely diminished in size.

With regard to Mr. Mott's iron bar, when he pulls one end he diminishes, in some unknown way, the pressure between the particles of the iron, and allows the pressure of the æther on the other end to produce its effect.

N.B. This is only the language of a theory, and that theory not mine; nevertheless, I think it is consistent with itself.

Glenlair, Aug. 13 J. C. M.

Reflected Rainbows

I READ with great interest, in Prof. Tyndall's American lectures, a statement about the rainbow which appeared to me so extraordinary, that I determined to test it on the first opportunity.

The statement (I have not the book with me here, and give merely my recollection of the substance) is that, owing to the want of the necessary condition of parallelism the rays scattered from rain-drops cannot be so reflected as to show a rainbow by reflection from the surface of a lake.

Of course we all know that the same rainbow cannot be seen from two places at the same time, and therefore no one would

* Die Atome und ihre Bewegungen, von Gustav Hansemann. E. H Mayer: Coln, 1871.)

expect to see the *same* rainbow directly and by reflection. It is also reasonable to suppose that, as a rainbow is often seen from one place and not from another, a rainbow may often be seen directly and not reflected, or *vice versâ*. The reference to the necessary condition of parallelism shows that it is something more than these obvious deductions from the laws of reflection to which Prof. Tyndall wishes to draw attention in the passage mentioned. Until I tried the experiment described below, I imagined him to mean that there was something about the direction or arrangement of the rays of light producing a rainbow, which prevented their forming a rainbow or anything like one, after reflection from the surface of still water. It is not always easy to arrange so as to have a rainbow and a still lake to experiment upon. I managed, however, to get satisfactory substitutes in the spray bow at the falls of the Rhine near this, and a small pool of water. I was greatly disappointed on looking into my pool, to see reflected not only the scenery of the falls, but also a very fine spray bow.

What then can Prof. Tyndall mean? How is this peculiarity of rainbows to be observed? I have tried it in the only way of which I could think, but am now inclined to believe that I must have mistaken Prof. Tyndall's meaning.

Schaffhausen, Aug. 23 Z. X. Y.

The Origin of Nerve Force

ONE at least of the "obvious difficulties" which your correspondent, Mr. Henry R. Proctor, finds in my hypothesis as to the origin of Nerve Force, would scarcely have existed if he had directed his attention to a sentence in my article (NATURE, July 31), which runs thus: "In what are termed hot-blooded animals, that is, in mammals and birds, the difference of temperature between the surface and the interior is considerable under all natural circumstances, and in them there is a regulating action of the skin by which they maintain a uniform internal temperature, *always hotter than the surface*, whatever that of the external medium may be." The correctness of this proposition as regards the human being is now a physiological fact, as many observers from different starting points have arrived at the same conclusion; among others, my proof of it has appeared in the "Journal of Anatomy and Physiology" (vol. vi. November 1871). When the temperature of the atmosphere is above 70° F. the amount of perspiration is always proportionate to the temperature, and is sufficient to maintain the depths of the body at 98° or so. Below 70° the same condition results from the influence of cold on the cutaneous vessels, they contracting in proportion to the degree of cold, and so modifying the radiating and conducting power of the body surface. There is never therefore any reversal of the current, or a temperature at which it is *nil*.

Your correspondent's third paragraph contains an assumption, as great and not so reasonable as my own. Why should we have to assume that the body has to be kept at a constant temperature of 98° or so? There is no *a priori* reason in its favour. It may be said that the chemical changes which occur, being dependent on the properties of albumen, fibrin, &c., could not be continued under other circumstances. That, however, is only a shifting of the ground of argument, for it is much more reasonable to suppose that the properties of the animal tissues are the result and not the cause of the conditions under which they have been brought into existence.

I may mention that the physiological phenomena attending the immersion of the body in air and water of different temperatures are of quite a different character; they are scarcely comparable, and can be shown not to depend to any extent on the different conducting powers of the media, or their different specific heats. Immersion of the nude body in air of 30° is not rapidly fatal, even if the temperature is not kept up by violent exercise; and I cannot understand "immersion in water at 30°."

If the comparative coldness of the brain were the effect of absorption of heat in the building up of its elaborate texture, we should expect to find a similar condition in the muscles, which are also of very complicate construction. Such, however, is not the case, and therefore another explanation has to be found, which my hypothesis supplies.

Aug. 26 A. H. GARROD

The Flight of Birds

I HAVE just read with great interest, in NATURE of Aug. 21, Capt. J. Herschel's account (elicited by Mr. Guthrie's letter, vol. viii. p. 86) of his ocular and telescopic observations of Indian kites at rest in mid-air, and I am tempted to offer an explanation which occurs to me of the way in which that aërial balance may be maintained.

If there was no quiver of the wings perceptible "at an apparent distance of ten or twelve feet,"—if the very tips of the wings "looked as steady as those of a stuffed specimen,"—then certainly the theory of self-support by muscular action must be abandoned, and the problem is reduced to one in which we have only to consider the weight and shape of the bird with outspread wings and the velocity and direction of the wind.

If the direction of the wind is slanting upwards with moderate velocity, it is conceivable that a bird, facing the wind, with outspread wings in a plane inclined between the horizontal and the direction of the wind, might remain at rest, from the following considerations:—

If the air were at rest, the bird, with the plane of its wings inclined a little downwards and forwards, would not fall vertically, but would slide obliquely forwards down the air, like a returning boomerang, or an inclined sheet of paper let fall, and would reach the earth at some point far from the vertical. But suppose, instead of the air being at rest, there were a slant upward current of air meeting and balancing the slant fall of the bird: then the bird would remain motionless in mid-air.

Capt. Herschel rejects (perhaps too hastily) the notion of "slants of wind," and asks "what becomes of the horizontal force" of the wind. Surely its effect would be to balance the horizontally resolved portion of the bird's slant fall, just as the vertically resolved portion of the slant current of wind would balance the vertically resolved portion of the slant fall.

Different degrees of inclination and force of the wind might be met (within limits) by different degrees of slope and spread of the wings.

I must confess this is only theory. We want more observations, as keen and careful as Capt. Herschel's, to ascertain the force and direction of the wind attending this arrest of motion in mid-air. Slant currents are common enough on a small scale among house-walls, and on a larger scale we may see how the wind pounces down on a land-locked water, or presses up a mountain side. In a steady wind, the shapes of hill and valley must cause certain regular currents variously inclined to the horizontal, and some of these, I suppose, the eagles find and use. On the lee side of a hill (as in the case given by Captain Herschel) there would be a current rising from the eddy to join the main course of the wind. The conditions described by Mr. Guthrie were just such as would throw the wind into upward slanting currents.

We should want a well-balanced weather-cock with a double vane (one plate in a *horizontal*, the other in a vertical plane), to tell the *vertical* as well as the horizontal deviation of the wind.

Dacre Park, Lee, S.E., Aug. 24 HUBERT AIRY

Mallet-Palmieri's "Vesuvius"

MY absence in Spain during the months of March and April prevented my having seen NATURE for the 20th March, and left me until a few days since in blissful ignorance that it contained a lengthy critique by Mr. Mallet on my review (NATURE, Feb. 6) of his translation of "Palmieri's "Incendio Vesuviano." This accounts for my silence, as, had it not been the case, a reply from me would certainly have appeared at the time.

For, being "the reviewer reviewed," I suppose I am indebted to my habit of not taking advantage of a reviewer's privilege, but of signing my name in full, since I do not find that Mr. Mallet vouchsafed a reply to any other review of his book, not even to that contained in the *Geological Magazine* for March, which, as the organ of British Geological opinion, might be expected to have the preference over mine, even if its reviewer had not incurred special claims on Mr. Mallet's attention, by having handled his production in a vastly less tender manner than I had done.

In comparing the two translations of Palmieri's little pamphlet, I give preference to that in German by the eminent mineral chemist Rammelsberg, if for no other reasons, for its cheapness, and because the translator puts forth the work of the Italian professor entirely on its own merits as one which did not require to be heralded by any elaborate preface to make it take with the public, and also because it seems somewhat unfair to see the worthy Professor's excellent observations made a vehicle for introducing the public to what, although entitled "an introductory sketch of the present state of our knowledge of terrestrial vulcanicity," &c., is far from being such, and in greater part but a one-sided exposition of Mr. Mallet's own views of what he terms vulcanicity and vulcanology, and which, to quote one of his reviewers, "has really no connection with Palmieri's report."

It is unnecessary here to occupy space in splitting hairs over the exact definition of words, such as theory, hypothesis, force, &c., being quite content to assume that the readers of NATURE fully understood the sense in which I employed them; but when the abstracts published in the "Proceedings of the Royal Society" are generally admitted to be faithful reports of the main features of the Memoirs read before the Society, and here it is not a question of details, I ask any rational individual whether Mr. Mallet, merely because he considers the abstract of his paper as "most meagre and incomplete," is justified in using such words (p. 382) as "Mr. Forbes commences with an important error as to a matter of fact, by referring to 'Mr. Mallet's Dynamical Theory of Volcanic Energy,' as published in the Proceedings of the Royal Society for 1872."

When an author commits himself to print, he should also be prepared for the consequences; yet the tone of Mr. Mallet's critique evidently indicates extreme irritation in finding his views commented upon before his communication to the Royal Society is published in full, explaining in other words, that before this is done nothing is known about them—a state of things eminently suggestive, both that the scientific men who, he is pleased to inform us, have already expressed themselves in his favour, may, after all, have been somewhat hasty in so doing, and also that Mr. Mallet would have been more wise if he had withheld his self-laudatory sketch until the publication of the evidence in favour of his views had afforded the scientific world the opportunity of forming a mature judgment as to their soundness.

Volcanic rocks, or rather rock species, are commonly arranged under the two classes, Trachytic and Pyroxenic, names proposed by Bunsen as the equivalents of acid and basic, and it is hardly necessary to observe that when the mineralogical and chemical natures of rocks are to be compared, some such classification must be taken into account, since it would be as absurd to liken a trachytic to a pyroxenic rock as chalk to cheese; it must also be remembered that the same volcanic cone may emit lavas of both these classes, a fact observed by the Scientific Commission at the eruption of Santorin, when in exactly similar manner to many ancient outbursts, the trachytic preceded the subsequent and more abundant pyroxenic lavas. As regards the mineralogical and chemical constitution of unaltered volcanic rocks, nothing is more certain than that from whatever part of the world they proceed, they are essentially made up of a very limited number of mineral species, always the same, and the application of the microscope to petrology has now proved this to be the case also, when they are of so compact a texture as not to admit of their constituent minerals being distinguished by the naked eye. The examination of any large collection of volcanic rocks cannot fail to impress the observer with the wonderful similarity of the various rock specimens from one volcano to corresponding ones from others situated at the greatest distances; and ample evidence of this may be seen in the writer's extensive collection, the result of many years' labours in the volcanic districts of Europe, America, Australasia, and Africa, and in which, for example, specimens may be seen of trachytes from Auvergne, the Rhine, or the Andes, undistinguishable from one another when placed side by side, other lavas from Otaheite (where, however, Pele's hair is not found, as mentioned by Mr. Mallet), to all appearance identical with those from Etna, both of which volcanic districts he has had good opportunities for studying.

Pele's hair, from Hawai, in the Sandwich Islands, so called from its having been blown by the action of the winds over the surface of the molten lava into hairlike filaments resembling spun glass, is simply pyroxene, a mineral which, next to felspar, is the most common constituent of the lavas of all volcanos.

When, however, Mr. Mallet asks, "Are the ancient basalts and trachytes identical with the modern ones or with each other in different localities?" the answer to the first question is simply no, for the results of modern petrological inquiry tend to show, although no sharp line can be drawn, that the volcanic rocks which made their appearance in the successive stages through which our globe has passed, although more or less characteristic of the epoch, were analogous to, but not absolutely identical with, those which either preceded or succeeded them; and to the second question the reply is, that they are identical in mineralogical and chemical constitution, and often even approximate closely in percentage composition.

