THURSDAY, JULY 13, 1905.

THE POPULARISATION OF SCIENCE.

The New Knowledge. By Robert Kennedy Duncan, Professor of Chemistry in Washington and Jefferson College. Pp. xviii+263. (London: Hodder and Stoughton, 1905.)

THE author of this attempt to make the progress of recent discovery in chemistry and physics understanded of the people remarks in his preface:—

"The great expositors are dead, Huxley and Tyndall and all the others; and the great expositor of the future, the interpreter of knowledge to the people, has yet to be born."

And (but it must be added quite modestly) he attempts to wear the cloak of the prophet. He is right, on the whole, when he says that "the progressive teacher, particularly in the high school or smaller college, finds it often exceedingly difficult to gain access to the original sources of knowledge," and, it may also be remarked, to understand them when he does. Hence any serious attempt made by one sufficiently versed in science to avoid error, and with sufficient appreciation of the difficulties of one who has not made science his speciality to know how to present facts and their interpretation, is deserving of a cordial welcome. Indeed, most scientific men are in the position of outsiders towards sciences not their own; and an allusion to the recent effort made by the Chemical Society to present the year's progress to their Fellows is here not inappropriate, for to such an extent is specialisation now carried that it is practically impossible for the physical chemist to follow the researches of the organic chemist, and *vice versâ*. Their "Annual Reports on the Progress of Chemistry for 1904" will be much appreciated by all chemists. It is true that the organic chemist, for example, may consider the amount of space devoted to his branch insufficient, and the treatment of the subject-matter somewhat scrappy; yet to one who has no time to follow in detail the work of the specialists published in numerous journals during the year, a summary like this is of the greatest value. It is very desirable, in subdivisions of a science, as well as in separate sciences, that the bearing of one branch of knowledge on another should be realised, and so far understood; and the Chemical Society is to be congratulated on its new effort. It is to be hoped that a similar plan will be adopted by physiologists, geologists, and, indeed, by all those who labour for the "promotion of natural knowledge."

But to return to Prof. Duncan's book. Beginning with the "three entities," matter, ether, and energy, an attempt is made in seven pages to give the reader some idea that these are the conceptions in terms of which the modern man of science interprets nature. The doctrines of the conservation of mass and of energy, and the necessity for the assumption of the existence of ether are indicated. I doubt whether an entire outsider would gain much by reading this chapter; still, if it stimulates him to think, and to try to acquire clearer ideas on the subject, much will have been accomplished. We have then certain elementary conceptions of chemistry expounded, molecules, atoms, compounds, and elements, and so closes part i., which consists of eleven pages.

To give the reader an idea of the author's style, a quotation from the first paragraphs of part ii. may be made.

"We believe—we must believe, in this day—that everything in God's universe of worlds and stars is made of atoms, in quantities x, y or z respectively. Men and women, mice and elephants, the red belts of Jupiter and the rings of Saturn are one and all but ever shifting, ever varying, swarms of atoms. Every mechanical work of air, earth, fire and water, every criminal act, every human deed of love or valor: what is it all, pray, but the relation of one swarm of atoms to another?

"Here, for example, is a swarm of atoms, vibrating, scintillant, martial,—they call it a soldier,—and, anon, some thousands of miles away upon the South African veldt, that swarm dissolves,—dissolves, forsooth, because of another little swarm,—they call it lead.

"What a phantasmagoric dance it is, this dance of atoms! And what a task for the Master of the Ceremonies. For mark you the mutabilities of things. These same atoms, maybe, or others like them, come together again, vibrating, clustering, interlocking, combining, and there results a woman, a flower, a blackbird or a locust, as the case may be. But to-morrow again the dance is ended and the atoms are far away; some of them are in the fever germs that broke up the dance, others are 'the green hair of the grave,' and others are blown about the antipodes on the winds of ocean. The mutabilities of things, and likewise the tears of things: for one thing after another,

> 'Like snow upon the Desert's dusty Face
> Lighting a little hour or two—is gone,'

and the eternal, ever-changing dance goes on."

Now this purports to be very fine writing, but does it gild the pill of science? I am inclined to think not. Still, tastes may differ.

It would be unfair to judge of the book, however, by this quotation. The subsequent sections deal with the periodic classification, gaseous ions, corpuscles, and here a very lucid account is given of the method of estimating the velocity of a corpuscle, and of the relation of the charge to the mass; really in these sections the author has established his character as a clear expositor. Positive ions are then considered, and then natural radio-activity, in which there is a capital sketch of the discovery of radium and of its properties. A subsequent chapter treats of thorium, uranium, radium, and actinium, with the reproduction of Prof. Rutherford's latest results, and the section concludes with the radio-activity of substances in general. The next "part" deals with the resolution of the atom and with atomic disintegration, and an intelligible account is given of Prof. J. J. Thomson's most recent work. The heat-emitting property of radium is next dealt with, and then there is a summary of the "electrical nature of matter." The book concludes with part v., entitled "Inorganic Evolution and Inorganic Devolution," discussing intelligently and intelligibly Sir Norman Lockyer's theories

relating to stellar temperatures and stellar change, and the problems of the sun's heat, the mechanical pressure of light, and the re-construction of a universe are the concluding chapters. The last chapter of all, the validity of the new knowledge, deals with the question, Is all this true? And here there is a touch of philosophy. For "A system is 'true' if it is entirely consistent and coherent, if it is completely self-explanatory."

"There is no criterion of absolute truth, there is no way of attaining to absolute truth, and we may as well acknowledge it. Should we therefore abandon the world-riddle? Assuredly not. If we may never *know* a system to be true, we may *believe* it to be true. We may not have a knowledge of truth, but we may have a recognition of it." "Meanwhile this system of the new knowledge . . . is simply the outermost circle covering the greatest area of knowledge, and while its diameter is by no means infinite, it is the truest expression of the truth attainable at this time, and as such is vastly useful. Its utility in the evolution of knowledge is its sole apology for existence."

This work is the first attempt which I have seen to bring into suitable compass, in an intelligible manner, the various problems which are occupying the attention of many physicists and chemists. There are few errors, and these are unimportant. Whether the author might not have omitted much fine writing is a question of taste. But even if it be regarded as ill-placed, it does not destroy the intrinsic value of his work. W. R.

THEORETICAL GEODESY.

Trattato di Geodesia Teoretica. By Paolo Pizzetti. Pp. ix+467. (Bologna: Zanichelli, 1905.)

SIGNOR PIZZETTI has treated the subject of geodesy in a thoroughly exhaustive manner. The theoretical portion of the book, dealing with the formulæ used in geodesy, is very ably demonstrated, and the mathematical proofs of the various problems are sufficiently clear to be easily followed by those practically uninitiated in the subject. The same, however, cannot be said of the descriptive narrative of geodetical operations in general. The book, in fact, impresses one far more from the theoretical than from the practical point of view. The absence of practical demonstrations of the use of the various formulæ must be a great loss in a work of this nature, and for this reason it compares unfavourably with such standard treatises as Puissant's "Traité de Géodesie" and Clarke's "Geodesy," where ample practical illustrations of the application of geodetical formulæ are given to help the student in this complicated subject. Even a few examples taken from any modern geodetic triangulation would have been of the greatest assistance. Theory alone is almost bound to have a deterrent effect.

The book contains a short and concise history of the several hypotheses as to the form and constitution of the earth prior to any actual geodetical operations, but the account of the several measurements of "arcs of meridian" is very meagre, and confines itself practically to mentioning those measured in Peru and Lapland in the eighteenth century.

Doubtless these "arcs" played a most important part in geodesy, but subsequent measurements have been of equal importance, and have been carried out with the advantage of superior knowledge and more perfect instruments.

Like most Continental geodesists, the author adheres to the data for the figure of the earth deduced by Bessel in 1840, and it is only in an appendix that any reference is made to Clarke's determination. This, I think, is scarcely fair to English geodesy, considering that Clarke had the advantage of a far larger number of arcs whence to deduce his values, as given in his excellent treatise in 1880. A reference to these values should find a place in every standard work on geodesy, and it is noteworthy that the American Geodetic Survey, which previously employed Bessel's values, has, within recent years, discarded them in favour of Clarke. This was in great part due to the close agreement between Clarke's values and those deduced by the Americans themselves in their various arc measurements.

Several chapters are devoted to the mathematical proof of the various functions of a spheroid of revolution. On the whole, they are easily followed, and differ but slightly from those used by Puissant in his great work. The formulæ in chapter iv. for the determination of the geographical coordinates are similar to those used in the Indian auxiliary tables. Here, particularly, the want of definite examples is greatly felt, and I cannot but think that Signor Pizzetti would greatly enhance the value of his work by adding a few taken at hazard from any survey. The actual illustration given in this chapter is one but rarely used in geodesy.

Three chapters are given up to the description of base measurements and the practical observation of geodetic angles. It may at once be said that the account is far from thorough, and the practical student desirous of studying the methods to be employed in the field would glean but a scanty knowledge. Mention is made of some of the more important instruments used in base measurement, such as Borda's rods, Ibenaz's apparatus, and the American contact duplex bars, but no word is given of Colby's compensation bars, and only the slightest reference is made to measurements by means of steel or invar tapes or wires. There is little doubt that in future all geodetic bases will be measured by the latter means. Only quite recently in South Africa bases have been measured with an extraordinary degree of precision with invar wires.

As regards the measurements of the angles, there is but little information as to the practical work to be done, but a very exhaustive treatise is given of the causes of the various instrumental errors. It is mainly in agreement with those chapters in Chauvenet's "Astronomy" dealing with this subject.

Reference is made to the various instruments used for astronomical work, such as transit—altazimuth—and zenith telescopes. The various errors to which such instruments are liable is very carefully gone into.

A short history is given in chapter viii. of the general development of triangulation from the time of Snellins to the present day, but it consists mainly in mentioning some of the more striking incidents connected with the subject, such, for instance, as the use of electric light in the work connecting Spain and Algiers.

The question of lateral refraction is gone very fully into, and a table is given showing the mean triangular errors proportional to triangles of different sizes. The deduction is then made that the effect of lateral refraction increases with the mean length of a side of a triangle up to about 90 kilometres, after which it begins to decrease again. This is a particularly interesting problem, and the table, which is taken from a recent triangulation in Germany, certainly confirms the deduction. It is of course assumed that the closing errors of triangles are due in most part to lateral refraction. The usual methods of calculating and computing triangulation are very thoroughly dealt with.

Precise levelling forms the greater part of chapter ix., but an exceedingly full and clear demonstration is given at the beginning of the various formulæ relative to atmospheric refraction and to trigonometrical differences in heights of stations. This is treated in a really very clear manner.

Three chapters are devoted to the theory of probability and its application to geodesy. The theoretical portion has been well demonstrated, and differs but little from the numerous text-books on this subject; but where the attempt is made to apply the method of least squares to a network of triangulation, the want of taking a practical example is at once felt. Clarke, in his "Geodesy," gives numerous examples of how to apply theory to practice, but Signor Pizzetti leaves the student utterly in the dark on this important point.

Perhaps the two most interesting chapters are left to the end. They deal with the subject of projections, which is gone into with every care. There is scarcely any well known projection which is not very fully explained.

Altogether this book is a distinct addition to any geodetic library. W. J. JOHNSTON.

OUR BOOK SHELF.

The Food Inspector's Handbook. By Francis Vacher. Fourth edition. Pp. xvi+231; illustrated. (London: The Sanitary Publishing Co., 1905.) Price 3*s.* 6*d.* net.

THIS is a pocket volume intended for the use of sanitary and other officers concerned in the inspection of food. It describes, in simple, untechnical language, the naked-eye characters of the various foodstuffs met with in ordinary commerce, and points out the physical signs by which unwholesome food may be detected.

The first sixty pages deal chiefly with the statutory powers by virtue of which the food-supply of the community is supervised. They include a summary, with explanatory comments, of the various enactments —Public Health Act, Sale of Food and Drugs Acts, and so on—bearing upon the control of food from the inspector's point of view. Next follow chapters treating of meat, poultry, and fish. This is the most important part of the book, and the notes upon the *ante-* and *post-mortem* signs of those diseases which render flesh-food unfit for consumption, or which seriously depreciate its quality, will be especially valuable to sanitary officers who have had no veterinary experience. A subsequent chapter is allotted to fruit and vegetables, and one to milk; the rest of the book gives short descriptions of cereals, dairy products, tea, sugar, spices, and so forth. This section, though of interest to the food inspector, is of less concern to him than the foregoing, the quality of the articles mentioned being generally a matter for decision by analysis, not for condemnation at sight.

The author gives sensible advice, and his little volume should be found very useful to those for whom it is written. The only inaccuracy we have noted is suggested in the statement that "Dutch cheese is below the standard per cent. as regards fat"; this might imply that there is a legal standard, which is not the fact. C. S.

Manuale dell'Ingegnere Elettricista. By Attilio Marro. Pp. xv+689. (Milan: Ulrico Hoepli, 1905.) Price 7.50 lire.

THIS book forms one of the useful series of "Manuali Hoepli," which already comprises over 800 distinct treatises. Its aim is to give to engineers and electrical constructors most of the information and data that they are likely to require in practice. On this account it is not so much a text-book as a classified collection of rules and data; but on account of its containing a large amount of explanatory matter it lies intermediate between a treatise on electrical engineering and a pocket book of electrical rules and tables. The type being small but clear, a very large amount of useful information is collected in a small compass. The numerical data have been obtained principally from recent papers published in the journals of electrical engineering, and are collected in 115 tables. The work is illustrated with 192 cuts and is furnished with a good index. Its size well adapts it to be a handy pocket book of reference, and it is likely to prove of considerable use.

Poisonous Plants of all Countries. By A. B. Smith. Pp. xvi+88. (Bristol: J. Wright and Co., 1905.) Price 2*s.* 6*d.* net.

THE author has collected a fairly representative list of poisonous plants, which he has arranged according to the action produced and the organs affected, but there is no mention made of the part or parts of the plant which furnish the poison. The descriptions, which form the main part of the text, are sufficient where reference is made to the whole plant, but the majority are too meagre to be diagnostic. The string of vernacular names which is quoted in several cases does not serve any useful purpose, whereas beyond the mere name of the toxic principle information which is much required is not given.

LETTERS TO THE EDITOR.

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

The Constant of Radiation as Calculated from Molecular Data.

IN NATURE, May 18, I gave a calculation of the coefficient of complete radiation at a given absolute temperature for waves of great length on principles laid down in 1900, and it appeared that the result was eight times

as great as that deduced from Planck's formula for this case. In connection with similar work of his own, Mr. Jeans (*Phil. Mag.*, July) has just pointed out that I have introduced a redundant factor 8 by counting negative as well as positive values of my integers ξ, η, ζ.

I hasten to admit the justice of this correction. But while the precise agreement of results in the case of very long waves is satisfactory so far as it goes, it does not satisfy the wish expressed in my former letter for a comparison of processes. In the application to waves that are not long, there must be some limitation on the principle of equi-partition. Is there any affinity in this respect between the ideas of Prof. Planck and those of Mr. Jeans?

Terling Place, Witham, July 7. RAYLEIGH.

Proposed Observation of Mercury during the Solar Eclipse.

DURING the eclipse of the sun on August 30 next there will be an opportunity of making a very interesting observation on the planet Mercury, to which I ask permission to direct attention.

Mercury at the time of the eclipse will be very close to the line joining the earth and sun—about 2° 54′ south and 2° 54′ preceding the sun—*i.e.* at an angular distance from the sun's centre of nearly 4° 6′. Accordingly, the illuminated part of Mercury will be an excessively thin crescent which, if Mercury have an atmosphere, will have its horns prolonged by atmospheric refraction.

If a sufficiently skilled observer is provided with a telescope upon which he can use a power of 200 without loss of definition, and mounted—probably as an alt-azimuth—so that it can be set beforehand upon Mercury, the apparent size of Mercury will be that which would be presented by a circle one-tenth of an inch across, viewed with the naked eye from a distance of ten inches.

This ought to be sufficient magnification to see whether the horns of the crescent are prolonged, and, if so, it is perhaps not impossible that the light would be sufficient to enable a spectrum of the tips of the crescent to be seen.

If the whole of this programme can be carried out, we should find out whether Mercury has an atmosphere, and possibly learn something as to the constituents of the atmosphere. G. JOHNSTONE STONEY.

30 Ledbury Road, W., July 10.

The Planet Uranus.

ASTRONOMICAL amateurs will have an excellent opportunity of identifying Uranus on about July 16 next, for the planet will be in conjunction with the star 1 Sagittarii (mag. 5·3) on the night following that date.

The position of Uranus at transit (10h. 30m.) will be :—

R.A. 18h. 5m. 58s., Dec. S. 23° 42′ 21″,

while that of the star will be (1905·5) :—

R.A. 18h. 5m. 57s., Dec. S. 23° 43′ 16″,

so that the planet will pass about 1 minute of arc north of the star. The latter may be easily picked up, as it is nearly 4° S. of the triple star μ or 13 Sagittarii (mag. 4·1).

Unfortunately, the objects will be low in altitude (15°), and the moon happens to be full on the date of conjunction.

On June 24 and July 8 I found Uranus a little fainter than the star 1 Sagittarii. I have carefully observed the planet on several nights in a 12½in. Calver reflector, powers 100 to 475. The disc appeared faint with a bluish tinge, and no belts or other markings could be detected, but the telescope is too small to deal effectively with an object of this description.

Bristol, July 9. W. F. DENNING.

The Exploration of the Atmosphere above the Atlantic.

A PLAN for systematic work of this kind, which was proposed by the writer in 1901 at the Glasgow meeting of the British Association (Report, p. 724) after he had obtained the first observations with kites flown from a Transatlantic steamer, is now being partially realised. Last summer Prof. Hergesell, on board the Prince of Monaco's steam-yacht *Princess Alice*, executed sixteen kite-flights above that part of the Atlantic bounded by Spain, the Canaries and the Azores, but without finding the expected south-west anti-trade, although a height of nearly 15,000 feet was reached (NATURE, vol. lxxi. p. 467). The present expedition, which will repeat Prof. Hergesell's investigations and continue them further south, is made possible through the cooperation of our distinguished French colleague, M. Teisserenc de Bort, whose steam-yacht *Otaria*, of 350 tons, with a speed of 11 knots, and fully equipped for aërial exploration, has just sailed from Gibraltar, and, at the joint expense of her owner and the writer, will proceed towards the equator by way of Madeira, Canary and Cape Verde Islands, making frequent soundings with kites through the trade winds and equatorial calms. By means of the self-recording instruments lifted by the kites, it is expected that there will be ascertained the thermal and hygrometric conditions of the various strata traversed, and the depth and force of the trade wind in the different latitudes. If the kites do not reach the south-west return trade, which has been observed on the Peak of Teneriffe, the vertical range of observation may be increased by liberating hydrogen balloons from Madeira and noting their drift.

Mr. Clayton, meteorologist of the Blue Hill Observatory, left Boston on June 3 to join the *Otaria* at Gibraltar. During his voyage to the Azores on the White Star liner *Romanic* he flew kites, with instruments attached, almost daily to the height of from five-eighths to three-quarters of a mile, thus securing the highest observations in mid-Atlantic, and it is interesting that this was done on June 7, the day appointed for the international observations in the upper air here at Blue Hill and in Europe. In general, the temperature was found to decrease with altitude at less than the adiabatic rate, and the relative humidity to decrease also, but in one ascent there was a rise of temperature with altitude, preceding a change of wind from west to south. A new form of folding kite was employed, and it is encouraging to learn that the heights attained were limited by the length and strength of the wire on the hand-reel, which did not permit more than one of these kites to be attached. On the two days when no flights were made, a following wind became too light on board the steamer to lift the kites, whereas, on the yacht, this condition would have been obviated by simply lying-to, or steaming against the wind.

While the cruise of the *Otaria*, which is to last only six weeks, can hardly do more than elucidate certain questions relating to the high atmosphere in the tropics, it will demonstrate the possibilities and difficulties attending the extensive survey that the writer desires to undertake, and which received the endorsement of the International Meteorological Committee at Southport in 1903.

A. LAWRENCE ROTCH.

Blue Hill Meteorological Observatory, Hyde Park, Mass., U.S.A., June 26.

Ancient Antarctica.

PROF. H. F. OSBORN has said that the demonstration of "the former existence of an Antarctic continent is one of the greatest triumphs of modern science." But even if this be true, everyone must allow that it occurred a very long time ago. This is proved by the great differences that exist between the floras and faunas of the three great southern continents. These differences are much greater than those between the floras and faunas of North America and Eurasia, and consequently the land connections must have been broken up in the south long before they were in the north. We infer the former existence of an Antarctic continent from the existence of granite and foliated schists in South Victoria Land, and evidence that it was formerly connected with northern lands is found in the existence of flightless insects living there in the few patches of mosses and lichens which manage to struggle through the winter. These insects are not flightless through degeneration, but belong to an order which never possessed wings.

It is very improbable that the ancestors of these minute insects were carried or blown to where they are now found; they must have travelled to their present positions by land. That is, the Antarctic continent south of New Zealand and Patagonia must, at some time or other, have joined on to northern lands.

In the islands of the Antarctic Ocean we have further evidence of a former land connection in the earthworms belonging to the family Acanthodrilidæ, which are characteristic of Antarctic regions. A spider also lives on Bounty Islands which is closely related to one from Cape Horn. But spiders seem to have special facilities for crossing barriers, and the insects found on Bounty Islands are all related to New Zealand forms. I do not include here the evidence of the plants of the Antarctic islands, for most plants do not require that the land should be actually continuous to enable them to spread.

But if the flightless insects and the earthworms imply a former connection with northern lands, that connection must have been a very long time ago, before the spread of insects and angiospermous plants over the world, that is, not later than the Jurassic period. If there had been any land connection in Tertiary times, there would have been a much greater mixing of the animals and plants.

It is evident that the flora, and perhaps the fauna, of Antarctica were formerly much richer than at present, as is proved by the fossil plants of South Victoria Land, and it is also probable that both fauna and flora were killed off by an increasingly rigorous climate. It is not necessary to assume a former Glacial epoch for this, for higher plants and animals could hardly resist the present climate, and there is no palæontological evidence of a period of greater cold than now having ever existed in the southern hemisphere. On the contrary, the biological as well as the palæontological evidence is against the idea. For the much modified plover, Chionis, and the insects of Kerguelen Land, as well as the remarkable flora of the Antarctic islands, show that the islands could not have been covered with ice for a very long time.