The well-known researches of Bunsen on the volcanic rocks of Iceland, followed up by those of Abich on those of the Caucasus, showed the simplicity and identity in chemical constitution of volcanic rocks, and the later results of trustworthy chemical analyses, not of fragments chipped off at random, but of such as represent the mass of the unaltered rock itself, are every day bringing forward more complete evidence of this being the case; this is, without doubt, well understood by Professor Palmieri, for the very words cited by Mr. Mallet, in which he mentions that "two specimens of the same lava appear indeed to have their constituents in different proportions" are qualified by stating that the observatory did not possess the means of arriving "at any conclusion" on this point, and by expressing the hope that Prof. Fuchs, who had specially devoted himself to this subject, would, by employing "well selected and sufficiently large specimens," obtain satisfactory results. Not only do all chemists and mineralogists know that there may exist a considerable difference in the percentage composition of mineral species which are of identical chemical constitution, but in answer to Mr. Mallet's questions as to iron blast-furnace slags, every scientific metallurgist will admit that the basis of good smelting, necessitates the production of slags having a constant and definite chemical constitution, and that not only should the slag from every two tappings be identical in this respect, but that so long as the furnace works properly, and the same materials are charged into its mouth, the same slag will also flow from its hearth; many years' practical experience in the management of blast-furnaces, and the numerous analyses of slags which I have made, some of which will be found published as far back as 1846 in the British Association reports on the crystalline slags, have not only fully satisfied me on this point, but shown me examples of iron blast-furnaces, which, from their having been constantly fed with precisely the same ore, fuel, and flux, have not only for successive tappings, but for years, produced slags, not only identical in chemical constitution, but in which the percentage of the constituent silica and bases have only varied within extremely small limits.

When Mr. Mallet, however, asks such questions as whether the *crystalline* minerals of volcanic rocks are identical, and furnishes in his critique the most ample evidence of his confounding chemical constitution with percentage composition, ignoring altogether the laws of isomorphism and the substitution of bases, I believe mineralogists will absolve me from taking up more space in discussing further these questions. The implication of being unacquainted with the works of von Waltershausen, Senft, Blum, and my good friend Zirkel, which have been in my hands, I might almost say warm from the press, is easily disposed of, as numerous references will be found to them in my published papers; curiously enough, not long back I referred in a paper to opinions of von Waltershausen which are diametrically opposed to those held by Mr. Mallet; in the *Geological Magazine* for 1867, p. 227, references will be found to the other three works. If Mr. Mallet's knowledge of recent petrology is based upon "Blum's Handbuch der Lithologie," which he recommends "above all," I would remind him that this work, although a very excellent one when it was written in 1859, is now quite antiquated, this branch of mineralogica science being then, as it were, only in its cradle as compared to the great advances which have been made during the last eight or ten years: "von Waltershausen vulkanische Gesteine" appeared still earlier, in 1853.

I would remark that neither in this communication, nor in my review, was it the intention to take into consideration Mr. Mallet's theory of volcanic energy, and it was only alluded to because, in his introductory sketch, he so altogether overlooked those explanations which, notwithstanding his reply, will still be demanded by chemists, mineralogists, and geologists, before they can accept his views; I still object most strongly to the tone and style of his introductory sketch, and I am not alone in doing so.

Thornton Cottage, Aug 8. DAVID FORBES

Explosion of Chlorine and Hydrogen

SOME time ago, being desirous of showing a class the explosion of chlorine and hydrogen by artificial light, I devised a simple method which was perfectly successful. Equal volumes of the two gases, prepared separately by the usual methods, were mixed in a stout test tube and confined by a greased cork. This was placed upright on a little wooden stand, and kept in its place by a brass clip. About an inch of magnesium ribbon was suspended in a small tin shade by means of a wire clip. The magnesium being placed near the tube and lighted, the gases united with a report, jerking the cork to the ceiling, but in no case breaking the tube. W.

A NEW BUBALE, FROM ABYSSINIA

THE British Museum has just received a series of skins of a new Bubale from Abyssinia called Tora. It is like the Hartibeest for having a white patch on the rump, and white inside the ears, but it is without any black on the face or on the outer side of the limbs. It is of a bright pale bay colour, with black tuft on the tail, and the horns are much more slender than in the Hartibeest. I propose to call it *Alcephalus tora*.

J. E. GREY

FROM AMERICA TO ENGLAND BY BALLOON

THERE appears every likelihood that before the end of the year a feat will be attempted which seems to have been first seriously proposed thirty years ago by Prof. Wise, an American aëronaut, who is now making preparations to cross the Atlantic to England in a monster balloon. The American correspondent of the *Standard* has given full details of the elaborate construction of this balloon, and states the reasons which inspire Prof. Wise with unhesitating confidence that he will be able successfully to accomplish his aërial voyage.

The balloon, when completed, will be 160 ft. high, and the globe will be over 100 ft. in diameter. It will be able to lift from the ground, including its own weight, 14,000 pounds, and will have a net carrying capacity for passengers and ballast of 6,900 pounds. It will contain 600,000 cubic feet of illuminating gas, though only 400,000 feet will be put into it to allow for expansion in the higher regions of the atmosphere. The other details of construction are most elaborate, and every precaution seems to be taken to insure success and to provide for the safety of the four persons who are bold enough to risk their lives to gratify their curiosity and endeavour to increase the sum of human knowledge. The four voyagers will be Prof. Wise, Mr. Donaldson, an agent of the *Daily Graphic*, and a skilled mariner—for a copper-fastened cedar lifeboat, 22 ft. long and 4½ ft. beam, forms part of the appurtenances.

The hypothesis on which the enterprise is projected, is that there is a prevailing east-going current of air at an attainable elevation, in which a balloon can pass eastward from the American continent to Europe. The current is believed to be half-a-mile or more above the surface of the earth, and to move at the rate of from 50 to 150 miles an hour. It was a knowledge of this current that made Mr. Charles Green, the celebrated English aëronaut, say, in 1840, that he should start from America rather than from England to traverse the Atlantic in a balloon. The cause of the current is less definitely known than the fact. A French *savant* attributes it to "a decrease of participation in the rapidity of the rotary motion of the earth." Prof. Wise believes that this upper current of air, in the temperate zones, moves from west to east, because of the mingling of the south-west and north-west trade-winds in their circuits, in accordance with the laws of temperature and the aërial motion of the earth. The two currents, he believes, slide over each other, and the balloonist who knows his business can strike such a point as will carry him eastward, as it were, between them. That is to say, the zone lying between the 35th and 36th parallels is "a nodal zone," in which the south-west and north-west winds induce an intermediate current which moves nearly due east. In this highway the motion is about a hundred miles an hour.

The theory of the east-going current seems to be pretty well admitted. The direct experience which bears most strongly upon it is limited. There are three memorable balloon trips which are noteworthy. The current seems to set persistently eastward, deflected slightly towards the north by the rush of equatorial air towards the north. Prof. Wise, in 1859, in his trip from St. Louis to Jefferson county, in the State of New York, found the current almost due east; he travelled in balloon 1,156 miles in 19 hours. The speed here was only 61 miles an hour; but this can be accounted for. The great balloon voyage made by Nadar from Paris to Hanover was almost due eastward. This journey of 600 miles was made in about six hours—about a hundred miles an hour, although it was over the uneven surface of the Continent, diversified by hill, vale, stream, and so on. In the trip of Mr. Green, from London to Wellburg, in Nassau, the journey was about 600 miles, and was performed at the rate of about a hundred miles an hour, and there were the British Channel and other irregularities in the way of smooth sailing.

On the other hand, however, Mr. Glaisher in his experiments, in consequence of what Mr. Green had stated with regard to the constant prevalence of a current from the west, paid special attention to this point, and in his reports to the British Association in 1863 and 1864,* collected together the different directions in which the balloon had moved at different heights in his several ascents. From these it appears that the direction of the wind was quite as capricious at heights exceeding 5,000 ft. as it is on the surface of the earth. In Mr. Glaisher's winter ascents he did generally meet with a current from the south-west, certainly; but the number of such ascents was not great, and they were not to sufficient elevations to afford very trustworthy results. It is certain, however, that if there existed over England anything like a current of air constant in direction, it must have manifested itself distinctly in the course of Mr. Glaisher's thirty ascents, in all of which the direction of the wind at different elevations was a subject of careful observation.

Again, Prof. Newton of Yale College has written a letter to a recent number of the *Daily Graphic*, in which, from the observed behaviour of the luminous trains sometimes left by the brighter meteors at from forty to seventy miles high, he draws certain inferences which do not seem altogether favourable to Prof. Wise's theories. What these inferences are will be seen from the conclusion of his letter:—

"We have, then, at the *bottom* of the atmosphere, inconstant winds. We have just above us strata of air moving in diverse directions, for the lower clouds may move one way, the upper clouds another, while at the surface the winds may perhaps blow in a third. At two islands at short distances from each other we often have different winds.

"Again, we have for air near the top of the atmosphere, at least so high up that the density is exceedingly small, this fact, that lines (usually inclined to the horizon) only five or ten miles long almost always have their ends in air that is moving in different directions.

"Between the highest cloud and the lowest meteor trains lies an unknown region. It may be that here are uniform westerly winds. In the absence of direct observation neither this nor the contrary may be asserted. But it seems to me more rational to suppose that the complex system of currents at the bottom of the atmosphere is in direct connection with that at the top, and that there is a like complex system of currents and winds throughout the intermediate space. Of course, the general drifting of the air in the temperate zone to the east is unquestioned.

Prof. Joseph Henry, of the Smithsonian Institution,

* British Association Reports, 1863, p. 507, and 1864, p. 313.

who has had thirty years of observation in this direction, says:—

"'All the observations that have been made in the motions of the atmosphere, as well as the deductions from theoretical considerations, lead to the conclusion that the resultant motion of the air around the whole earth, within the temperate zones, especially about the middle of them, is from west to east.' Prof. Watson, the distinguished astronomer of the Michigan University, writes, 'I beg to say that there ought to be a strong current of air moving eastward in the upper regions, and that the experience of aëronauts goes to show that what the theory predicts actually exists. It seems to me quite possible to make an aërial voyage to Europe, and with great rapidity.' William H. Wahl, secretary of the Franklin Institute at Philadelphia, writes, 'I believe that, generally, Prof. Wise's proposition, concerning the existence of the elevated easterly current, is correct, and the same view is entertained upon theoretical grounds by meteorologists.' To the same effect writes Prof. Brocklesby, of Trinity College, author of 'Elements of Meteorology,' a work recognised as the best elementary text-book on the subject."

Still Prof. Henry is by no means enthusiastically in favour of seeing the dangerous voyage undertaken; he speaks of it as at the best extremely hazardous, and would prefer that some one else in whom he is less interested than he is in Prof. Wise would undertake the risk. His letter to Mr. Wise, in which he thus speaks, is worth quoting for its meteorological value. He says—

"I have no doubt of the fact that, if your balloon can be sustained in the air sufficiently long, a voyage might be made across the Atlantic; but this is the point which, it would appear to me, from my partial knowledge of what has been accomplished in the art of ballooning, is yet to be satisfactorily established. No one, however, has had more experience in the art than yourself, and you ought not to venture on the hazardous voyage without the fullest assurance that the balloon can be sustained at the requisite elevation for, say, ten days.

"I think it probable that over the ocean at a considerable elevation, the tendency to meet adverse currents will be less than over the land; on the other hand, however, there will be a chance of meeting a cyclone, which might carry you around a circle of several thousand miles, and throw you back over the coast of the United States, since you would be most likely to meet the northern portion of the great whirl, which would be moving in the western direction, the only possible escape from which would be by ascending to a very high elevation. The higher temperature of the Gulf Stream tends to produce an ascent of air above it during the colder months of the year, but in summer this effect would scarcely be perceptible.

"Your remark in regard to the greater velocity of the easterly motion of the balloon at night is in accordance with meteorological principles, since at this period the unequal heating of the earth by the direct rays of the sun does not take place, and hence adverse currents are not as frequent. The cooling of the atmosphere in that part of the earth which is in the shadow will tend to produce at the surface of the earth, after sunset, a westerly current, while at a certain elevation above the earth, the current would at the same time be in an opposite direction. In the morning, just before and after sunrise, the current at the surface of the earth, produced by the cooling, would be eastward, while that in the atmosphere above would be westward."

There can be no doubt that this daring expedition, whether it descends without mishap on the shores of Europe, or comes to grief in the middle of the Atlantic, will add something to our knowledge of the atmosphere; but many will no doubt think that all the knowledge that will be acquired by this sensational and hazardous method might be acquired by safer and more ordinary methods. We certainly, with all our heart, wish the enterprise complete success; but we think it very pertinent to refer to some remarks on the project in *La Nature* by the experienced balloonist, M. G. Tissandier. After referring to the theory of the easterly current in the atmosphere, M. Tissandier says, "We leave to the aëronaut all the responsibility of this hypothesis, which appears to us to be based upon vague conjectures; we should have a little more confidence in the resources which he expects to find above the Gulf Stream. This warm river, which traverses the extent of the Atlantic, should draw along with it a current of air, which the aërial navigator might take advantage of.

"We do not doubt the good faith of the aëronaut, who has already proved himself to be possessed of boldness and courage, but we believe he has not maturely considered the problem he proposes to solve. To go from New York to England, the aëronaut must travel a space of about 5,500 kilometres. Suppose that exceptional good fortune favours him, that a favourable wind, of mean intensity, having a speed of ten metres per second, blew regularly from west to east, without deviation, he must necessarily sojourn in the atmosphere six or seven days at the least, since the distance traversed in twenty-four hours will be, according to our hypothesis, 864 kilometres. But can an aërostat, no matter how voluminous it may be, constructed under existing conditions, and notwithstanding its complete impermeability, remain in the atmosphere for seven days? To this we reply, with the utmost confidence, in the negative. In fact, when a balloon quits the earth, as it rises a part of the enclosed gas is at once expelled by the dilatation due to the diminished pressure of the atmosphere; but the aërostat soon plunges into regions where the temperature is much lower than that of the strata of terrestrial air which it has left. The cold contracts the gas, the balloon loses its ascending power and descends. To maintain it at the level it has reached, it is necessary to diminish the weight, and the aëronaut throws out ballast. If he pass a first night at great altitude, it is certain that he will be thus obliged almost continually to lighten his craft. Next morning, as the sun rises, the bright burning rays heat the gas contained in the aërostat. The balloon, which had partly collapsed during the night, begins to fill out, the loose material stretches like the head of a drum, and it mounts into the higher regions of the atmosphere. It is now that the aëronaut will feel the want of a portion of the ballast he was obliged to cast away during the night. If the sun is hot, the balloon will rise so high that it will be necessary to moderate its ascent by letting off some of the gas. During the second night the reverse process takes place. This time the aëronaut has no longer the same resources as before; the ballast, which is his life, is being continually exhausted. I willingly admit he may have sufficient for the second and even for the third night; but will he have enough for the sixth and seventh night, if the differences of temperature of day and night are considerable, as is probable? The moment will soon come when the sacks of sand will be empty; the balloon will descend without any means being able to hold it back. But instead of encountering a hospitable soil, it strikes against the crest of the waves. The anchor instead of biting, will plunge in vain in the waters; if the wind is violent, in spite of their life-boat, the voyagers may be prepared for a most horrible fate. The aërostat will be piteously raised by the wind, and the terrified train will shoot from wave to wave over the surface of the ocean. Unusually clever will be the men carried along by such a force, if they could manage to find the means of detaching the life-boat."

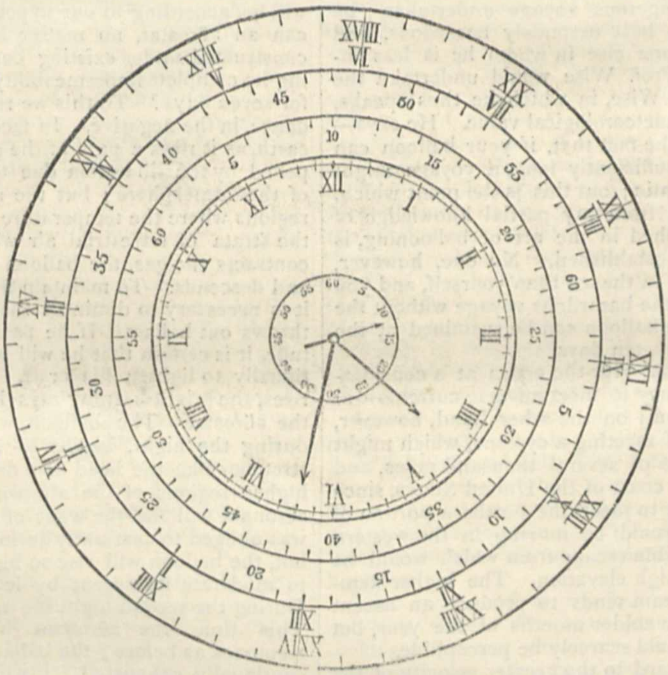
It is certainly true that it would be very difficult to sustain a balloon at a considerable elevation for six days (if the height of the balloon is a matter of indifference, the guide rope as used by Green would be quite sufficient to answer this purpose, even with an ordinary balloon), but we think the management of the balloon may be very well left to Prof. Wise, whose opinion on all practical points of aërostation is probably of more value than that of any other man living. Of all the persons who have devoted themselves professionally to ballooning as a source of income, Prof. Wise is certainly the ablest, and his work on Aëronautics shows him to be possessed of considerable scientific claims. The project could not, therefore, be in better hands; and considering the originality and boldness displayed by Prof. Wise in several of his very numerous ascents, there is every reason to believe that nothing will be left undone to bring it to a successful issue. In all the technical matters relating to the balloon, therefore, Prof. Wise may be well trusted to take the best course; and with regard to the meteorological questions involved by consulting not only American meteorologists but also Mr. Glaisher and other gentlemen who have studied the question of the winds in relation to aërostation, it is clear that he intends to leave no stone unturned to obtain the best information attainable, and, at all events, merit success.

MAYNE'S SIDEREAL DIAL

THIS instrument consists of two moveable circles, which may be made of brass or pasteboard, placed in a common watch-case. The lower and outer one shows the hours doubled up to XXIV., and divided into quarters. The upper one, which is also inner, shows the sixty minutes, 5, 10, &c. This circle is a narrow one, and works on the plain inmost rim of the lower one, so as to admit of the hours being seen outside the minutes.

Each circle being set to show at the top of the case, where the XII. of the watch comes, the "Sidereal Time at Mean Noon" (given in the Nautical Almanack for each day in the year), the watch is placed in the case, and will continue to show the sidereal time corresponding to mean time approximately for six hours, after which interval the minute circle should be *put on* one minute to ensure greater exactness.

This will be found a near enough approximation for the amateur observer, using an equatorial instrument, and this simple method will be found to save an infinite amount of trouble *in finding objects whose R.A. is recorded in a catalogue, to those who, like the inventor, are unprovided with a sidereal clock.*



Mr. Norman Lockyer has suggested as an improvement, the use of a watch with the *seconds'* hand in the centre; this would necessitate a third, and still inner circle for the sixty seconds, by which, indeed, subject to an hourly correction of, say ten seconds being *put on*, the dial would be rendered accurate enough for rough transit observations; and this circle and *seconds'* hand have been added to the original design in the woodcut, where the dial is set to V. (3/4) 47·10, the Sidereal Time at Mean Noon for the 18th June, 1873, the hands of the watch representing IV. (1/2) 32·12, which gives the corresponding Sidereal Time X. 19·22 (or applying the last-named correction, say 45 seconds for 4½ hours), X. 20·7.

It is as well perhaps, though scarcely needful, to add (for no one would be likely to make a mistake of 12 hours) that as the dial in the Example also reads XVII. (3/4) 47·10, and as the mean time by the watch may be A.M. or P.M., the observer should bear in mind which half of the 24 hours, both astronomical and mean, he is working in.

The third or *seconds* circle is not indispensable, as the seconds hand, even in the ordinary position, can be made to fulfil its object, by setting it at noon to the Sidereal Second on the meridian; thus, in the Example, it would be set to 10, instead of to Zero, when the dial is set at noon, the correction for the equivalent of the lapsed interval being applied subsequently as required. But this involves altering the watch, which is objectionable; the use of the third, or *seconds'* circle, is therefore recommended, for although the seconds' hand, as placed in most watches, would not actually *point* to the Sidereal second, it is easy to refer the *position* of the mean second to the corresponding part of the watch's face, where the third circle can be read off at once.

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ON THE SCIENCE OF WEIGHING AND MEASURING, AND THE STANDARDS OF WEIGHT AND MEASURE *

IV.

THE IMPERIAL STANDARD YARD

THE immediate superintendence of the construction of the new standard yard was entrusted, in the first instance, to Mr. Baily, who conducted all the preliminary investigations and experiments. After his death in August 1844, it was undertaken by Mr. Sheepshanks, by whom and under whose direction by far the largest proportion of the actual operations was carried out, and all the comparing operations of the several standards of length made, up to the period of his death in August 1855. By this time the work was so far completed that not a single additional comparison of line measures was required. The detailed account of the construction of the new standard yard, and its verified copies, was then undertaken by the Astronomer Royal, with the aid of the documents left by Mr. Baily and Mr. Sheepshanks; and the winding-up of the work of the Commission, and the distribution of the scientifically verified copies of the standards also devolved upon the Astronomer Royal, as the chairman. The magnitude of the operations may be estimated from the fact of the number of micrometer readings for all the comparisons exceeding two hundred thousand; and amongst the operations it was found necessary to construct an entirely new system of thermometers. It should not be forgotten that the scientific gentlemen who bestowed so much of their valuable time, attention, and labour, during several years upon the experiments and observations for the important object of the restoration of the national standard of length, declined to accept any pecuniary remuneration.

The length of the new standard yard was determined in a similar manner to the determination of the weight of the new standard pound, by taking the mean length of the most authoritative standards which constituted the best primary evidence of the lost standard yard.

This standard measure of length had been constructed by Bird, in 1760, under the directions of the Committee of the House of Commons on Weights and Measures, first appointed in 1758. Its length was taken from a similar yard which had been constructed by Bird in 1758.

FIG. 8.—Standard Winchester Bushel of Henry VII ⅛ size.

Each of these standard yards consisted of a solid brass bar 1·05 inch square in section, and 39·73 inches long. Near each end of the upper surface gold pins or studs 0·1 inch in diameter were inserted, and points or dots were marked upon the gold to determine the length of the yard. The comparing apparatus in use at that period consisted of a beam compass with two fine measuring points, which could be adjusted to the dots on the standard measures under comparison. But the result of numerous comparisons of this kind made from time to time previously to the destruction of the standard in 1834, had been to leave the edges of the holes indented and irregularly worn away, so that the original centre was very difficult to ascertain. Mr. Baily, who had made some comparisons with this standard yard in the early part of the year 1834, describes the holes as appearing, under a microscope, like the miniature crater of a volcano.

The length of the standard yard of 1758, had been based upon that of the then existing Exchequer standard yard, which had been constructed in the reign of Queen Elizabeth in 1588, and upon the length of the Royal Society's standard yard, constructed as a scientific standard measure in 1742. It had been determined, upon comparison, to agree as nearly as possible with these two authoritative measures of a yard.

The two standard bars of 1758 and 1760 were found amongst the ruins of the Houses of Parliament, but they were too much injured to indicate the measure of a yard which had been marked upon them.