The relations between the avifaunas of Australia and South Africa are much closer than exist between those of Australia and South America, and this is just what we should expect if the ancestors of the present birds had spread down from the north under the present condition of land and sea, for the land connection between Australia and South Africa is far more intimate than that between the former place and South America. But the contrary is the case with the Mammalia, some of the tortoises, snakes, frogs, some of the fresh-water fishes, a large number of insects, and the family Cryptodrilidæ of earthworms. This implies that at some former time a closer connection existed between Australia and South America than between Australia and Africa. The question is, Was this connection by means of an Antarctic continent? Or was it by a Pacific continent?

The principal objection to the southern route is that the connection between Australia and South America is shown by a number of subtropical animals—such as Osteoglossum and Ceratodus—none of which have left any trace of their passage through New Zealand. We cannot suppose that New Zealand was disconnected at the time from the Antarctic continent, for it, also, has distinct relations with South America, but for the most part by means of different animals from those which show the Australian connection. If the connection was in either the Cretaceous or the Eocene period, we might suppose that the climate was warm enough for the passage of the subtropical animals by the Antarctic route, but, if so, why are there no traces of marsupials and South American frogs in New Zealand? If, on the other hand, we suppose the ancestors of these animals to have crossed from Australia to South America by a South Pacific continent, we can understand how the subtropical forms would not have come so far south as New Zealand, while the New Zealand forms would have crossed at a higher latitude. In favour of this we have a member of the Iguanidæ in Fiji, as well as the evidence of the land shells of Polynesia, which are not a collection of waifs and strays, but form a distinct group of a very early type, which, however, has not yet been found in South America.

We still have to consider the floras and the marine faunas of the Antarctic islands. Here we see a number of birds—such as cormorants and gulls—as well as fishes and plants, which could hardly spread round the world under the present conditions of land and water. That this spreading was a comparatively late one is proved by the near relations between the species. But if there had been continuous land at the time, land animals would have spread with the marine ones. It is therefore necessary to suppose that this last spreading of species in Antarctic latitudes was by means of a number of islands. Probably this was in Pliocene times, if we may judge by the amount of differentiation which has taken place since then.

I therefore conclude that the hypothesis which best explains the phenomena is the following:—

(1) That in the Jurassic period an Antarctic continent existed which connected South America with New Zealand and South Africa.

(2) That this continent sank in the Cretaceous period, and that Antarctica has never since been connected with northern lands.

(3) That in the Cretaceous or early Eocene a Pacific continent connected New Guinea and New Zealand with Chili.

(4) That this land sank at the close of the Eocene.

(5) That in the Pliocene a number of islands existed in the Antarctic Ocean, which have since then disappeared.

F. W. HUTTON.

The British Slugs.

MR. J. W. TAYLOR has just published part ii. of his admirable "Monograph of the Land and Freshwater Mollusca of the British Isles," containing a discussion of the slugs of the genus Arion. It is a matter of interest that, notwithstanding the great amount of information gathered in recent years, the beautiful bicoloured varieties of *A. ater* appear to hold their own as truly endemic inhabitants of Britain. These are three in number, though Mr. Taylor treats the third as merely a subvariety.

(1) *Arion ater*, var. *albolateralis*, Roebuck, 1883. Back black, sides white.

(2) *Arion ater*, var *Roebucki* (*bicolour*, Roebuck, in error). Back brown, sides yellow.

(3) *Arion ater*, var. *Scharffi*, Cockerell, 1893. Back black, sides yellow.

Mr. Taylor retains the name *bicolour* for the second variety, but it is not the *bicolour* of Moquin-Tandon, as was formerly supposed, and a new name is necessary. It is appropriate to name it after Mr. Roebuck, who first made it known. These magnificent slugs are of western distribution in the British Islands, and have quite a wide range. The only evidence of their occurrence on the Continent is Scharff's statement that Simroth found specimens "similar" to var. *Roebucki* on the shores of the Baltic; and the possibility that the Norwegian var. *medius*, Jensen, may be similar to *albolateralis*, though it is very likely not even of the same species. A quite different variety of *A. ater* is the wholly black form *aterrima*, said to be especially northern and montane. According to Mr. Taylor, this is exclusively British, except that it appears to be represented in Spain and Portugal by a similar animal named *hispanicus* by Simroth. However, I had always regarded this *aterrima* variety as the one so described from France by Dumont and Mortillet (*cf. Science Gossip*, 1889, p. 212, "the pitchy black variety found in swamps"), and if it is not, the name *aterrima*, applied to it by Mr. Taylor, cannot stand. At the opposite pole of variation from *aterrima* is the brilliant red form *A. ater*, var. *coccinea* (Gistel), which is hardly ever found in England, but is abundant in the warmer and drier regions of Central Europe.

Incidentally, it may be remarked that the name *Arion hortensis*, var. *subfusca*, employed by Mr. Taylor, cannot be retained, as it is founded on *Limax subfuscus*, C. Pfr., a homonym of *L. subfuscus*, Draparnaud.

T. D. A. COCKERELL.

University of Colorado, June 26.

NOTES ON STONEHENGE.[1]

VII.—ON THE DARTMOOR AVENUES.

SOME years ago I referred in NATURE to the numerous alignments of stones in Brittany, and I was allowed by Lieut. Devoir, of the French Navy, to give some of his theodolite observations of the directions along which the stones had been set up.

The conclusion was that we were really dealing with monuments connected with the worship of the sun of the May year, a year which the recent evidence has shown to have been the first recognised after the length of the year had been determined; thus replacing the lunar unit of time which was in vogue previously, and the use of which is brought home to us by the reputed ages of Methuselah and other biblical personages, who knew no other measurer of time than the moon.

There was also evidence to the effect that in later times solstitial alignments had been added, so that the idea that we were dealing with astronomically oriented rows of stones was greatly strengthened, not to say established.

So long as the Brittany alignments were things of mystery, their origin, as well as that of the more or less similar monuments in Britain, was variously explained; they were models in stone of armies in battle array, or they represented funeral processions, to mention only two suggestions. I should add that Mr. H. Worth, who has devoted much time to their study, considers that some sepulchral interest attaches to them, though he thinks it may be argued that that was secondary, even as are interments in cathedrals and churches. About burials associated with them, of course, there is no question, for the kistvaens and cairns are there; but my observations suggest that they were added long after the avenues were built, as some cairns *block* avenues. Perhaps a careful study of the mode of burial may throw light on this point.

The equivalents of the Brittany alignments are not common in Britain; they exist in the greatest number on Dartmoor, whither I went recently to study them. The conditions on high Dartmoor are peculiar.

Blinding mists are common, and, moreover, sometimes come on almost without warning. From its conformation the land is full of streams. There are stones everywhere. What I found, therefore, as had others before me, was that as a consequence of the conditions to which I have referred, directions had been indicated by rows of stones for quite other than ceremonial purposes. Here, then, was a possible third origin. It was a matter of great importance to discriminate most carefully between these alignments, and to endeavour to sort them out. My special inquiry, of course, was to see if they, like their apparent equivalents in Brittany, could have had an astronomical origin. The first thing to do, then, was to see which might have been erected for worship or which for practical purposes.

In doing this there is no difficulty in dealing with extremes. Thus one notable line of large flat stones has been claimed by Messrs. R. N. Worth and R. Burnard as a portion of the Great Fosseway (Rowe's "Perambulation," third edition, p. 63); it has been traced for eighteen miles from beyond Hameldon nearly to Tavistock, the stones being about 2 feet thick and the road 10 feet wide.

There are two notable avenues of upright stones at Merrivale; they are in close connection with a circle, and could have had no practical use. These stones, then, we may claim as representing the opposite extreme of the Fosseway and as suggesting an astronomical, as opposed to a practical, use; the adjacent circle, of course, greatly strengthens this view.

It is between these extremes that difficulties may arise, but the verdict can, in a great many cases at all events, be settled without any very great hesitation, especially where practical or astronomical uselessness can be established. But even here care is necessary, as I shall show.

The stones now in question, originally upright, are variously called avenues, rows, alignments or parallelithons. Their study dates from 1827, when Rowe and Colonel Hamilton Smith examined those at Merrivale (Rowe, *op. cit.*, p. 31). Their number has increased with every careful study of any part of the moor, and doubtless many are still unmapped.[1] The late Mr. R. N. Worth, of Plymouth, and his son, Mr. H. Worth, have given great attention to these monuments, and the former communicated a paper on them to the Devonshire Association for the Advancement of Science in 1892 (Trans., xxv. pp. 387–417).

Photo. by Lady Lockyer.

FIG. 17.—The Southern Avenue at Merrivale, looking East.

A word of caution must be said before I proceed. We must not take for granted that the stone-rows are now as they left the hands of the builders. The disastrous carelessness of the Government in the matter of our national antiquities is, I am locally informed, admirably imitated by the Devonshire County and other lesser councils, and, indeed, by anybody who has a road to mend or a wall to build. On this account, any of the rows may once have been much longer and with an obvious practical use; and

[1] Continued from p. 34.

[1] Only yesterday (June 15) that excellent guide of the Chagford part of the moor, Mr. S. Perrott, showed me an avenue (Azimuth N. 20° E. true) near Hurston Ridge which is not shown in the 1-inch map.

those which now appear to be far removed from circles may once have been used for sacred processions at shrines which have disappeared.

Again, the rows of stones we are now considering must not be confounded with the "track lines" or "boundary banks" which are so numerous on Dartmoor and are represented in Wiltshire according to Sir R. C. Hoare; these serve for bounds and pathways, and for connecting and enclosing fields or houses.

Dealing, then, with stone rows or avenues, which may be single, double, or multiple; any which are very long and crooked, following several directions, are certainly not astronomical; and it is easy to see in some cases that they might have been useful guides at night or in mist in difficult country with streams to cross. This possible utility must not be judged wholly by the present conformation of the ground or the present beds of streams.

For multiple avenues it is hard to find practical uses such as the above, and we know how such avenues were used in Brittany for sun worship. Mr. Baring Gould considers there were eight rows in an avenue on Challacombe Down 528 feet long; of these only three rows remain, the others being represented by single stones here and there (Rowe, p. 33). I shall have something to say about this avenue further on.

Although, as I have said, long rows bending in various directions are not likely to have had an astronomical origin, it must not be assumed that all astronomical avenues must be *exactly* straight. This, of course, would be true for level ground, but if the avenue has to pass over ridges and furrows, the varying height of the horizon must be reckoned with, and therefore the azimuth of the avenue at any point along it.

I think it possible that in the Staldon Moor row we have the mixture of religious and practical intention at which I have before hinted. Both Mr. Lukis and Mr. Hansford Worth have studied this monument, which is two miles and a quarter long. There is a circle at the south end about 60 feet in diameter, while at its northern end there is a cairn.

Where the line starts from the circle the direction of the row is parallel to many sight-lines in Cornwall, and Arcturus would rise in the azimuth indicated. But this direction is afterwards given up for one which leads towards an important collection of hut circles, and it crosses the Erme, no doubt at the most convenient spot. More to the north it crosses another stream and the bog of Red Lake. All this is surely practical enough, although the way indicated might have been followed by the priests of the hut circles to the stone circle to prepare the morning sacrifice and go through the ritual.

But there is still another method of discrimination. If any of these avenues were used at all for purposes of worship, their azimuths should agree with those already found in connection with circles in other parts of Britain, for we need not postulate a special race with a special cult limited to Dartmoor; and in my inquiries what I have to do is to consider the general question of orientation wherever traces of it can be found. The more the evidences coincide the better it is for the argument, while variations afford valuable tests.

Now, speaking very generally (I have not yet compared all my numerous notes), in Cornwall the chief alignments from the circles there are with azimuths N. 10°–20° E. watching the rise of Arcturus, N. 24°–28° E. watching the rise of the May sun, N. 75°–82° E. watching the rise of the Pleiades. The variation in the azimuths is largely due to the different heights of the horizon towards which the sight-lines are directed.

The conclusion I have come to is that these alignments, depending upon circles and menhirs in Cornwall, are all well represented on Dartmoor associated with the avenues; and further, so far as I have learned at present, in the case of the avenues connected with circles, there are not many alignments I have not met with in connection with circles in Cornwall and elsewhere.

This is not only a *prima facie* argument in favour of the astronomical use underlying the structures, but it is against the burial theory, for certainly there must have been burials in Cornwall.

In order, therefore, to proceed with the utmost caution, I limit myself in the first instance to the above azimuths, and will begin by applying a test which should be a rigid one.

If the avenues on Dartmoor had to deal with the same practices and cults as did the circles in Cornwall, they ought to prove themselves to have been in use at *about* the same time, and from this point of view the investigation of the avenues becomes of very great importance, because of the destruction of circles and menhirs which has been going on, and is still going on, on Dartmoor. We have circles without menhirs and menhirs without circles, so that the azimuths of the avenues alone remain to give us any chance of dating the monuments if they were used in connection with sun worship. The case is far different in Cornwall, where both circles and menhirs have in many cases been spared.

On Dartmoor, where in some cases the menhirs still remain, they have been annexed as crosses or perhaps as boundary stones, and squared and initialed; hence the Ordnance surveyors have been misled, and they are not shown as ancient stones on the map. In some cases the azimuth of the stones suggests that this has been the sequence of events.

It will be seen from the above that I have not tackled a question full of pitfalls without due caution, and this care was all the more necessary as the avenues have for long been the meeting ground of the friends and foes of what Rowe calls "Druidical speculations"; even yet the war rages, and my writing and Lieut. Devoir's observing touching the similar but grander avenues of Brittany have so far been all in vain; chiefly, I think, because no discrimination has been considered possible between different uses of avenues, and because the statements made by archæologists as to their direction have been quite useless to anybody in consequence of their vagueness, and last of all because the recent work on the Brittany remains is little known.

I began my acquaintance with the Dartmoor monuments by visiting Merrivale, and the result of my inquiries there left absolutely no doubt whatever on my mind. I was armed, thanks to the kindness of Colonel Johnston, the director of the Ordnance Survey, with the 25-inch map, while Mr. Hansford Worth had been so good as to send me one showing his special survey.

The Merrivale avenues (lat. 50° 33′ 15″) are composed of two double rows, roughly with the azimuth N. 82° E.; the northern row is shorter than the other. Rowe, in his original description (1830), makes the northern 1143 feet long; they are not quite parallel, and the southern row has a distinct "kink" or change of direction in it at about the centre. The stones are mostly 2 or 3 feet high, and in each row they are about 3 feet apart; the distance between the rows is about 80 feet.

I have before pointed out that an avenue directed to the rising place of a star, if it is erected over undulating ground, cannot be straight. I may now mention another apparent paradox. If two avenues are directed to the rising place of the same star *at different times*, they cannot be parallel. It is not a little curious that absence of parallelism has been used against avenues having had an astronomical use!

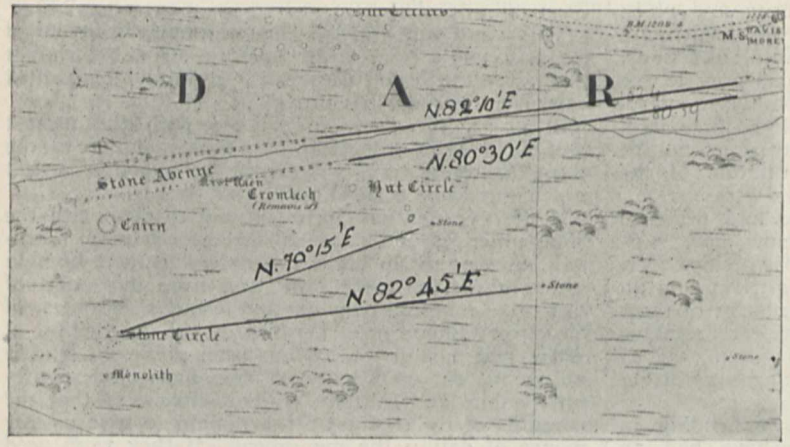


FIG. 18.—Plan, from the Ordnance Map, showing the avenues, circle and stones at Merrivale, with their azimuths.

Both the Ordnance surveyors and Mr. Worth have shown the want of parallelism of the two avenues, and Mr. Worth has noted the kink in the southern one. The height of the horizon, as determined from my measures, is 3° 18′. The results of these inquiries, assuming the Pleiades to have been observed warning May morning, are as follows:—

Azimuth	Authority	N. Declination	Date B.C.
		° ′ ″	
N. 83·15 E.	Worth	6 47 47	1710
82·30	Worth	7 16 20	1630
82·10	Ordnance	7 32 0	1580
80·40	Worth	8 26 0	1420
80·30	Ordnance	8 30 0	1400

To simplify matters we may deal with the Ordnance values and neglect the small change of direction in the southern avenue. We have, then, the two dates 1580 B.C. and 1420 B.C. for the two avenues. The argument for the Pleiades is strengthened by the fact that at Athens the Hecatompedon was oriented to these stars in 1495 B.C. according to Mr. Penrose's determination of the azimuth.

Now this is not the first time I have referred to avenues in these notes. The azimuth of one at Stonehenge was used to fix the date at which sun worship went on there. That avenue, unlike the Dartmoor ones, was built of earth, and it is not alone. There is another nearly two miles long called the Cursus. So far, I have found no solstitial worship on Dartmoor, so there are no avenues parallel to the one at Stonehenge leading N.E. from the temple. But how about the other? *It is roughly parallel to the avenues at Merrivale, and I think, therefore, was, like them, used as a processional road, a via sacra, to watch the rising of the Pleiades.*

I said roughly parallel; its azimuth is about the same (N. 82° E. roughly); but the horizon is only about 1° high; it was therefore in use before those at Merrivale; the exact date of use must wait for theodolite values of the height of the horizon, but in the meantime we can see from the above estimates that the declination of the Pleiades was about N. 5° 28′ 30″ and the date of use 1950 B.C., that is some 300 years before the solstitial restoration.

Mr. Worth's survey gives another line of stones which is not shown in the Ordnance survey. It is undoubtedly, I think, an ancient line, although it is not shown in the Ordnance map, a clear indication of the difficulty of discriminating these avenues on land cumbered with stones in all directions. Its azimuth is N. 24° 25′ E., and the height of the horizon 5° 10′. This gives us Arcturus at the date 1860 B.C., showing that, as at the Hurlers, Arcturus was used before the Pleiades. Hence a possible *astronomical* use is evident, while this row, like the others, could have been of no *practical* use to anybody. It is interesting to note that this single row of stones is older than the double ones; this seems natural.

It is worth while to say a word as to the different treatment of the ends of the south avenue now that it seems probable that it was used to watch the rising of the Pleiades. At the east end there is what archæologists term a "blocking stone"; these observations suggest that it was really a *sighting* stone. At the west end such a stone is absent, but the final stones in the avenue are longer than the rest. This may help us to determine the true direction of the sight-lines in other avenues, and, indeed, I shall show in the sequel that it affords a criterion which in some cases is entirely in harmony with other considerations.

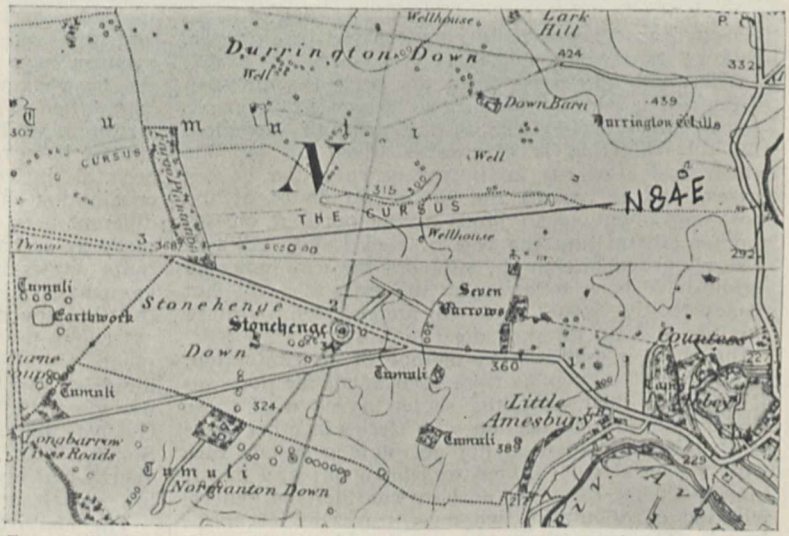


FIG. 19.—Reprint of Ordnance Map showing that the Cursus at Stonehenge is nearly parallel to the Merrivale Avenue. The azimuth is 82° and not 84° as shown in the figure.

NORMAN LOCKYER.

SOLAR AND TERRESTRIAL CHANGES.

THE problem of the relations between sun-spots and other solar phenomena and weather has engaged the attention of men of science for many years past. The results of their investigations have not, perhaps, been so satisfactory or conclusive as were at first anticipated, but this, fortunately, has not diminished the enthusiasm of those interested in the solution of the problem. The ordinary public who were attracted by the apparent simplicity and probability of the relations suggested have undoubtedly been disappointed with the results. There has hence been a tendency for some time past to depreciate investigation in this field of science. On the other hand, the experience of the recent droughts and famines in India, Australia, and South Africa has directed attention strongly to the probable relation between variations of solar activity and the larger variations of rainfall over the earth's surface. The aqueous vapour precipitated as rain over large land areas such as India is produced by evaporation over distant oceanic areas, and is thence carried to the areas of discharge by the larger atmospheric currents. These actions are the direct results of the conversion of solar energy, and any large variation in the supply of that energy must be accompanied with, and followed by, corresponding changes in the amount of evaporation and atmospheric movement, and hence, also, of amount and distribution of rain. The determination of the relations thus indicated is not merely of value from the scientific standpoint, but has important practical bearings, as it may lead to a satisfactory method of long-period weather forecasting —a question which is largely engaging the attention of meteorologists at the present time.

Three lines of observation (and hence also of investigation) carried on at the present time furnish data for the solution of the problem. These are the observations of terrestrial magnetism, of terrestrial atmospheric meteorology, and of solar phenomena.

A large number of magnetic observatories, furnished with the most delicate and sensitive instruments, provide a continuous record of the changes of the earth's magnetic state by its action on magnetised needles at the earth's surface.

The work of meteorological observation has made great progress during the past twenty-five years. It has not only been extended and improved, but is carried on much more systematically than hitherto. Unfortunately its record is very imperfect, as it is probably not too much to say that over at least five-sixths of the earth's surface, including the greater part of the interior of Asia and Africa, and over the larger oceanic areas and the Polar regions, the amount of observation is exceedingly small and of little value for the solution of the problem. There is hence a continuous record of the meteorological changes of the earth's atmosphere over barely one-sixth of its surface. There is, moreover, no general collection and publication of the meteorological data in such a form as to give a continuous history of the larger atmospheric variations and changes in progress over even that sixth part of the earth's surface.