Bird's standard yard of 1760 had been left in the custody of the clerk of the House of Commons, and no legal authority was given to it as a standard of length until the passing of the Act 5 Geo. IV. C. 74, in 1824, already referred to. Meanwhile, other scientific standards of length had been constructed which may now be noticed.

In 1785, the first geodesical operations were begun, upon which the Ordnance Survey of the United Kingdom has since been founded, by General Roy's measurement of the base on Hounslow Heath. The standard used in the first instance for that purpose was that known as General Roy's scale, 42 inches in length, and constructed by Mr. Bird. This scale was based, not on the legal Exchequer Standard, but upon the Royal Society's scale, with which the whole length of the first 36 inches of General Roy's scale was compared, this constituting the *Ordnance yard.* Two standard yards of superior construction, belonging to the Ordnance Department, were placed at the disposal of the Standards Commission.

* Continued from p. 329.

These were bars of iron, and line standards, the lines being marked on gold pins at mid-depth of the bar, notches being cut in it for that purpose. They had been compared with the imperial standard in 1834, and a statement of their comparison was published in 1847 in the account of the measurement of the base at Lough Foyle.

Towards the close of the century, some important scientific operations for the improvement of the standards were undertaken by Sir George Shuckburgh. In 1796, a new standard measure subdivided in fine lines, and since known as "Shuckburgh's scale," was constructed under his direction, by Mr. Troughton, together with a new comparing apparatus carrying micrometer microscopes. This is stated to have been the first occasion on which this mode of optical comparison was employed, being substituted for the beam compasses previously used. The Shuckburgh scale, which is now in the possession of the Royal Society, consists of a brass bar 67¾ inches long, 1·4 in. wide, and 0·42 in. thick. It is a scale of 5 feet, divided by lines into feet, inches, and tenths of inches, each inch being numbered. It was adopted by the Standards Commission of 1819 as the scientific standard of length, as distinguished from the legal standard of the Exchequer. The length of the yard was laid down on the Shuckburgh scale from Bird's standard, and it had also been accurately compared with each of the other standard yards previously mentioned, and their lengths had been transferred by beam compasses to the Shuckburgh bar.

In pursuance of the recommendation of the Royal Commission of Weights and Measures appointed in 1819, and of the Act of 1824, passed to carry their recommendations into effect, a new Exchequer standard yard for regulating commercial measures of length was constructed under Capt. Kater's superintendence. It was not, however, laid down from the legal standard yard, which, together with the legal standard pound, remained in the custody of the Clerk of the House of Commons, but from the length 1—36 in. of the Shuckburgh scale, which was considered by Capt. Kater to be identical with the imperial standard.

The official standard yard constructed for the Exchequer, under Capt. Kater's superintendence, in 1824, and intended for the verification of the local standard yards used by inspectors for comparing trade measures, consists of a slender brass rod with two wooden handles, as an auxiliary end measure, and a bed measure, being a bar of brass one inch square with rectangular steel terminations of the same width projecting above the surface of the bar. The distance between the interior faces of the steel terminations is intended to be equal to the length of the imperial yard. This yard bed and rod were used together from 1825 to 1870, for verifying all the local standard yards of similar though ruder construction. A standard yard, with the legal subdivisions marked upon it, and of improved construction, having a convenient comparing apparatus attached to it, has since been substituted, and is now used in the Standards Department.

Four other standard yards of more scientific character were also made under Capt. Kater's directions, and are now in the Standards Office. These bars of brass are of the same width and thickness as the Shuckburgh Scale, and have the length of the yard defined by fine points upon gold studs in the middle axis of the bar, the thickness of the bar being reduced at its extremities one-half with this object. All these standard yards were constructed by Dollond. By an ingenious contrivance the point at one end of the bar, not being placed exactly in the centre of the circular gold stud, was made susceptible of adjustment, by turning the stud round; and after final adjustment of each yard and repeated comparisons with the Shuckburgh Scale, no perceptible error could be detected in any of them. A similar standard measure made for the Royal Society in 1831 was considered by the Commission to be the most favourable type of Kater's yard.

Having thus described the principal standard yard measures then existing, we may return to the operations of the Standards Commission. For determining the true length of the new standard yard, a provisional standard yard was employed by Mr. Sheepshanks. This was a new brass bar, called by him "Brass 2," and was accurately compared by him with the standards deemed to be the most authoritative, and which had been *directly* compared with the lost standard, viz. Shuckburgh's scale, Kater's yard made for the Royal Society, and the two Ordnance yards. The results in terms of the lost imperial standard were as follows:—

	In.		
Brass bar 2	= 36·000084	by comparison with	Shuckburgh scale 0–36 in.
,,	= 36·000280	,,	,, 10–46 in.
,,	= 36·000229	,,	Kater's Yard of 1831.
,,	= 36·000303	,,	Ordnance Yard, No. 1.
,,	= 36·000275	,,	,, No. 2.
,,	= 36·000234	by mean of all.	

Mr. Sheepshanks preferred 36·00025, as being sufficiently near the truth, and in constructing the new standard, he assumed as the basis of his proceedings—

FIG. 9.—Standard Wine Gallon of Queen Anne, ¼ size.

Brass 2 = 36·00025 in. of lost imperial standard, at 62° Fahr., and this conclusion met with the assent of the Commission.

In the construction of the new standard of length, the following decisions were made by the Commission:—

1. The length of one yard to be the standard unit of length.

2. After considering whether the measure of length should be defined by the whole length of the bar, that is to say, an *end-standard*, or by the distance between either two points or two lines marked upon the bar, a *line-standard* was adopted in preference.

3. For the material of the bar, gun metal or bronze composed of

Copper	16 parts
Tin	2½ ,,
Zinc	1 ,,

was adopted after a series of experiments by Mr. Baily, and was recommended by him as containing the properties most essential for the construction of a standard intended to last through many ages, viz., almost perfect immunity from rust, with proved elasticity and rigidity.

The test bar of this alloy, when loaded at the centre with $5\frac{1}{2}$ cwt., broke without bending.

4. The form of the standard to be a solid bar 38 in. long, and 1 in. square in section. The measure of a yard to be defined by the distance between two fine lines perpendicular to the axis of the bar, marked upon gold studs at the bottom of cylindrical holes drilled from the upper surface to the mid-depth of the bar.

The gun-metal, or bronze, thus adopted for the new standard, has since been known as "Baily's metal," and this designation is engraved upon the Imperial standard yard.

In order to select the most perfect specimen for the new standard of length, 40 line-standard yards were constructed of Baily's metal, and one of these was finally selected as the Imperial standard, not only from its representing, with the greatest precision, the assumed length of the lost standard yard, but also from the clearness of its defining lines, and from its general good workmanship. Four of the remaining yards nearest in length to the new standard were selected as Parliamentary copies, and deposited in the same places as the Parliamentary copies of the standard pound already mentioned; and the rest were in like manner distributed amongst different countries and public institutions in this country.

Several other similar line-standard yards were also constructed for experimental purposes, being accurately verified by Mr. Sheepshanks, and were disposed of in like manner, viz.

The defining terminations of these end-bars consist of a plug of agate, slightly conical and shrunk into a similar conical hole at each end of the middle axis of the bar. The ends of the bars are ground and polished in a spherical form, the centre of the spherical surface being the middle of the bar.

All the numerous comparisons of the standard yards were made by Mr. Sheepshanks in one of the lower cellars at Somerset House, under the apartments of the Royal Astronomical Society, where the new micrometrical comparing apparatus constructed for the purpose by Messrs. Troughton and Simms, was fixed.

A full description of the comparing apparatus will be given under head V. of Weighing and Measuring Instruments, and their Use.

The Commission for restoration of the standards having terminated their labours, recommended in their final report that the new imperial standards of the yard and pound be deposited at the Exchequer Office, there to be preserved under such regulations as to Parliament might appear fitting. In expressing their adherence to the recommendation of the Committee of 1841 that no reference should be made to natural elements for the values represented by the standards of weight and measure, they also recommended that so much of the Act 5 Geo. IV. c. 74, as provided for the restoration of the standards in the manner therein provided be repealed, and that the standards should in no way be defined by reference to any natural basis, such as the length of a degree of the meridian on the earth's surface in an assigned latitude, or the length of a pendulum vibrating seconds in a specified place. They considered the ascertaining of the earth's dimensions and the length of the seconds pendulum in terms of the standard of length, and the determination of the weight of a certain volume of water in terms of the standard of weight, as scientific problems of the highest importance, to the solution of which they trusted that Her Majesty's Government would always give their most liberal assistance, but they did not urge them on the Government as connected with the conservation of standards.

These recommendations were carried into effect by the Act of 1855, 18 and 19 Vict. c. 72, for legalising and preserving the restored standards of length and weight, sec. 1 of which repealed the provisions of the Act of 1824 concerning the restoration of the standards by reference to the pendulum and to the weight of a cubic inch of water.

Under the provisions of the Act of 1855, the imperial standards were deposited in 1855, in the office of the Exchequer. On the consolidation of the ancient Office of the Exchequer with the Audit Office in 1866, and the creation of the Standards Department of the Board of Trade, under the Standards Act, 1866, 29 and 30 Vict. c. 82, the custody of the imperial standards was transferred to the Warden of the Standards, the head of the new Standards Department, and the imperial standards are now deposited in a fireproof iron chest in the strong room in the basement of the Standards Office, which has been specially adapted for their safe preservation. Provision is contained in the Act for the comparison once in every ten years of the three Parliamentary copies of the imperial standards deposited at the Royal Mint, in charge of the Royal Society, and in the Royal Observatory, Greenwich, respectively, with the imperial standards of length and weight, and with each other. Under this Act new scientific duties were also imposed upon the Standards Department, the Warden of the Standards being charged with conducting all such comparisons, verifications, and other operations with reference to standards of length, weight, or capacity, in aid of scientific researches or otherwise, as may be required.

In connection with the question of the derivation of a standard unit of length from a natural constant to be found in the ascertained dimensions of the earth, it may be added that Sir John Herschel has pointed out the fact of the length of the polar axis having been determined, from the combined results of all the scientific measurements of arcs of the meridian, to be equal to 500,482,296 inches of our imperial standard yard, and that if one five-hundred-millionth part of the polar axis were adopted as a new standard unit, to be called the "geometrical inch," it would differ from the imperial inch less than one-thousandth part of an inch; a difference so small as not to be measured by any ordinary method, and only by the aid of the nicest scientific instruments. For all "ordinary practical purposes," the geometrical inch would be identical with the imperial inch; whilst for high scientific measurements for astronomical purposes, it would connect by an unbroken numerical chain the small units with which mortals are conversant in their constructions and operations with the great features of nature, and more especially with those greater units in the measurements of the universe with which astronomy brings us in relation. It would also produce a more exact ratio between our units of length and weight, the avoirdupois ounce being nearly a "geometrical ounce," or one-thousandth part of the weight of a geometrical cubic foot of distilled water. That is to say, whilst the existing legal weight of a cubic foot of distilled water is 997·136 ounces, the weight of a geometrical cubic foot of water would be 998·1 ounces. And as the imperial half-pint is the measure of ten ounces of distilled water, the ratios of these units of length, weight, and capacity would thus be brought within such practical limits of precision as would meet every possible requirement of commercial exigency.

III.—*Derived Units and Multiples and Parts of Imperial Standard Units.*

The Imperial Standard Gallon and Bushel.