The third branch of observation, that of solar phenomena, has made wonderful progress during the past fifty years. Previously the telescopic examination of the sun's surface had disclosed the eleven-year periodicity of the sun-spots. Latterly the combination of the spectroscopic and telescopic observation of the sun has revealed the complexity of the changes in progress throughout the depth of its atmosphere, and of which the sun-spots are only one and a very partial expression. This field of investigation is so promising that solar observatories have been established in many countries, and a continuous record of the solar changes, so far as they are indicated by present methods of observation, is now possible by combining the data furnished by all the observatories. The work of correlating the three classes of observation has, however, not yet been commenced in a systematic manner, although the necessity is now fully recognised.

It is now generally, if not universally, admitted that the sun is practically the sole source of the energy which maintains the movements of the earth's atmosphere. It is the centre of a continuous outflow of radiant energy, a very small portion of which is intercepted and appropriated by the earth, where it is converted into other forms of energy. The investigation of the rate of this flow of energy and its time variations, the analysis of the total energy into its elements as that of a series of oscillatory movements of different periods and amplitudes or wave-lengths, and the problem of its distribution in its passage through the atmosphere and at the earth's surface are each in little more than the initial stages. In some departments of the investigation, as, for example, the laws of the absorption of the solar energy during its passage through the earth's atmosphere, much work has been done, but with comparatively little result.

The appropriation of solar energy by the earth affects it mainly in two ways, first, as a whole, determining or modifying its magnetic condition, and secondly, partially, affecting the atmosphere and a thin surface layer of the solid or liquid mass. Any variation in the flow of solar energy, periodic or irregular, will theoretically give rise to corresponding changes in the earth's magnetic condition and its atmospheric movements. The determination of the relations between the three classes of variation is on the whole the most important problem in this field of inquiry into the solar energy and its variations and effects.

The first part of the problem, that is, the relation of the variations of solar energy (as manifested and measured by the observable changes in the number and extent of the sun-spots, prominences, &c.) to those of the magnetic condition of the earth shown by its action on a magnetised needle suitably suspended, is comparatively simple, as the earth appears to be similarly affected as a whole and throughout its whole mass. The variations are indicated as clearly and satisfactorily by an observatory in India or Australia as at Kew in England. There are undoubtedly local variations which may require to be eliminated in order to obtain the general variation. It has, however, been conclusively established by observations in different regions that there is a general parallelism between the amount and extent of the magnetic variation or disturbance and the number and magnitude of the sun-spots and prominences. The rule is, the larger the number of sun-spots the greater the amount of the magnetic variation and disturbance. The relation can, however, at the present stage only be considered as statistical, as it has not been established for single sun-spots. In other words, the observed outburst or sudden appearance of a single spot or prominence is not invariably accompanied by a terrestrial magnetic disturbance. Various reasons have been given for the failure of parallelism in detail. Hence all that can be inferred at the present time is that definite relations (of a statistical kind) of great importance have been obtained which more than justify the continuance of this branch of the inquiry, and make it desirable that the work of terrestrial magnetic observation and investigation, and of comparison with solar phenomena, should be maintained and if possible extended.

Numerous attempts, only very partially successful, have been made to establish similar definite relations between solar and terrestrial atmospheric variations. The South Kensington observatory has done much valuable work in this direction. It is, however, doubtful whether the results obtained by any of the investigators in this branch are generally accepted.

The reasons for this very partial success are almost self-evident, and are due to the complexity of the problems presented by the movements of the atmosphere, more especially as modified by the presence of very varying amounts of aqueous vapour, the result of the processes of evaporation and condensation. The effects of the solar variation on the earth's atmosphere are, in fact, distributed and manifested in very varying proportion between the different elements of observation, and the direct effect of a solar variation on one element may be followed by an opposite effect due to variation of another element, so that the final result may be opposite in character to the initial effect. Thus an increase of solar radiant energy would, if there were no increase of aqueous vapour amount, cloud or air movement, undoubtedly increase pressure and temperature. If these changes, however, give rise to increased vertical and horizontal movement, it is possible that as a later result pressure probably, and temperature possibly, might both be decreased below their original or normal level, and hence that the observed change might be the opposite to that of the direct effect of the original variation. Also there is another source of difficulty in this branch of the inquiry, due to the fact that in the case of some of the elements of observation a positive variation over a considerable area of the earth's surface must necessarily be accompanied with a negative variation of corresponding amount in some other region as part and parcel of the total change. The changes in these elements, taken over the earth's surface, must either be completely compensatory, as is probably the case for pressure, or partially compensatory, as is undoubtedly the case for rainfall.

It is also necessary to bear in mind that the instrumental appliances for magnetical and meteorological observations are of very different orders of exactness. Magnetic instruments, more especially those for continuous autographic registration, are of great delicacy. Meteorological instruments are, on the other hand, much less delicate, and the most important of all from certain points of view, viz. the instruments for registering the direction and rate of air movement, are especially coarse, and their individual observations are necessarily affected with large errors.

The problem of the relations between solar and terrestrial meteorological variations is hence complicated and difficult. It evidently requires for its complete solution the collection and coordination of data for the whole of the earth's surface, and the careful employment of statistical methods regulated by thorough knowledge of the physics of the atmosphere.

The difficulties of the problem are great, and explain the comparative want of success of investigators hitherto. It is, however, certain from theoretical considerations that there are definite relations, and that their determination is of great importance, equally from the scientific and the utilitarian point of view.

The observational data for a more systematic investigation are now considered by many to be sufficient, if collected, compared, and discussed as a whole, to promise more satisfactory and valid conclusions than have hitherto been obtained, and perhaps a first approximate solution. This opinion found expression fully at the meeting of the British Association at Southport in 1903. Sir Norman Lockyer, director of the Solar Physics Observatory, South Kensington, read a report giving a summary of the results of previous investigations in "Simultaneous Solar and Terrestrial Changes" to Section A of the British Association. The members of the International Meteorological Committee present at the meeting joined in the discussion, and it was decided that the time had arrived for joint and concerted action. A commission to act as a subcommittee of the International Meteorological Committee was formed to discuss meteorological observations from the point of view of their connection with magnetism and solar physics. The commission held several meetings at Cambridge in 1904 during the British Association week. Several additional members were added to the commission, which now includes the names of the leading authorities in the three associated branches of science.

The chief work of the commission at Cambridge was to lay down principles for the selection of the data required for comparison, and to arrange for the choice of stations and observatories from which it would be desirable to obtain data prior to entering into communication with the various organisations that it would be necessary to ask for assistance in the collection of data.

It has been arranged that a meeting of the commission shall be held in connection with the meeting of the International Meteorological Committee at Innsbruck in September. A number of important matters will there be considered. Amongst these are the final selection of magnetic and meteorological observatories from which data are to be collected, the mode of publication of the data received by the commission, and probably, also, of the methods to be employed in the work of comparison and discussion of the data. Hofrath Prof. Julius Hann has suggested for consideration a method of determining the variation of temperature during a sun-spot period. This will, it is hoped, lead to an interesting discussion on the methods of investigation most suited and appropriate for the determination of the relations between solar and terrestrial phenomena.

THE PROPOSED COLLEGE OF APPLIED SCIENCE.

THE appearance of the preliminary report of the Departmental Committee on the Royal College of Science and Royal School of Mines, which was published in our issue of last week, brings us an important step nearer the realisation of an object after which men of science have long striven; the provision, that is, of a great metropolitan college—liberally endowed, handsomely housed, adequately equipped, and generously staffed—designed amply to supply that higher technical instruction for which there has been little provision hitherto, but upon which our well-being as a commercial and manufacturing nation ultimately depends.

The report shows that the committee has been engaged wisely in determining what precisely the existing facilities for instruction in applied science are, and in gathering the information necessary to decide what the new college should supply in addition to these, so as to place London, as the centre of the Empire, in a condition to compare educationally with Berlin, for example, or with many great American cities. It is unnecessary here to recapitulate the recommendations of the committee, but the special wisdom of

one or two of its conclusions cannot be insisted upon too earnestly or too often.

The new institution must be in no sense parochial, nor must it be allowed to become merely metropolitan. From the beginning the design must be to give the college an Imperial character, and every means must be taken to encourage young men possessed of the necessary qualifications, in whatever part of the Empire they may be, to attend its courses and avail themselves of the means offered by it of becoming familiar with recent advances in technology and with any branch of applied science in its highest form.

The new institution must not be allowed to become merely another technical college on a larger scale—of technical institutes we have many already. The "duly qualified students" referred to by the committee should have already received collegiate training, and have taken a degree. To quote the report:—"Admission to these higher courses should be restricted to duly qualified students who, it is hoped, would be attracted from all parts of the Empire." The public must be taught to estimate the success of the new institution, not by the number of its roll-call, but by the number of expert engineers of all kinds, of original technical chemists, of machine designers, and so on, who are trained within its portals.

But besides being able to supply the future manufacturer with the very latest results from the research laboratories of workers outside its walls, the new institution, if it is to be really successful, must itself be an active centre of research. As the report says:—"It is of the first importance that there should be no divorce between teaching and research in technology on the one hand and in pure science on the other," and the new college must be as notable for its success in research in technology as for the ability possessed by its staff to acquaint the student with the findings of recent scientific work. Unless from the beginning the student feels he is under the influence of professors who are not only familiar with all the conditions of actual manufacture in its most successful form, but who are responsible also for the improvements in technical processes which win success, the institution will neither do the work expected of it nor win the confidence of our manufacturing magnates and merchant princes. Only that science—whether pure or applied—really lives which grows continually, and such growth without patient research is impossible. The new institution must above all things be the growing point of our national system of technical instruction.

To fulfil these two functions—on which the report rightly lays very great emphasis—the staff of the Imperial college must be both numerous and the best available. In other words, the institution must of necessity be a costly one, judged, that is, from the standard adopted previously in this country for estimating educational expenses. But if properly selected such a staff will very soon show, by the results accomplished, that generous expenditure on higher education is a remunerative form of national expenditure. It is gratifying to find from the report that there is every prospect that a sufficient revenue will be eventually forthcoming, in the provision of which funds the State will take its part. We learn from the *Times* that the Government has decided to allocate 20,000*l.* a year to the college out of the Treasury subsidy for the maintenance of the Royal College of Science and the Royal School of Mines, and that an intimation to this effect has been made by the Chancellor of the Exchequer to Mr. Haldane, the chairman of the Departmental Committee.

There is every reason to hope that London will ere long have at South Kensington a college of applied science which will be as much admired as the similar institution at Charlottenburg, and prove as useful to the industries of this country as the Berlin college has to those of Germany.

NOTES.

As the new buildings of the University of Sheffield were opened by the King at the time the present issue of NATURE was being prepared for press, we cannot do more than record the fact, reserving a description of the buildings and an account of the opening ceremony for a subsequent number.

THE annual meeting of the Imperial Cancer Research Fund was held on July 5 at Marlborough House, the Prince of Wales presiding. Sir William Church moved the adoption of the secretary's, superintendent's, and treasurer's reports, which was seconded by Mr. Tweedy. Mr. Henry Morris moved that the best thanks of the meeting be given to His Royal Highness for presiding, which was carried with acclamation. The Prince of Wales in reply alluded to the researches which had been carried out in the laboratories of the fund, and expressed his satisfaction that the committee had again secured the services of Sir William Church as chairman of the executive committee.

THE summer show of the Royal Horticultural Society was opened on Tuesday last, and will remain open until this evening. It is being held for the first time in the grounds of Chelsea Hospital. The society appears to be in a very flourishing condition, more than 1000 new fellows having been added within the last few months.

THE Albert medal of the Society of Arts for 1905 was, on Wednesday, July 5, at Marlborough House, presented by the Prince of Wales, as president of the society, to Lord Rayleigh "in recognition of the influence which his researches, directed to the increase of scientific knowledge, have had upon industrial progress, by facilitating, amongst other scientific applications, the provision of accurate electrical standards, the production of improved lenses, and the development of apparatus for sound signalling at sea."

THE French Association for the Advancement of Science will this year meet at Cherbourg. The session will extend from August 3 to 10.

THE summer meeting of the Institution of Naval Architects will take place on July 19, 20, and 21 in the hall of the Society of Arts. The following papers will be read and discussed:—"Tactics and Strategy at the Time of Trafalgar," by Admiral Sir Cyprian Bridge, G.C.B.; "The Ships of the Royal Navy as they Existed at the Time of Trafalgar," by Sir Philip Watts, K.C.B., F.R.S., vice-president; "The Classification of Merchant Shipping, illustrated by a Short History of Lloyd's Register," by H. J. Cornish; "Experiments with Models of Constant Length and Form of Cross Sections, but with varying Breadths and Draughts," by Lieut.-Col. B. Rota; "Experiments on the Effect of Depth of Water on Speed, having Special Reference to Destroyers recently Built," by H. Yarrow; "Deductions from Recent and Former Experiments on the Influence of the Depth of Water on Speed," by W. W. Marriner; "The Failure of some large Boiler Plates," by J. T. Milton; and "A Comparison of the Performances of Turbines and Reciprocating Engines in the Midland Railway Company's Steamers," by W. Gray.

THE London congress of the Royal Institute of Public Health will be held from Wednesday next, July 19, to Tuesday, July 25, under the presidency of Sir James Crichton Browne. The meetings will take place at King's College, Strand, and at the Polytechnic, Regent Street. In connection with the congress there will be an exhibition of sanitary and educational appliances at the Regent Street Polytechnic, and this will remain open until July 28.

THE *British Medical Journal* announces that a tuberculosis exhibition, arranged under the auspices of the National Association for the Study and Prevention of Tuberculosis, and of the Committee on the Prevention of Tuberculosis of the Charity Organisation Society, will be held in New York in November next. The object of the exhibition is the education of the people. In addition to exhibits illustrating different phases of the tuberculosis problem, and especially the treatment of the disease, popular lectures will be delivered by specialists.

THE Long Fox memorial lecture for this year will, says the *Lancet*, be delivered in November by Dr. E. Markham Skerritt.

M. CURIE was last week elected a member of the Paris Academy of Sciences.

THE Mary Kingsley medal of the Liverpool School of Tropical Medicine has been awarded to Dr. Laveran, of the Pasteur Institute, Sir Patrick Manson, K.C.M.G., F.R.S., and Col. Sir D. Bruce, K.C.B., F.R.S.

LORD KELVIN AND SIR WILLIAM CHRISTIE, Astronomer Royal, were at the final meeting of the present session of the Optical Society made honorary members of the society.

IT is stated in *Science* that Prof. William Osler has been made honorary professor of medicine at the Johns Hopkins University.

THE president of the Board of Agriculture (the Right Hon. Ailwyn E. Fellowes) will distribute the diplomas and prizes at the South-eastern Agricultural College, Wye, on Friday, July 21.

WE learn from the Royal Society that as an adjunct to the International Laboratory of Physiology on Monte Rosa, a lower laboratory, with a hostel, has been established at Col d'Olen. This lower laboratory is mainly intended for biological research, but it is understood that provision has also been made for the study of terrestrial physics and meteorology. The Royal Society has the permanent nomination to two posts, each of which includes a living room in the hostel, a bench in the laboratory, and the use of apparatus; but the expenses of living and of special researches must be borne by the investigators. The laboratory is especially connected with the University of Turin, but is under the immediate direction of a committee. Applications for nominations to the two posts referred to above may be addressed to the secretaries of the Royal Society, Burlington House, London, W.

A REUTER telegram from Florence states that the instruments of the Delle Quercie Observatory of that place recorded on Sunday last severe earthquake shocks as taking place in a distant country.

THE death is announced from Belgium of M. Elisée Reclus, the French geographer, in his seventy-sixth year. At the University of Berlin he studied under the great geographer Karl Ritter. Having in 1851, because of his political opinions, to leave France, he travelled for six years, visiting England, Ireland, North America, Central America, and Colombia. Returning to his native country in 1857, he contributed numerous articles on his travels to periodical literature, and published a small volume entitled "Voyage à la Sierra-Nevada de Sainte Marthe." Later he wrote two books dealing respectively with the earth and the ocean. He began at Clarens, on the Lake of Geneva, the work of his life—the "Nouvelle Géographie Universelle," the first volume of which appeared in 1876. The work was issued in parts, and was completed in 1894, the whole occupying nineteen volumes. On the conclusion of this great task Reclus began another work dealing with the historical side of human development, *i.e.* with history as influenced by geographical conditions. He left this book, it is said, in a complete state, ready for publication.

THE death of Prof. Hermann Northnagel, of Vienna, in his sixty-fifth year, is announced. He made many contributions to medical literature, and by these and his discoveries in regard to heart action he was well known in the medical profession. Prof. Northnagel was a corresponding member of the Royal Medical Society of this country.

MANY of our readers will be glad to learn that steps are being taken to raise a memorial to the late Prof. G. B. Howes, F.R.S. In the circular letter on the subject which has reached us it is pointed out that his death was probably due most of all to overstrain occasioned by his unsparing zeal in the acquisition of full and accurate knowledge and the undeviating readiness with which he imparted the fruits of his genius and learning, not only to his regular pupils, but to every association which asked for his assistance. It is proposed that the memorial shall take the form of an endowment fund for his widow and daughter. Subscriptions should be sent as soon as possible to the honorary treasurer, Mr. Frank Crisp, 17 Throgmorton Avenue, E.C., marked on the cover "Howes Memorial Fund." We trust there will be a generous response to the appeal.

A MEETING of members of the Essex Field Club took place, by invitation of Lady Warwick, at Easton Lodge on Saturday last to inaugurate a photographic and pictorial survey and record of Essex. The object of the scheme is to make a permanent collection of photographs and other pictures of objects of interest, also maps, plans, and other documents, in order to give a comprehensive survey and record of all that is valuable and representative of Essex. The pictures, plans, &c., will be deposited and placed on view in the museum of the Essex Field Club at West Ham, and it is hoped that all the photographic societies and unattached photographers of the country will assist the committee in its work that its object may be attained.

WE are indebted to a correspondent for a copy of a supplement to the Selangor *Government Gazette*, dated April 28, containing a report from the district surgeon of Klang on "the progress of anti-malarial measures carried out at Klang and Port Swettenham," in the Federated Malay States, during the past four years, from which we learn that in 1901 malaria was very prevalent both at Klang and Port Swettenham, there being much swampy ground in which, as well as in wells, ditches, and pools, Anopheles were found breeding. Active work was undertaken in the shape of tree felling, the clearing of undergrowth, the filling up of abandoned drains, the inauguration of a system of drains to carry off and prevent

the stagnation of rain water, the notification, and if necessary the removal to hospital, of cases of malaria, and the use of kerosene and the administration of quinine, with such marked success that at the present time malaria has practically, if not absolutely, disappeared from the places where the aforesaid measures have been carried out, while the remainder of the district remains much as it was. The report is a striking testimony to the value of the discovery by Major Ronald Ross.

A COMMITTEE appointed some years ago by the laboratory section of the American Public Health Association has recently issued its report on standard methods of water analysis. The committee in formulating the report has ascertained in a comprehensive manner the views of American analysts in regard to the bacteriological, chemical, physical, and microscopical examinations of water, and much cooperative work has been done in connection with the differentiation of species of bacteria. The need for greater uniformity in water analysis methods is universally recognised, and in the further standardisation of analytical and bacteriological methods in this country regard should be had to the report of the American committee. The part dealing with the identification of species of bacteria would appear to be specially valuable. The report is reprinted from the *Journal of Infectious Diseases* (May).

IN connection with the Agricultural Education and Forestry Exhibition at the recent show of the Royal Agricultural Society there was a section devoted to meteorology, organised by the Royal Meteorological Society. One feature was a typical climatological station with all the necessary instruments; another was an exhibition of diagrams, maps, photographs, &c., illustrating the effect of weather upon agriculture. Barometers, thermometers, rain gauges, sunshine recorders, &c., were also shown, and an address was given each day by Mr. W. Marriott on meteorology in relation to agriculture.

WE have received from the meteorological reporter to the Government of India (Dr. G. T. Walker) the *Monthly Weather Review* for November, 1904, and the *Annual Summary* for 1903. In the *Monthly Review* the data are presented from two different points of view:—(1) the prevalence and spread of diseases, and (2) their connection with agricultural questions. For this purpose India has been divided into two large groups of divisions, from what may be termed the medical and agricultural standpoints. The vastness of the area, and the number of tables that the discussions necessitate, are somewhat bewildering. The *Annual Summary*, however, completes the discussion, and the aggregate data are presented in an elaborate but clear and able manner. From the agricultural standpoint, India is divided into 57 meteorological districts; the tables show, for each element, the departures of the monthly and annual mean values for 1903 from the averages of past years, and the leading features are clearly illustrated by a series of carefully prepared charts.

THE English titles of the *Journal of the Meteorological Society of Japan* for May show that it contains several interesting articles, *e.g.* on the earthquake of April 15, the hot wind at Taito in Formosa, and others. Mr. T. Okada contributes a note in English on the relation between the pulse-rate and atmospheric pressure. The author quotes a table by Prof. Clayton, who made an ascent of Pike's Peak in 1901 by means of the railway, and therefore without exertion, and Mr. Okada has calculated the atmospheric pressure at each station up to 4313 metres, from Hann's simplified barometric formula. A glance at the table shows that the pulse-rate regularly increases with decrease of atmospheric pressure, and he gives a simple equation by the use of which the actual and calculated values exactly agree. This formula shows that a decrease of 9 mm. of pressure causes an increase of one beat of the heart per minute.

WE have received a copy of the report and results of observations for the year 1904 at the Fernley Observatory, Southport. The work carried on at this institution is of considerable importance; the observatory represents the coast district of the north-west of England, between Liverpool and Fleetwood, while somewhat to the east is the inland observatory of Stonyhurst. All these stations, except, perhaps, Fleetwood, are equipped with complete self-recording instruments. The Southport Observatory undertakes, in addition to the usual work of a first order station, considerable experimental work connected with rainfall, evaporation, wind, &c., at various subordinate stations in its vicinity. It also publishes a useful table of comparative climatological statistics at health resorts and large towns. The tables show that at Southport the year 1904 was very dry, the rainfall being 7·4 inches below the average. The maximum shade temperature was 82°·4, on July 11, and the minimum 22°·0, on November 27; the lowest radiation temperature was 13°·4, on February 29. The director is Mr. J. Baxendell, meteorologist to the Southport Corporation, and the chief assistant Mr. F. L. Halliwell, who, in connection with Mr. Baxendell and Mr. W. H. Dines, has invented several large sensitive recording instruments which are now adopted at various important stations.