With respect to measures of capacity, the sole unit of all imperial measures of capacity, established by the Act of 1824 is the standard gallon, containing 10 lbs. avoirdupois of distilled water, weighed against brass weights in air at the temperature of 62° Fahr., the barometer being at 30 inches. From the imperial standard gallon is derived the imperial bushel of 8 gallons, the standard of capacity for dry goods commonly sold by heaped measure, or incapable of being striken. Various units of measures of capacity had been previously established in this country at different periods. In Magna Charta, three such units are recited, "there shall be throughout our realm, one measure of wine, one measure of ale, and one measure of corn." Of these, the most ancient known was the Winchester corn bushel, of the capacity of about 2150·42 cubic inches, together with the Winchester corn gallon of 272¼ cubic inches. We have no record of any other standard measures of capacity being actually constructed, until the standard ale gallon of 282 cubic inches was added by Queen Elizabeth, and the standard wine gallon of 231 cubic inches by Queen Anne. All these old standard measures were discontinued as legal measures in 1824, and the new imperial standard gallon of 272·274 cubic inches, and the bushel of 2218·191 cubic inches, constructed and verified under Capt. Kater's superintendence, have since continued to be the standard units of imperial measure for liquids and for dry commodities.

The Exchequer standards of the imperial gallon and bushel formed part of the complete series of secondary standards constructed and accurately verified under Kater's superintendence in 1824. These standards, together with other secondary standards, subsequently legalised, have served for regulating all the commercial weights and measures of Great Britain and her colonies and dependencies from 1824 up to the present time. The Exchequer standards were transferred to the Standards Department of the Board of Trade in pursuance of the Standards Act, 1866.

H. W. CHISHOLM

(*To be continued.*)

THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE session of this young Association which has just been concluded at Lyons appears to have been altogether successful, and according to the Reports read the Association is in an exceedingly prosperous condition, both as to number of members, income, and the carrying out of the scientific aims which it has in view. The number of members who attended the Lyons Congress was very satisfactory. The capital fund at the end of 1872 was 136,464 francs, and the income for 1873 is expected to be 24,000 francs. One of the aims of the Association is to give an impulse to Science in the provinces, and, as we recorded some time ago, the members of the Association resident about Bordeaux have formed a local association, and it is hoped a similar result will follow in the case of each town where the yearly meetings are held. The Association has received invitations for its next session from various French cities, and it has been decided to hold the meeting of 1874 at Lille. M. Wurtz was elected President for the ensuing year.

The accounts which have come to hand are mainly concerned with the work done in the Medical Section. Last week we gave a few extracts from the Presidential Address of M. De Quatrefages, and shortly we hope to be able to give a *résumé* of the work done in the various sections, as well as of the more important public lectures. Meantime we shall give a brief sketch of the general work which has been done.

In the general meetings, Dr. Blanc, an Indian military surgeon, read an important paper "on the means of arresting the propagation of cholera," founded on experiments made by himself. M. A. Gaudry, Professor at the Jardin des Plantes, Paris, gave a lecture on a botanical subject. Dr. Bertillon also gave a lecture on "Demography," *i.e.* the Natural History of Society. M. de Lesseps talked in a familiar and pleasant way of the proposed railway across Central America. M. F. Papillon read a paper on the connection between the Sciences and Metaphysics, and the Abbé Ducrost gave a lecture on the Prehistoric Station of Solutré.

The part of the Congress which is undoubtedly the most attractive consists in the excursions and the public lectures; the former interest strangers, and the latter, members. Besides the special excursions organised by certain sections and parties of members, there have been three general excursions—one to the prehistoric station of Solutré; a second to the sides of the plateau of Les Dombes; a third to the mines and furnaces of Voulte-sur-Rhône, in Ardèche, and a fourth, which set out last Friday and was to last for two days, to Geneva and the shores of its lake.

There have been three public lectures: the first was given by M. Karl Vogt, of Geneva, on Volcanoes; the second by M. Janssen, on the Physical Constitution of the Sun; and the third by M. Aimé Girard, on the Recent Progress of Industry.

NOTES

THE final arrangements for the Bradford meeting of the British Association are as follows:—The first General Meeting will be held on Wednesday, Sept. 17, at 8 P.M. precisely, when Dr. Carpenter, LL.D., F.R.S., &c., will resign the Chair, and the President-Elect, Prof. W. A. Williamson, F.R.S., will assume the presidency, and deliver an Address. On Thursday evening, Sept. 11, at 8 P.M., a Soiree; on Friday evening, Sept. 19, at 8.30 P.M., a discourse by Prof. W. C. Williamson, F.R.S., of Manchester, on Coal and Coal Plants; on Saturday evening, Sept. 20, a Lecture on Fuel to working men only, by Mr. Siemens, F.R.S.; on Monday evening, Sept. 22, at 8.30 P.M., a Discourse on Molecules, by Prof. Clerk Maxwell, F.R.S.; on Tuesday evening, Sept. 23, at 8 P.M., a Soiree; on Wednesday, Sept. 24, the concluding General Meeting will be held at 2.30 P.M., and in the evening a Grand Concert will be given in St. George's Hall, at 8 P.M. The excursions on Thursday, Sept. 25, will be to Harrogate, Ripon, Studley, Bolton Abbey, Gordale Scarr, Malham, Clapham Caves, Settle Caves, and Ingleboro'. Lists and prices of lodgings, and other general information will be given, on application at the Local Secretaries' Office, Bradford.

IT is said that a portion of the immense wealth of the late eccentric Duke of Brunswick is to be devoted to the founding of a Faculty of Medicine in Geneva.

THE King of Prussia has conferred on Prof. Helmholtz the Order of Merit for Science and Art.

THE October number of *Petermann's Mittheilungen* will contain an account of Professor Nordenskiöld's Arctic Expedition during 1872-3, in the direction of Spitzbergen, which has not, geographically, been very successful. The steamer *Solhem* reached Tromsö on August 6, and the following telegram of that date has been received from Prof. Nordenskiöld:—"Just arrived here, all well. My resolution to undertake another ice-journey towards the north after the sledge-journey round North-east-land, has been rendered impracticable through want of provisions, which has compelled us to return. Instead of this we have undertaken extensive deep-sea dredgings as well as botanical, magnetic, and geological researches. I bring with me, besides other from various formations, very important collections of Miocene flora, as well as of two formations which belong to an older geological period hitherto altogether unknown in the Polar regions. These collections throw new light upon the prevailing flora and the climate of former periods, as well as upon the changes which these have undergone."

ACCORDING to the report of the Meteorological Department an earthquake occurred at Nottingham at ten minutes to seven o'clock on Friday morning last.

PROF. PALMIERI stated in the Neapolitan papers on Aug. 12, that, according to observations on Vesuvius, new earthquakes may be expected.

THE Berlin medical journals record the death, from cholera, on August 20, of Dr. Otto Obermeier. His death is supposed to have been the immediate consequence of his intense devotion to Science. Having too great confidence in his power of resisting infection, in consequence of having not taken fever during his investigations on that disease, he kept in his bedroom pathological specimens taken from persons who had died of cholera, and also portions of their excreta; and it is believed that in this way he became infected. According to one account, he injected some blood from cholera patients into his own vessels. He was so devoted to his inquiry that, after he had become aware of the condition in which he was, he made some microscopic examinations on his own blood. His death occurred after an illness of seven hours, in the thirty-first year of his age.

THE late Mr. John Stuart Mill has left property to the amount of 14,000*l*. Of this he has left to any one university in Great Britain or Ireland that shall be the first to open its degrees to women, 3,000*l*.; and to the same University a further sum of 3,000*l*. to endow scholarships for female students exclusively. His copyrights he bequeaths in trust to Mr. John Morley, to be applied in aid of some periodical publication which shall be open to the expression of all opinions, and which shall have all its articles signed with the names of the writers.

THE planet No. 131, discovered by Prof. Peters, has been named Vala.

No. 1,952 of the *Astronomische Nachrichten* contains the following ephemeris of the one discovered by M. W. Tempel at Milan on July 3 last:—

1873.	R.A. h. m. s.	South Declination. ° '
Sept. 4	2 7 17	14 38
,, 8	2 9 0	15 26
,, 12	2 9 58	16 12
,, 16	2 10 15	16 54
,, 20	2 9 52	17 31
,, 24	2 8 49	18 6

This ephemeris is by Signor J. V. Schiaparelli; it is for 0 h. Milan time. The same number of the *Astronomische Nachrichten* contains a short article upon this comet by Mr. L. Schulhof, assistant at the Observatory of Vienna, wherein he says, "It does not admit of doubt that we have here to do with a periodic comet of short revolution, the exact calculation of the orbit of which I shall enter upon without delay."

Two new comets have been recently discovered; the one by M. Henry, at Paris, the other by M. Borelly, at Marseilles.

M. STEPHAN, the Director of the Marseilles Observatory, has succeeded in re-finding Brorsen's comet. The correction of Mr. Plummer's ephemeris is as follows:—

$$\text{R.A.} + 2^h\ 7^m$$
$$\text{Dec.} - 15'\ 8''$$

WE understand that the Board of Examiners for the mining district of South Durham, Whitby, and Cleveland allow candidates for examination, under the New Mines Regulation Act, to count one or two years passed at the College of Physical Science in Newcastle the same as the like period served under indentures to a mining engineer, or as one or two years' experience in a mining office. This offers a very great advantage to young men who intend to devote themselves to the profession of mining engineering.

THE following candidates have been successful in obtaining Royal Exhibitions of 50*l*. per annum for three years and free admission to the courses of instruction under the Science and Art Department:—Royal School of Mines, Jermyn Street, London: William Hewitt, aged 21, teacher; C. S. Fleming, 20, assistant teacher; Samuel Barratt, 22, assistant teacher. Royal College of Science, Dublin: Henry Louis, 17, student; Robert H. Reilly, 18, student; Thomas Arnall, 22, rule-maker.

A SUM of 500*l*. having been placed at the disposal of the Council of the Society of Arts, through Sir William Bodkin, by a gentleman who does not wish his name to appear, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer the following prizes: Five prizes for carrying out the purpose of the donor, each prize to consist of the Society's medal and 50*l*. Testing-rooms will be provided, in which the various competing articles may be tested in sucession, each competitor having allotted to him in turn a room and chimney, for a limited period, where he may fix his apparatus for the purpose of its being tested by the judges appointed by the Society of Arts, the same to be removed when directed by the judges; such fixing and removal to be at the cost of the competitor. The competing articles must be delivered at the London International Exhibition, South Kensington, on December 1, 1873, with a view to their being tested, and subsequently shown in the Exhibition of 1874.

THE last number of the *Society of Arts' Journal* contains a Report on Cooking Apparatus at the International Exhibition, by Mr. G. W. Yapp.

IT is stated that a new Literary Review will be published at the beginning of next year, covering the same ground as the *Athenæum*, the *Academy*, and *Notes and Queries*. It will supply a regular weekly account of English and foreign literature, science, and learning, the fine arts and archæology, music, and the drama. It is added that the proprietors have purchased all rights in the *Fortnightly Academy Journal*, and intend to make that the scientific and learned part of the new paper, though whether under the name of the *Academy* or some other name is not yet determined.

A LIFE of Claparède, with an admirable portrait, precedes his posthumous work, entitled "Recherches sur la structure des Annélides Sédentaires," which is published as the new volume of the "Memoires de la Société de Physique de Genève."

WE have received a little pamphlet containing a very interesting account, by Mr. J. Logan Lobley, of the excursion of the Geologists' Association to the Malvern district during the 21st and five following days of last month.

WE have received Reports of the meetings of the Eastbourne Natural History Society for April 18 and May 23. At the former meeting, a paper by Miss A. Woodhouse was read on *Odoxa moschatellina*, and the Rev. A. K. Cherril read one "On Mosses." At the latter meeting the following papers were read:—"The Orchidaceæ, with special reference to the species found near Eastbourne," by Miss Hall and Miss A. Woodhouse; *Ceratostoma Helvellæ*, by C. J. Muller; and "The Alluvial Beds of the Wish," by the Rev. E. S. Dewick, F.G.S.

A CORRESPONDENT writes us that he has just obtained a specimen of quartz with gold found at Wanlockhead, Dumfriesshire. It is a fragment of a detached mass of quartz which weighed about ten pounds, throughout which gold was diffused. Gold has long been collected from the sand of some of the rivulets at Wanlockhead and Leadhills, but no instance was before known of gold having been found in its matrix. The specimen which our correspondent has contains about as much gold as might be equal to the third or fourth of a sovereign, along with brown iron ochre diffused over one of the surfaces of the quartz.