THE Board of Agriculture and Fisheries has received, through the Foreign Office, a copy of a despatch from the British Consul at Munich reporting that 200,000 eggs of a new kind of whitefish (*Coregonus Albula*) of the Salmonidæ family, imported from Lake Peipus, in Russia, were hatched last year with excellent results at the fish-breeding station at Starnberg, near Munich. It is the intention of the Bavarian Fisheries Society, under which the experiments have taken place, to continue trials for five consecutive years to the same extent as hitherto, in the hope that the fish first placed in the different lakes may have spawned by then.

THE *Bulletin of the Johns Hopkins Hospital* for May (xvi., No. 170) contains papers on various medical subjects and on cancer, &c., in bitches. Dr. Hemmeter, in an article of considerable interest, discusses the history of the discovery of the circulation of the blood. He remarks that no less than six individuals have been credited with this discovery—Servetus by the Spaniards, Colombus, Ruini, and Cesalpinus by the Italians, Harvey by the English, and Rabelais by the French. He then proceeds critically to survey the evidence for and against the claims of these, and also of Galen, Malpighi, and others whose anatomical discoveries were almost necessarily precursors of the conception of the blood circulation. Dr. Hemmeter finally concludes that "the discovery of the circulation of the blood was the work of almost a millennium from Aristotle and Galen to Harvey, but the one who first logically drew true consequences out of hundreds of years of preceding work, and upon whose broad intellectual shoulders all subsequent investigations rested, was William Harvey; and to-day, 328 years after his birth, we may side without reservation with the words of Bartholin: "At Harveyo omnes applaudunt circulationis auctori."

ANOTHER mounted specimen of the great auk has just been sold to a Continental museum by Messrs. Rowland Ward for 400*l*. There are, it is said, practically seventy known specimens, most of which are in State museums.

EXPERIMENTAL work for the purpose of protecting the sugar-growing industry in the Sandwich Islands has been undertaken by the new owners of the group with characteristic energy, and we have before us the first issue of Entomological Bulletins published at Honolulu on behalf of the Experiment Station of the Hawaiian Sugar Planters' Association. The present part is the first instalment of a series to be devoted to the homopterous insects commonly known as leaf-heppers (jumping relatives of the ordinary aphides, or plant lice) and their enemies, and treats of the minute parasites known as Dryinidæ, by which these pests are themselves attacked. Attempts have been made to introduce foreign dryinids into Hawaii in order that they should assist in keeping down the leaf-heppers, but at present with only partial success, owing to the fact that some of the introduced kinds do not prey on these insects. Any leaf-hepper attacked by a dryinid may be reckoned as good as dead, for even the contents of its head and eyes are mercilessly sucked dry by its uninvited "guest." The truth of the old rhyme about "little fleas and lesser fleas" is, however, forcibly emphasised in the case of these parasites, which are in turn attacked by what our American friends are pleased to call hyperparasites. "How hardly the dryinid parasites," writes Mr. R. C. L. Perkins, the author of the paper and director of the experiment station, "are at times pressed by their various hyperparasites, we often observed. To cite one instance, from about fifty cocoons of several species of parasites obtained near Cairns, one solitary male alone emerged, all the rest being hyperparasitised, and similar observations were made in several localities."

DR. WILLIS'S annual report of the Royal Botanic Gardens, Peradeniya, Ceylon, for 1904 is chiefly devoted to the work connected with investigations in economic botany. As a new departure, the formation of a cotton experiment station in the dry region of north-central Ceylon, supplied with water from irrigation tanks, is of primary importance. The difficulty of clearing the land was enhanced by scarcity of coolie labour, but the soil is excellent, and the situation seems to be well suited to the production of Sea Island cotton; rubber is also being experimentally cultivated in this region. In connection with rubber, the checking of the canker disease observed on two Hevea plantations and the high values obtained for some samples of Castilloa rubber are of interest.

MR. E. P. STEBBING contributes a note to the *Indian Forester* (May) on the satisfactory results which have been obtained by soaking bamboos in crude Burma petroleum in order to keep off the boring beetles, species of Dinoderus known as shot-borers. The article by Mr. G. H. Myers, a member of the Bureau of Forestry, on "Forestry Education in the United States," is noteworthy as indicating the aspirations which stimulate this and similar departments. The importance of practical training and of a knowledge of American requirements is emphasised.

AN hereditary abnormality in the human hand and foot and its relation to Mendelism form the subject of an article published in the papers of the Peabody Museum of American Archæology and Ethnology (vol. iii., No. 3). The abnormality in question came under the notice of the author, Dr. W. C. Farabee, some years ago in Pennsylvania, and consists in the suppression of one phalange, or joint, in each of the fingers and toes, with the exception of the thumb and great toe, which were abnormally shortened. The whole hand was extremely short and "podgy," and this feature was associated with shortness of bodily stature. Thirty-seven persons, all related, were affected with the malformation, which was inherited in accordance with Mendel's law for five generations. Although a tradition that every other child in the family had short fingers did not prove to be exactly true, yet almost precisely half the number of offspring displayed the abnormality. In one instance a regular alternation of normal and abnormal individuals continued until the eighth child. The total number of offspring descended from the original abnormal individuals is 69, of whom 33 are normal and 36 abnormal, distributed as follows:—in second generation, 4 normals and 4 abnormals; in third, 5 and 7; in fourth, 7 and 9; and in fifth, 17 and 16. The case affords strong confirmation of the general truth of the Mendelian doctrine.

THE general report of the Geological Survey of India drawn up by the director, Mr. T. H. Holland, F.R.S., shows that during the past year much valuable work has been done, and that results of scientific interest as well as of immediate economic importance have been obtained. Among advances of unusual scientific interest is the discovery of a new series of the remarkable family of elæolite-syenites near Kishengarh, in Rajputana. In economic work the department has kept in touch with the numerous developments of private enterprise in the mining of coal, gold, manganese ore and salt, and has demonstrated the existence of iron ores of industrial value. An interesting discovery is that India possesses a possibly valuable asset in the deposits of laterite, which cover considerable areas in the peninsula and in Burma, as it is shown that laterite often exhibits the essential characters of bauxite. The subject is dealt with exhaustively in the *Records of the Geological Survey of India* (vol. xxxii., part ii.) by Mr. Holland, who gives analyses of the best samples which have so far been tested. These laterites or bauxites were collected in the Madras Presidency, in the Central Provinces, in Central India, in Bengal, and in Bombay, and the percentages of alumina reach as high as 67·88. In the same issue of the Records Mr. Holland publishes returns of the Indian imports and exports of mineral products in 1904. The export of 154,880 tons of manganese ore is a remarkable feature, and the rapid increase in the export of Indian mineral oil is also noteworthy.

WE have received from the Peruvian Government copies of Bulletins Nos. 22 and 23 issued by the Corps of Mining Engineers. The former is a monograph on the mineral resources of the province of Otuzco, by Mr. F. Malaga Santolaya. The province contains rich deposits of gold and silver ores and coal of good quality, as well as ores of copper, lead, manganese, and antimony. The second bulletin is a report of a commission on the Cerro de Pasco mines, signed by the chairman, Mr. C. E. Velarde. It contains a useful summary of the Peruvian mining law and a detailed description of the Cerro de Pasco deposit, originally worked as a silver mine, but now with increasing depth yielding chiefly copper ore.

THE Sociological Society has issued a pamphlet containing an address by Dr. James Bryce on the aims and programme of the society, together with the first annual report of the council and a list of members. The report outlines the circumstances attending the inauguration of the society, and enumerates the aims which it has in view. A brief account of each of the meetings held during the

year with which the report is concerned is given, and a statement of accounts supplied. Dr. Bryce points out in his address that the members of the society may be divided into three classes, viz. those who devote themselves specially and scientifically to the business of research in all those lines of inquiry which concern man as a social being; those interested in sociology as educated and intelligent men; and practical men who are not able to devote themselves entirely to scientific study, but have to deal with sociological problems in the course of their daily life.

THE first number of a new periodical devoted to birds has just made its appearance at Cape Town. It is called the *Journal of the South African Ornithologists' Union*, and is the organ of the association recently formed under that name. Besides information relative to the new union and reports upon the proceedings of its first meetings, this number contains original articles upon South African birds by Major Sparrow, Mr. F. J. Ellemor, Mr. G. C. Shortridge, and Mr. A. Roberts. The journal is edited by Mr. W. L. Sclater (the president of the union), Dr. Gunning, and Mr. Bucknill, and will appear at irregular intervals, "when sufficient matter has been received."

MANY inquiries having been made for part ii. of the *Museum Boltenianum*, 1798 (which relates to Mollusca, and is very scarce), it has been decided to reproduce a few copies by photographic fascimile from the Crosse copy now in the British Museum (Natural History), and to sell the same at 2*l.* per copy if a sufficient number of subscribers be forthcoming. The work, if issued, will be produced under the supervision of Mr. F. W. Reader. Those wishing to subscribe should apply to Mr. E. R. Sykes, 3 Gray's Inn Place, Gray's Inn, London.

THE *Journal of the Royal Sanitary Institute* (vol. xxvi., No. 6) is mainly devoted to housing problems. Mr. Turton introduces a discussion on re-housing tenants dispossessed from insanitary property, Dr. Louis Parkes a second on housing in mansions let as flats, and Dr. Robertson a third on certain aspects of the housing problem.

THE *Psychological Bulletin* (vol. ii., No. 6) contains a report of the proceedings of the north central section of the American Psychological Association, a paper by Raymond Dodge on the illusion of clear vision during eye movements, various reviews, notes, &c.

A SECOND edition of the "Key to the Classifications of the Patent Specifications of France, Germany, Austria, Norway, Denmark, Sweden, and Switzerland in the Library of the Patent Office" has now been published at the Patent Office. The price of the "Key" is 6*d*.

MR. JOHN MURRAY has just issued the ninth edition of Mr. Edward Whymper's guide to "The Valley of Zermatt and the Matterhorn," and the tenth edition of his guide to "Chamonix and the Range of Mont Blanc." The price of each volume is three shillings net.

WE have received from Messrs. Hurst and Blackett a copy of a map of Lhasa drawn to a scale of 4 inches to a mile. The map is based on the survey in 1904 of Captain C. H. D. Ryder and Captain H. M. Cowie, with a few additions by Mr. Perceval Landon.

THE first of a series of illustrated papers by F. J. Sprague on "The Electric Railway" appears in the *Century Magazine* for July; it gives many interesting particulars of the early experiments made in electric traction.

THE articles contained in the *Bulletin of the Johns Hopkins Hospital* for June (vol. xvi., No. 171) are all of considerable medical interest, and comprise papers on the ætiology and pathogenesis of pernicious anæmia, by Dr. Bunting, on recurrent phlebitis, by Dr. Briggs, on heart block in mammals, by Dr. Erlanger, &c.

MESSRS. GURNEY AND JACKSON announce the preparation in three volumes of a translation by Dr. C. A. Keane of Lunge's "Technical Methods of Chemical Analysis."