A DESPATCH from Havana, dated August 19, states that late advices from Lima and Peru report a serious accident had occurred sixty miles from that city. A body of earth, estimated at 10,000,000 cubic yards, fell from a mountain side into a valley, severely injuring a number of persons, and damming up a river, the water of which had risen 109 feet above its usual height. Engineers were of opinion that the water would soon burst its barriers, when it would rush towards Lima, sweeping everything before it, and submerging the lower portion of the city. Several towns in Chili had been greatly damaged by earthquakes.

AS the result of a recent careful study of the drug *Pareira brava*, Mr. Daniel Hanbury has discovered that, instead of its being obtained from *Cissampelos pareira*, of the natural order *Menispermaceæ*, the genuine *Pareira brava* is the stem and root of a plant which he has identified with *Chondrodendron tomentosum* of Ruiz and Pavon. The drug of English commerce, however, is mostly of larger size than the root of *Chondrodendron* and is of doubtful origin, the structure of the wood being also that of the order *Menispermaceæ*.

UNDER the title of "On Coal at Home and Abroad," Messrs. Longman have recently published in one volume the following three articles, contributed to the *Edinburgh Review* by the Rev. J. R. Leifchild :—1. Consumption and Cost of Coal ; 2. On the Coalfields of North America and Great Britain ; 3. Fatal Accidents in Coal Mines. The republication of these papers at the present time is very opportune ; they will be found to contain a great deal of information on the all-important "Coal question," as well as many interesting details concerning the working of coal mines and the character and condition of the miners.

ZOOLOGISTS will find in Dr. Theodore Gill's "Synoptical Tables of Characters of the Mammalia," prepared for the Smithsonian Institution of Washington, an excellent, concise, and accurate description of the characters of the families of the Mammalia, in a form more scientific and manageable than any yet published, at the same time that the merits of the most modern suggestions are fully weighed. The biography of the subject is also exhaustively treated.

THE Brighton Aquarium is an institution which all biologists undoubtedly look to as one from which much valuable information may be obtained on points connected with the habits and peculiarities of the animals which it has such advantages in retaining. The communications made public by its "Consulting Naturalist," however, are of a character very different from what we should expect from one so favourably placed. A fresh arrival is thus announced :—"One of the funniest little 'cusses' ever turned out of Nature's workshop, in the shape of a seal, made a bow to the public in the Brighton Aquarium a few days ago." This is followed, later on, by a *quasi* advertisement of the concert given in the building, in which the seal is playfully made to do duty as the butt for pun and slang quotation.

THE additions to the Zoological Society's Gardens during the past week include two Persian Sheep (*Ovis aries*), presented by Mr. W. H. Shirley ; a Diamond Snake (*Morelia spilotes*) from New South Wales, presented by Mr. H. Frieland ; two Robben Island Snakes (*Coronella phocarum*), presented by the Rev. G. H. Fisk ; two Chubb (*Leuciscus cephalus*) and a Barbel (*Barbus vulgaris*) presented by Mr. E. S. Wilson ; two Ring-tailed Lemurs (*Lemur catta*) from Madagascar ; a King Parakeet (*Aprosmictus scapulatus*) from New South Wales ; a Black Cuckoo (*Eudynamys orientalis*) from India, purchased ; a Weeper Capuchin (*Cebus capucinus* and a White-throated Sapajou (*C. hypoleucus*) from America, deposited.

A POSSIBLE NEW METHOD OF ELECTRICAL ILLUMINATION

IT will be in the recollection of the readers of the *Journal*, that, in April last, an analogy was pointed out between sunlight and the electric light, and that certain conditions were therein indicated as being most favourable to that particular development of light which would best bring out the separation of the power producing the light from the place of its manifestation. Those conditions were the employment of magneto-electricity, and the use of a closed incandescent conductor in an atmosphere which would not oxidise or otherwise affect the durability of the light-producing material. From the quotation from the Russian paper *Golos* which follows, it will be seen that the results anticipated are even now in the course of realisation, and all that practical men can do is, to wish the plan the success it seems to deserve, and to wait the result of the further exhibitions of its power in London and other places more accessible to the Western nations than St. Petersburg :—

"On Tuesday the 8-20 of May, a most interesting trial was made for the first time in public at the Admiralty House, St. Petersburg, under the auspices of Messrs. S. A. Kosloff and Co., the proprietors of the patent, of a new system of lighting by electricity, the invention of Mr. A. Ladiguin, of that town.

"Owing to the restricted space in the hall made use of on this occasion, the number of spectators was necessarily limited, but still they consisted of more than a hundred specialists from different countries, representatives of science, honourable visitors, and many reporters, who were all deeply interested, and unanimously decided that the trial was really successful.

"Up to the present time, as is well known, the electric light has been used only for lighthouses, as an electric sun illumination for signals, or on the stage, where a strong light may be required without regard to cost ; but thus far it has been quite impossible to employ it for lighting streets or houses.

"By the old method the electric spark was passed between two points of charcoal, each attached to a copper wire connected with an electro-magnetic machine.

"The disadvantages attending this mode consisted in the facts that, for each light a separate machine was required, and that the light so obtained, although very powerful, was impossible to be regulated, besides being non-continuous, owing to the rapid consumption of the charcoal points from exposure to air.

"All these difficulties Mr. A. Ladiguin has tried and apparently overcome most successfully.

"By his newly-invented method, only one piece of charcoal or other bad conductor is required, which being attached to a wire connected with an electro-magnetic machine is placed in a glass tube, from which the air is exhausted, and replaced by a gas which will not at a high temperature combine chemically with the charcoal. This tube is then hermetically sealed, and the machine being set in motion by means of a small steam-engine, the charcoal becomes gradually and equally heated, and emits a soft, steady, and continuous light, which, by a most simple contrivance, can be strengthened or weakened at the option of those employing it ; its duration being dependent solely on the electric current, which of course will last as long as the machine is kept in motion.

"Taking into consideration the fact that one machine, worked by a small three-horse power engine, is capable of lighting many hundreds of lanterns, it is evident what an enormous advantage and profit could be gained by the illumination of streets, private houses, public buildings, and mines with the new electric light. In the latter it must prove invaluable, as no explosion need ever be feared from it, and these lanterns will burn equally as well under water as in a room.

"Without mentioning the many advantages this mode of illumination has over gas, which by its unpleasant odour and evaporation is slowly poisoning thousands of human beings, and from which explosions are frequent, we can state that by calculations made, this electric light can be produced at a fifth of the cost of coal gas.

"We hope shortly to place before the public more complete particulars, as well as reports of further experiments which are proposed to take place in Vienna, Paris, and London.'

* From the *Journal of the Society of Arts*.

*GROWTH OR EVOLUTION OF STRUCTURE IN SEEDLING PLANTS**

THE continuous absorption of oxygen, and formation of carbonic acid, is an essential condition of evolution of structure, both in plants and in animals.

The above proposition in so far as it relates to animals will probably be admitted by all; the opposite opinion is, however, commonly held as regards plants; yet we propose to show that in these organisms, as in animals, growth as applied to evolution of structure, or organisation of material provided, is inseparably connected with oxidation.

The discussion of the proposition in question necessarily involves a preliminary view of the character of the gases exhaled from various plants. Commencing with the lower organisms as fungi, the uniform testimony is that these plants at all times expire carbonic acid, while it is chiefly in the higher plants, and especially in those which contain chlorophyll or green colouring matter, that carbonic acid is absorbed and oxygen exhaled. The inquiry then in reality narrows itself down to the examination of the growth of chlorophyll-forming plants.

Regarding these plants the statement is made and received, that they change their action according as they are examined in the light or in the dark, exhaling oxygen under the first condition, and carbonic acid under the second. Various explanations of this change of action have been given, that generally accepted accounting for it on the hypothesis of the absorption of carbonic acid by the roots, and its exhalation by the leaves when light is no longer present.

The change, on the contrary, appears to arise out of the fact that two essentially different operations have been confounded, viz: the actual growth or evolution of structures in the plant, and the decomposition of carbonic acid by the leaves under the influence of the light, to provide the gum or other materials that are to be organised. These two factors are separated by Prof. J. W. Draper in his discussion of the conditions of growth in plants. We propose to show that by adopting this proposition of two distinct operations in the higher plants, all the apparent discrepancies regarding the growth of these plants are explained.

The growth of seedlings in the dark offering conditions in which the act of growth or evolution of structure is accomplished without the collateral decomposition of carbonic acid, I arranged two series of experiments in which growth under this condition might be studied and compared with a similar growth in the light. That the experiments might continue over a sufficient period of time to furnish reliable comparative results, I selected peas as the subject of trial, since these seeds contain sufficient material to support the growth of seedlings for a couple of weeks.

To secure as far as possible uniformity of conditions between the dark and light series, and also to facilitate the separation, cleansing and weighing of the roots, each pea was planted in a glass cylinder, one inch in diameter and six inches long. These cylinders were loosely closed below by a cork, and filled to within half an inch of the top with fine earth or vegetable mould. They were then placed erect in a covered tin box or tube stand in such a manner that the lower end dipped into water contained in the box, while the whole of the cylinder except the top was kept in the dark. Thus the first condition for germination, viz., darkness, was secured; the second, warmth, was supplied by the external temperature, which varied from 70° to 80° F., while regularity and uniformity in the supply of moisture in both series was secured by having a box of cylinders or tubes for each and keeping the level of the water the same in both. The supply of oxygen was also equal and uniform, since the upper part of each tube presented a similar opening to the air.

Thus prepared, one box containing five cylinders was kept in a dark closet, while a second, similar in all respects, was placed in a window of an adjoining room, where it was exposed to direct sunlight five or six hours every day. To each tube a light wooden rod thirty inches in length was attached, and on this the growth of the seedling was marked every twelve hours. The hours selected were 7 A.M. and 7 P.M. I thus obtained the night and day, or dark and light growth of every seedling, as long as those in the dark grew. The seeds were planted on June 1st, and appeared above the ground on June 6th, when the measurements were commenced. In each series one seed failed to germinate; the record, consequently, is for four plants in each, and the history of the evolution of structures is as follows:

Evolution of Structure in the Dark.—In Table I. the seeds are designated as A, B, C, D, and each column shows the date on which leaves and lateral growths appeared. These constitute periods in the development of the plants, which are indicated by the number 1, 2, 3, 4, 5, 6. The weight of each seed is given in milligrammes.

Table I.—*Seedlings grown in the Dark*

		A.	B.	C.	D.
Weight of seed.		431.	466.	456.	500.
Period	1,	7th day.	7th day.	7th day.	7th day.
,,	2,	8th ,,	9th ,,	9th ,,	8th ,,
,,	3,	10th ,,	10th ,,	11th ,,	10th ,,
,,	4,	12th ,,	12th ,,	13th ,,	12th ,,
,,	5,	14th ,,	15th ,,	15th ,,	14th ,,
,,	6,	17th ,,	18th ,,	18th ,,	17th ,,

A glance at the above shows the uniformity as regards time with which the structures were evolved in each plant. It also indicates for each plant an equality in the number of periods of evolution, viz., 6, notwithstanding the difference in the weights of the seeds, and suggests that the power of evolution of structure in seedlings resides in the germ alone.

The character of the evolution in the six periods shows a steady improvement or progression.

In the first, the growth consists in the formation close to the stem of two partially developed pale yellow leaves.

The second period is similar to the first, except that the leaves are a little larger.

The third presents a pair of small yellow leaves close to the main stem, from between which a lateral stem or twig about one inch long projects, and bears at its extremity a second pair of imperfectly developed yellow leaves, from between which a small tendril about a sixteenth of an inch long is given off.

The fourth resembles the third, the lateral twig being longer, and the tendril three times as long as in the third.

The fifth is like the fourth, except that the tendril bifurcates.

The sixth is similar to the fifth, except that the tendril trifurcates.

Stem, leaves, twigs, tendrils of various degrees of complexity, all are evolved by the force pre-existing in the germ without the assistance of light.

Evolution of Structure in the Light.

Table II.—*Seedlings grown in the Light*

		E.	F.	G.	H.
Weight of seed.		288.	426.	462.	544.
Period	1,	—	6th day.	—	6th day
,,	2,	7th day.	7th ,,	7th day.	7th ,,
,,	3,	8th ,,	8th ,,	8th ,,	9th ,,
,,	4,	12th ,,	9th ,,	10th ,,	10th ,,
,,	5,	15th ,,	11th ,,	14th ,,	12th ,,
,,	6,	— ,,	13th ,,	— ,,	14th ,,

Table II. was obtained in the same manner as Table I, the columns representing the days on which lateral growths and leaves appeared. Though there is not the same uniformity as in Table 1, the periods are identical in both as regards the visible character of the evolution Nothing appears in the second that did not pre-exist in the first, and in the case of the seeds E and G the evolution is even deficient as regards the first and the sixth periods.

While the general character of the evolution in both series is similar, certain minor differences exist. In II. the leaves and tendrils are many times larger than in I., and they, with the whole plant, are of a bright green colour, instead of the sickly pale yellow of I.; but the light has not developed any new structure; it has only perfected those which pre-existed, and converted other substances into chlorophyll which is not an organised body.

Not only did the plants in the two series present similarities in evolution of structure, but the average weight of dry plant in each was very nearly the same, for:

455 of seeds in the dark produced 184 of dry plant, while
455 ,, light ,, 215 ,, ,,

A comparison of the parts below the ground with those above (both being dried at 212° F.) shows that the proportion of root to total weight of plant was also nearly identical, being,

* From Silliman's American Journal of Science and Art.

25 of root for 100 of plant in the dark, and
23 ,, 100 ,, light.

The close similarity in the evolution of visible structure in the light and in the dark, the small difference in the total weights of the plants grown in the same time in both series, and the close approximation in the proportional weight of root to plant, all justify the conclusion, that the growth in darkness and in light closely resemble each other, and that it is proper to reason as regards the nature of the action from the first to the second.

Another interesting fact which lends support to the opinion that the process of growth in seedlings developed in the dark is very similar to that occurring in those grown in the light, is the character of the excrement thrown out by the roots. It is well known that many plants so poison the soil that the same plants cannot be made to grow therein until the poisonous excretions from the roots of the first crop have been destroyed by oxidation. In the case of peas this poisoning of the soil takes place in a very marked manner, and I have found that in the pots in which peas have been grown in the dark, the soil is so poisoned by the excrements from the roots that a second crop fails to sprout. Does it not follow, that since in the two series with which I experimented, the excrements from the roots possessed the same poisoning action, the processes in the plants from which these excrements aaose must have been similar?

There remains an important argument concerning which nothing has thus far been said. It is to be derived from the consideration of the rate of growth in the light series during various periods of the day of twenty-four hours. If the evolution of structure in a plant in daylight is the result of the action of light, that evolution should occur entirely, or almost entirely during the day. If, on the contrary, it is independent of the light, it should go on at a uniform rate as in plants in the dark.

For the elucidation of this portion of the subject, I present the following tables; the first of which shows the growth by night, 7 P.M. to 7 A.M., of the seedlings in the dark series, compared with their growth by day, 7 A.M. to 7 P.M. The measurements were taken from the sixth to the twentieth of the month, the day on which growth ceased in the dark series:—

Table III.—*Seedlings grown in the dark*

	Night growth.		Day growth.
No. 1	$12\frac{3}{4}$ inches.		14 inches.
,, 2	$13\frac{1}{4}$,,		13 ,,
,, 3	$11\frac{3}{4}$,,		$11\frac{3}{8}$,,
,, 4	$12\frac{5}{8}$,,		$11\frac{3}{8}$,,
Average,	$15\frac{5}{8}$,,	Average,	$12\frac{3}{8}$,,

The total day growth and night growth under these circumstances are nearly equal, though there is a slight excess in favour of the night, amounting, as the table shows, to $\frac{1}{4}$ of an inch in 12 inches.

In Table IV. the growth of the light series is given in the same manner, by day and by night, for the same time, viz., to June 20. The thermometric and hygrometric conditions in both series were very similar, as indicated by the dry and wet bulb thermometers suspended in the vicinity of each set of tubes:—

Table IV.—*Seedlings grown in the light*

	Night growth.		Day growth.
No. 5	$3\frac{1}{4}$ inches		4 inches.
,, 6	8 ,,		7 ,,
,, 7	$5\frac{1}{4}$,,		$4\frac{1}{2}$,,
,, 8	$9\frac{1}{2}$,,		$8\frac{1}{2}$,,
Average,	$6\frac{1}{2}$,,	Average,	6 ,,

In the average, and throughout the table, with a single exception, not only is the uniformity in the rate of growth during the day and night shown, but the slight excess of night growth found in the series kept in the dark is likewise copied. We must therefore accept the conclusion that the act of growth or evolution of structure is independent of light, and that the manner of growth during the day is similar to that at night.

It will be noticed that the total average height attained in the light is only about half that in the dark series. The explanation of this we have already seen in the fact that in the former the leaves and tendrils were much larger than in the latter, while the dry weights were nearly the same. The material of the seed in the light series was consumed in extending these surfaces, while in the dark series it was spent in lengthening the stem.

Having established the continuous character of growth in seedlings, and the similarity of rate and nature of the process by night and by day, and admitting that at night plants throw off carbonic acid, it is not improbable that this carbonic acid arises, not from mechanical absorption by the roots, and vaporisation by the leaves, but as a direct result or concomitant of the act or process of evolution of structure.

To put the matter in the clearest form, let us first understand what growth is. It appears in all cases to consist in the evolution or production of cells from those already existing. According as the circumstances under which the cells are produced vary, so does the tissue ultimately produced vary. Cells formed in woody fibre become wood. Cells formed in muscle in their turn form muscles, but the starting point of the process in every instance is the formation of new cells.

If now we examine the evolution of cells under the simplest conditions, as, for example, in the fermentation that attends the manufacture of alcohol, we find that with the evolution of the torulæ cells carbonic acid is produced. The two results are intimately connected, and it is proper to suppose that since the carbonic acid has arisen along with the new cells, the latter operation must in some way involve a process of oxidation. Accepting the hypothesis that oxidation is attendant on these processes of cell growth under the simplest conditions, we pass to the examination of what occurs in the lowest forms of vegetable organisms found in the air.

The fungi, and indeed all plants that are not green, with a few exceptions, exhale carbonic acid and never exhale oxygen. In this case, in which cell production often occurs with such marvellous rapidity, the carbonic acid must have arisen as a consequent of the cell growth. It is improbable that it has been absorbed by roots and exhaled from the structures, either in these plants or in those produced during fermentation. In the latter there never are any roots, and in the former, even where roots are present, they bear a small proportion to the whole plant. The quantity of moisture exhaled by such growths is also insignificant, and out of proportion to the carbonic acid evolved. We must, therefore, in this case decline to accept the root-absorption hypothesis, and admit that the carbonic acid has arisen as a result of the cell growth in the plant.

Passing to the chlorophyll-bearing plants, we find that in the Phanerogamia it is only the green parts that at any time exhale oxygen, and then only under the influence of sunshine. The other parts of the plant above the ground, that are not green, viz., the stem, twigs, flowers, &c., are at all times, day and night, exhaling carbonic acid. The whole history of the plant, from the time the seed is planted, to its death, is a continuous story of oxidation, except when sunlight is falling on the leaves. The seed is put into the ground, and during germination oxygen is absorbed and carbonic acid exhaled. If the seedling be kept in the dark, oxygen is never exhaled, carbonic acid is, and the plant not only grows, but all visible structures except flowers are formed in a rudimentary condition. In the light the growth during the night time is attended by the evolution of carbonic acid, while during the day time the bark of the stem and branches is throwing off carbonic acid. When flowers and seeds form, the evolution of carbonic acid attending this highest act of which the plant is capable, is often greater than that produced at any time in many animals.

Everything in the history of plants, therefore, tends to show that the evolution of their structures is inseparably attended by the formation of carbonic acid; and it seems impossible, when we consider the evolution alone, to arrive at any other opinion than that already expressed—that, all living things, whether plant or animal, absorb oxygen and evolve carbonic acid, or some other oxidised substance, as an essential condition of the evolution of their structures. J. C. DRAPER

SCIENTIFIC SERIALS

THE first number of the *Zeitschrift für Ethnologie* for 1873, opens with an interesting paper by Dr. George Schweinfurth on the Monbutta Tribes of Central Africa, whose name and existence have hitherto been unknown to us. Dr. Ori and M. Jules Poncet had shown that there were important streams south of the Miam-Miam Territory, which took a westerly course, and that the banks of the most considerable of these rivers were occupied by a brown-skinned race differing widely from the contiguous negro tribes, both in colour and in civilisation. These are the Monbuttas, known also to the ivory-traders as the Guruguri, in allusion to their practice of boring their ears. Their country, which Dr. Schweinfurth visited in 1868, and where he remained for five weeks under the special protection of the king, Munsa, is a densely populated district lying between 3 and 4 N. lat., and 28 and 29 E. long., and bounded on the north by the Kibali, a copious stream which unites with the Gadda, and under the name of Uelle receives in its passage through the Miam-Miam country a number of other streams, that serve as feeders to Lake Tsad. The country of the Monbuttas, lying at an elevation of from 2,500 to 3,000 ft. above the level of the sea, consists of an ever-varying alternation of gently swelling hills and well-watered valleys, alike rich in palms and bananas, and every other form of luxuriant tropical vegetation. In this earthly paradise where Nature spares man the burden of labour, the people, although living under an organised system of government, and showing extraordinary skill in working metals and in other arts, are habitual cannibals. This is not from want of animal food, as elephants, buffaloes, antelopes and wild swine abound, but whatever the cause may be, the fact is undisputed that the cannibalism of the otherwise gentle Monbuttas exceeds that of any other known African nation, and is systematically gratified at the expense of the more degraded blacks living beyond their frontiers, whom they seize and carry away, driving their captives before them like a herd of sheep, and slaughtering them as they need them. The young children and the fattest individuals are kept for the royal kitchen, where the flesh is dried and prepared with capsicums and many savoury fruits for the king, Munsa, whose numerous wives have to take it in turn to cook for him. The power of the king is supreme, and it would appear that the land of the Monbuttas may rank as one of the most important monarchical states of Central Africa. In race the people seem to approximate to the Fulbe, and in language to the north equatorial African group. They recognise one supreme being, appear to have no outward symbols of worship, and practise circumcision.—Dr. P. Langerhans has a paper in this number on the anatomical features of interest belonging to a series of facial and cranial measurements, with the corresponding photographs, taken at Jerusalem from among the mixed population of Khurds, Armenians, and Negroes (from Dâr). As a contribution to human comparative anatomy the paper will be found useful.—Those interested in the study of the prehistoric remains of Holland and the Low Countries generally will find much serviceable matter in a paper by Dr. Friedel, who points out the distinctions between the Frisic-Germanic and the Celtic-Batavian remains, and passes in review the collections preserved in the various Dutch museums, of which that of Leyden is the most valuable in an ethnological point of view.

Poggendorff's Annalen der Physik und Chemie, No. 5, 1873.—This number contains several papers on electricity. Dr. Hermann Herwig investigates the influence of free electricity at the surface of electrodes, on electro-dynamic phenomena. His experiments were made with a delicate electro-dynamometer, in which the deflections of the bifilar and multiplier coils were compared, the electro-motive force and resistance being varied.—A paper by M. Edlund treats of the chemical action of the galvanic current and the distribution of free electricity on the surface of an electrode. The author applies his theory (of electricity being a phenomenon of the luminiferous ether), to the decomposition of water by a current, and institutes a comparison between what occurs in a ring-tube in which a gas is forced into circulation from a certain point, with the phenomena in a galvanic circuit. In another note the same author opposes von Bezold's explanation of "disjunction currents," which he thinks are due to an electro-motive force in the voltaic arc itself, not to a difference in tension between the electrodes.—M. Wüllner describes experiments confirming his former assertion (questioned by Schuster) that nitrogen, in Geissler tubes, gives both a band and a line spectrum. A valuable series of experiments on heat consumption in the solution of salts, and the specific heats of salt solutions is detailed by Dr. Winkelmann, who here extends the previous work of Graham and Person on the subject.—There are also papers on the change of volume of solid substances through the formation of chemical combinations of the same aggregate state (W. Müller), on the pole-points of a magnet (Riecke), on the dynamical principle of Hamilton in thermo-dynamics (Szily), on a new mode of exhibiting metallic spectra (Edelmann), and one or two others.

THE July and August numbers of the *American Naturalist* contain, among others, the following papers:—Dr. Elliott Coues discusses the relationship between the Prairie Wolf, or Coyoté (*Canis latrans*), and the common dog, taking a pointer as his type, which is much of the same size. The physiognomy of the former is said to be between that of a wolf and a fox, "but more doggy than either." Its affinities with the dog are shown to be extremely close.—Mr. T. M. Trippe gives reasons for instances of irregular migrations of birds, showing that some depend on human interference, and changes in climate, and others are as yet unexplained.—Prof. Verril describes a new species of Octopus (*O. bairdii*) from the bay of Fundy. It is somewhat related to *O. groenlandicus*, but differs in the hectocolylised arm being longer and otherwise different.—Alexander Agassiz, in a fully illustrated article, gives reasons in favour of the supposition that the pedicellariæ and spines of Echinodermata are only modifications of a single type form, to suit different purposes in the animal's economy.—Prof. W. J. Beal, on the phyllotaxy of cones, shows that the well-known laws of phyllotaxis are very general, nevertheless there are exceptions to them, well marked among some cones, as is proved by the author's examination of a very large number from the Norway spruce, in which $\frac{13}{34}$ and $\frac{13}{21}$ were the common fractions.—Mr. A. S. Packard, jun., treats of the distribution of Californian moths, bringing information on their peculiarities to bear on Prof. Gray's work on the distribution of Californian plants.—Dr. Theodore Gill has a paper on the status of Aristotle in systematic zoology, in which he gives very cogent reasons against that great philosopher having the knowledge of the principles of zoology which is ascribed to him by some. He concludes that "there is not the slightest evidence of any recognition of what is now understood by classification in any of the extant treatises of Aristotle on animals, and the systems framed to embody his generalisations have been constructed from isolated sentences wrested from their context, and simply reflect the framer's notions or his ideas as to what Aristotle might have supposed."—Prof. Bessey notes the sensitiveness of the stamens of *Portulaca* and *Claytonia*.

Mittheilungen der Naturforschenden Gessellschaft in Berne, 1872.—Prof. Dor has an article, in this number, on colour blindness. Various experiments are described; the method most preferred having been that of viewing spectral colours with a polarisation prism. The author rejects the Young-Helmholtz theory, which, as is known, supposes three colour-perceiving elements in the retina, those for perception of red, those for green, and those for violet (or blue). Among his objections are these: absence of anatomical proof; distinct vision of many of the colour blind; the spectrum as observed by two persons, brothers, who had no perception of red or violet, was of normal length; all the pathologically colour blind suffered from atrophy of the optic nerve through cerebral or spinal injuries; in these cases, the fibrous and cellular layer of the retina, and the optic nerve, to the brain, were atrophied, but not the rods and cones; in retinal disease, on the other hand, the perception of colours is not perverted, though diminished. He concludes that colour blindness is a cerebral affection.—A note by Dr. Adolph Vogt treats of the drainage of towns, in view of a faulty state of things at Berne.—The action of Buss's new governor is discussed in a paper of some length by the inventor.—Dr. A. Forster communicates a note on the falling stars of November last, also meteorological observations at the Berne Observatory during 1872. From the curve of daily temperature variations at Berne it appears that these are sometimes considerable, *e.g.* 18·6° C. in 24 hours, a fact of significance for health.—We may further note, in this number, some contributions to local botany, by Dr. Wydler.

SOCIETIES AND ACADEMIES

BELGIUM

Royal Academy of Sciences, June 7.—M. Quetelet presented a note on the solar eclipse of May 26, 1873.—M. Montigny gave the results of a second series of experiments made on the spire of Antwerp Cathedral, in which he determined barometrically the heights at several points, in winds of different direction and velocity. His tables show a difference between the calculated height and the real height, the latter being greater for winds of the eastern semicircle, while the former is greater for westerly winds. In north and south winds, and those closely neighbouring, the heights measured both ways closely agreed. The differences between true and barometric altitude for the same gallery increase regularly, but in contrary directions, from the meridian to the azimuths east and west, when they each attain their maximum value. The height, barometrically measured, increased, as a rule, with the velocity of the wind. No connection was demonstrable between barometric height and inclination of wind. Observations at Namur and Brussels are compared with those at Antwerp, and show a cycle like that just described, only the regions to which the maximum and minimum (barometric) altitude correspond are, at these places, in the contrary direction to those at Antwerp.—M. Melsens communicated a paper on the effect of reducing alcoholic drinks to very low temperatures. A liquor like brandy may be cooled to—60° C. without being painfully cold to a person taking it. From the phenomenon of congelation in ordinary and sparkling wines, M. Melsens seeks to show how wines and beer also may be improved by application of cold.—M. Louis Henry described researches on the etherised derivatives of alcohols and of polyatomic acids; also on propargylic compounds.—M. de Selys Longchamps made a third addition to his "Synopsis of the Gomphines," of which he can now enumerate 188 species (seventeen of these being new), arranged in forty-three genera and subgenera.—M. Van Beneden gave a summary account of results from a voyage to Brazil and La Plata. His main object had been to study the fauna of the American coast, and specially of Rio. He describes the frequent formation of lagoons by the deposit of a transverse bar separating the water of a bay from that of the sea. Fresh water continually entering such lagoons, their saltness disappears, and an interesting question was, how had the original ocean fauna, here enclosed, been affected by the change of physical conditions. M. Van Beneden made various dredgings in the bay of Rio (in which the tidal change of sea-level is very small), and in these lagoons, and promises future communications on the subject. He mentions having found in some lower forms of Crustacea (*Lernanthropides* and *Clavellinæ*) a double circulatory system like that in Annelides. Besides the lacunar system, in which circulates a colourless liquid having white globules, there is a complicated system of vessels with proper walls, containing red blood without globules. There is no connection; the two liquids do not mix. The colouring matter is hæmoglobin. The branchiæ and trunk, alternately contracting and dilating, put the liquids in circulation. The author also mentions having dissected a lamantin (disinterred for his benefit), and a dolphin, and describes exceptional features in both. The paper gives several interesting zoological facts.

July 5.—M. Quetelet read a paper on the calculation of probabilities, applied to the science of man; reviewing recent progress of statistical science in this direction, and giving numerical results in the case of stature and mortality.—M. Van Beneden presented two coloured drawings of Cetacea captured at the Cape of Good Hope. He thinks zoologists have too little regarded the system of coloration in such animals, and his remarks bear chiefly on this.—M. L. Henry communicated a paper on diallylic compounds, being part of a series of researches on glyceric derivatives.—M. Swarts followed with a note on some properties of pyrocitric acids.—M. Spring communicated some facts with reference to the oxygenated compounds of sulphur.

PARIS

Academy of Sciences, Aug. 18.—M. Bertrand, president, in the chair.—The following papers were read:—Fourth note on guano, by M. Chevreul. The author has found that the crystallisable matter C, described in his late notes, is an ammonia salt, and that the other body insoluble in cold water is a very complex mixture containing acid. He gave no further details.—Direct demonstration of the fundamental principles of thermodynamics, by M. A. Ledieu.—On the movements of the *Phylloxera* from place to place, by MM. J. E. Planchon and J. Lichtenstein.—M. de Lesseps demanded the appointment of a Commission by the Academy to examine his project of a Central-Asian railway.—M. Daubrée communicated a letter from Mr. Nordenskiöld, giving an account of the discovery, in recently fallen snow, of a carbonaceous snow containing metallic iron. This was first found at Stockholm; but the author, fearing that the powder might be due to the soot of the city, wrote to his brother, then in the centre of Finland, to collect snow there. The results were the same, and Mr. Nordenskiöld has obtained sufficient for a quantitative analysis which he proposed to make during the coming winter.—Researches on secondary ascending currents, and their application (continuation), by M. G. Planté.—A description of the cryptograph, by M. Pélegrin.—On algebraic left-handed curves, by M. Picquet.—Experimental researches on explosives, by MM. Roux and Sarrau.—A new method of estimating ammonia, organic nitrogen, and nitric acid in waters, soils, and manures, by M. Piuggari. The author proposed to convert all nitrogenous bodies into ammonia and nitric and nitrous acids by acting on them with a mixture of argentic chloride and potassic hydrate, and then converting the oxidised nitrogen into ammonia by nascent hydrogen. He proposed to estimate the resulting ammonia by Nessler's process, except when below 0·00001 grm., when he proposes a special reagent, composed of two drops of phenol and 5 or 6 c.c. of hypochlorite of soda, which gives a fine blue-violet colouration to ammoniacal liquors.—On the hydrochlorate of terpene, and on the isomerism of the bodies having the formula $C_{10}H_{16}HCl$, by M. Riban.—On the variations of hæmoglobin in the zoological series, by M. Quinquaud.—On the variations of the urine under the influence of caffeine, coffee and tea, by M. Rabuteau.—On the zoological position, &c., of the parasitic Acariaus known as *Hypopus*, by M. Mégnin.—On a deposit of silicified vegetables in the coal basin of the Loire, by M. Grand'Eury.—On the existence in the quaternary period of a large glacier in the mountains of Aubrac (Lozère) by M. G. Fabre.—Note on the meteors of November 27, 1872, by M. Ch. Dufour.—On the meteors of August 9 and 10, by M. F. Tisserand.—A note on the same subject, by M. Chapelas, concluded the business of the session.

August 25.—M. Bertrand in the chair.—The following papers were read:—On Zöllner's theory of solar scoriæ as being the cause of spots, by M. Faye. The author observed that this theory as recently developed in a communication to the Royal Saxon Academy agrees better with the known facts of the motions of the spots than does Secchi's eruption theory.—On the polar planimeter, by M. H. Resal.—On the thoracic and abdominal phosphorescent organs of the cocuyo of Cuba, by MM. Ch. Robin and A. Lubvulbène. The systematic name of this insect is *Pyrophorous noctilucus* (*Elater noctilucus* L.) Direct demonstration of the fundamental principles of thermodynamics, part vii., by M. A. Ledieu.—On the rapidity of reproduction in the *Phylloxera*, by M. Lichtenstein.—On a principle of union in universal chemistry, as applicable to organic chemistry, by M. E. Martin.—A letter was received from M. Wolf announcing the discovery of two new comets by MM. Boreilly and Paul Henry.—On the spectrum of comet III., 1873, by MM. Wolf and Rayet.—On the spectrum of the solar atmosphere, by M. G. Rayet. The author announces the discovery of the fact that the least refrangible of the two D lines is longer than the other, as he saw the former reversed when the latter was invisible.—Twelfth note on the effects of barometric changes on life, by M. P. Bert.—On hay-fever, by M. E. Decaisne. The author asserted that this disorder has no actual existence as a separate disease.—Experiments on the scolex of *Tænia mediocanellata*, by M. Saint-Cyr.—On the movements of the stamens in *Ruta*, by M. G. Carlet.

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