WE are asked to state that Mr. C. S. Sargent's "Manual of the Trees of North America (exclusive of Mexico)," which was reviewed in our issue for June 29 (see p. 197), is published in England by Messrs. Archibald Constable and Co., Ltd., 16 James Street, Haymarket, and that its price is 25*s.* net.

OUR ASTRONOMICAL COLUMN.

JULY AND AUGUST METEORS.—We have now nearly arrived at what is the most interesting period of the year for the meteoric observer. With skies often clear, with the air at an agreeable temperature, and with meteors visible in more than usual abundance, success is promisingly offered to everyone who practically enters upon the study of this important and complicated branch of astronomy.

In the previous months of May and June, with their strong twilight and a scarcity of meteors, there has been no special inducement to observers, but after the third week in July the nights will become perceptibly darker, early Perseids will begin to manifest themselves, and many Aquarids will probably appear towards the close of the month from a radiant at 339°–10°. Active showers in Sagittarius, Pegasus, Draco, Cygnus, Cepheus, Andromeda, and Cassiopeia will also be observed, but the radiant points will be more remarkable for their variety and number than for striking activity in individual cases.

It is an interesting feature in observations at this time of the year to watch the Perseids from their earliest arrivals (about July 15) to their most belated apparitions (about August 21), and to trace the motion of the radiant point towards the E.N.E. In the following table the position of the radiant is given for every third night:—

Date	Radiant α	Radiant δ	Date	Radiant α	Radiant δ
	°	°		°	°
July 18	18·0	+50·1	Aug. 5	37·6	+55·7
,, 21	20·8	+51·1	,, 8	41·5	+56·5
,, 24	23·8	+52·2	,, 11	45·7	+57·1
,, 27	27·1	+53·2	,, 14	50·0	+57·7
,, 30	30·5	+54·1	,, 17	54·4	+58·2
Aug. 2	33·9	+55·0	,, 20	58·9	+58·7

Moonlight will not much interfere with observation during the period from July 25 to August 9. At the time of the Perseid maximum (either on the morning of August 12 or 13) the moon will set as follows:—

	h.	m.
Thursday, August 10	12	52
Friday, August 11	13	45
Saturday, August 12	14	45

The moon will be increasingly gibbous, and though many meteors will doubtless be exhibited before moonset, it will be very advisable to count the number visible in the dark sky after our satellite has gone down, and particularly on the last two dates mentioned above, as the maximum is likely to occur between 2h. and 3h. 30m. a.m. when the radiant is high.

To give anything like a comprehensive list of the radiant points visible in July and August would require a large space, and is, moreover, unnecessary, a pretty complete summary of them having been published in *Astronomische Nachrichten*, No. 3874, for 1903 June 3.

THE FORMATION OF THE MARTIAN SNOW-CAPS.—A short note communicated by Prof. W. H. Pickering to No. 6, vol. xiii., of *Popular Astronomy* states that on examin-

ing a number of photographs of Mars, which were secured with the 11-inch Draper telescope during the period March 31 to April 30, it was seen that no snow-caps properly so-called appeared until April 23. The photograph of March 31 showed clouds on both the terminator and the limb, but no polar caps. On April 23 a clearly visible and extensive light area appeared at the southern pole, but was not bright enough for snow, rather resembling an extensive region of clouds. A very small light area appeared near to the northern pole on April 15, but was only seen with difficulty. A visual examination with a 24-inch reflector revealed the southern polar cap on April 30 as extending far towards the north in long. 340°.

Prof. Pickering thinks that when the clouds disperse snow will probably be revealed lying in their place. He also contends that the observed seasonal colour-changes from brown to green on such features as the Mare Erythræum is the surest evidence of the existence of vegetation on Mars.

RECENT OBSERVATION OF EROS.—From an equatorial observation of Eros on June 12, in which the planet's position was referred to that of δ Capricorni, Prof. Millosevich determined the following position :—

(1905 June 12d. 14h. 32m. 24s. M.T. Rome).
α (app.) = 21h. 48m. 41·74s. δ (app.) = − 16° 41′ 35″·3
(*Astronomische Nachrichten*, No. 4029.)

STANDARD TIME IN VARIOUS COUNTRIES.—An interesting and useful summary of the present status of the use of standard time the world over is given in appendix iv., vol. iv., of the *Publications of the U.S. Naval Observatory*. The director of the observatory, Rear-Admiral Chester, has prepared various tables in which he shows the relation of the standard time employed in each country, state, or colony, to the meridians of Greenwich and Washington. In the first table is given a summary of nations that use standard time, and it shows that, of the thirty-six nations specifically mentioned, twenty employ Greenwich time as the basis of their systems. The areas and population concerned in these twenty nations form a very large majority of the totals, and of the remaining sixteen no two agree. This Mr. Chester regards as a powerful argument in favour of the adoption of a universal time system.

Other tables show in detail the present status of the time systems employed in a large number of localities, and enumerate the dividing lines separating those contiguous areas in which different standards are in use.

HARVARD COLLEGE OBSERVATORY ANNUAL REPORT.—In the forty-ninth annual report of the Harvard College Observatory Prof. E. C. Pickering, dealing with the year ending September 30, 1904, gives a brief outline of the progress made in each of the many and various researches which are being carried out at that observatory.

Variable stars and asteroids were photometrically observed, with the polarising photometer, by Prof. Wendell, who, *inter alia*, found that the asteroid [7] Iris varies about one-quarter of a magnitude in a period of 6h. 12m. The measurement of all the Durchmusterung stars in zones 10′ wide at intervals of 5° was continued with the 12-inch meridian photometer, and the observations of many of the zones are now practically complete.

543 photographs taken with the 11-inch Draper telescope brought the total number secured with this instrument up to 15,030, and 1116 photographs were secured with the 8-inch Draper telescope, raising the total up to date to 32,094. It is proposed to extend this work to the spectra of the fainter stars by giving exposures of sixty minutes' duration and using only one prism. Many objects having peculiar spectra were discovered by Mrs. Fleming during the examination of the Draper photographs.

The Boyden and Bruce telescopes were employed continuously, and from the examination of the long-exposure chart plates Prof. Frost discovered many new nebulæ, &c., including 203 nebulæ in Virgo where the Dreyer (N.G.C.) catalogue mentions only 58.

The meteorological observations were continued at the Blue Hill Observatory, kites being employed on fourteen occasions. The average maximum height reached by the kites was 7750 feet above sea level, the maximum altitude attained on one occasion being 14,660 feet.

THE ACADEMIC SIDE OF TECHNICAL TRAINING.[1]

IT is not so very long ago that engineers, at any rate, became willing to recognise that technical training had an academic side at all. Almost the first, and still undoubtedly the greatest, representative of the academic side of our profession was the late W. J. Macquorn Rankine, who, after eighteen years of practical engineering experience, became professor of engineering in Glasgow in 1855, and held the chair until his death in 1872, and some of whose pupils have occupied, and now occupy, very high positions in the profession for which he did so much. Perhaps it may be said that Rankine was by nature rather a physicist dealing with engineering problems than an engineer (in spite of his love for the "three-foot rule"[2]) dealing with engineering problems. But only those of us who have had occasion carefully to study his work from the point of view of trying to teach subjects similar to his can ever know what an extraordinary physicist he was. But up to the years 1870 and 1880, Rankine's pupils and their contemporaries were not yet old enough to influence the body of the engineering profession, and there still existed a pronounced dislike on the part of an enormous number of engineers to anything academic, a dislike which can hardly be realised now by those who see the various professional bodies vieing with one another in their endeavours to ensure that their members shall have a proper and complete scientific training.

Now all the great engineering societies have recognised formally that no engineering training is complete without its academic side, and a very important committee, consisting of delegates from the five great engineering societies, with Sir William White as president, has been at work for some time, formulating their ideas as to the nature of the qualifying training, and going so far as to formulate also ideas as to the preliminary education of young engineers before they commence their academic training. I do not wish—rather I do wish very much, but it is not my subject to-day—to enter upon the very thorny questions involved in what that preliminary education ought to be according to the notions of a grown-up engineer. I will say, however, for it is no secret, that communications received from many headmasters of our great schools, while not going so far as some of us would like, are yet quite astonishingly radical in their ideas as compared not only with thirty, but even with fifteen years ago.

As to the general trend of our academic training, I think we engineers are entitled to say that it should be so arranged as best to train the best engineers. I put it in this way because I mean it to be understood that while on the one hand the *best* engineer is certainly not the man who knows his own business only and narrowly; on the other hand, I think we are entitled to demand that the engineer should not be looked upon as the mere bye-product of the training, but as the chief result to which other things are to be subordinated. I think that University College is not likely to fall into this mistake, but the point has really to be kept in mind in cases where, as here, the engineering education is only one branch of the wide range of education covered by the whole work of a university college.

In saying this, however, I particularly do *not* mean that the academic training of engineers should be laid out exactly on superficially utilitarian lines. The idea of giving a young man just as much mathematics, just as much physics, or just as much chemistry as the minimum that he can professionally require, is not only pernicious, but absolutely fallacious. I am sure that the only way of knowing a subject up to a certain point in such a fashion that, up to that point, it can be thoroughly utilised, is to study the subject up to a point very much further advanced. It is not at all a valid objection to the teaching of any particular point in mathematics or physics that it is more

[1] Abridged from an Address delivered before the Union Society of University College, London, on June 29, by Dr. Alex. B. W. Kennedy, F.R.S.

[2] Some talk of millimètres, and some of kilogrammes,
And some of décilitres, to measure beer and drams;
But I'm a British workman, too old to go to school;
So by pounds I'll eat, and by quarts I'll drink, and I'll work by my three-foot rule."

complicated or more advanced than anything which the engineer will be likely to require. That, in itself, is not an objection at all, because, as I have said, it is impossible really to master a scientific subject up to a certain, often very elementary, point without having at least a superficial knowledge of a much greater extent of the subject. But it is desirable, indeed necessary from our point of view, that the advanced work in purely scientific subjects should be specially chosen so as best to deepen and make certain the knowledge of the earlier work. This may be, and almost certainly is, a very different thing from choosing it so as to form the best basis for still further study of the particular science in question. In this connection I must point out—at least as my opinion—that it is a mistake to consider that there is only one mathematics or one physics, and that either the preparatory work or the whole teaching must necessarily be the same for everybody —for the man who is to devote himself to engineering, or for the man who intends to spend his life in physical work. For instance, I think an engineering student may be allowed to take for granted that A times B is equal to B times A (he is always quite prepared to believe it), and that it is perfectly reasonable to make to him dogmatic and probably in a sense erroneous, statements as to atoms (let us say) or as to the ether, without any of the qualifications which would be necessary supposing the atoms and the ether were to form the basis of the man's future studies.

It is no doubt a noble conscientiousness which sometimes prevents a man who is in the front rank among men of science from making to his students, as quite general, statements which he knows to be true only with qualifications or limitations. But the case is one in which often the general statement, given with authority, will really give the student a truer conception of the facts than a more accurate statement which is guarded by reasoning and explanations which he (that is, the student) cannot understand, and will almost certainly misunderstand. As a writer in NATURE put it a few days ago, referring to the theory of quaternions, "the truth is that very few students are able to appreciate to the full an absolutely logical argument until they have a certain amount of practical knowledge imparted to them more or less *by authority*."

There is one matter in connection with the teaching both of mathematics and physics to engineering students which I think might well be emphasised more than is generally the case. Whether it is desirable that it should be emphasised in dealing with the general student I do not venture to say. I mean the point that the answer to any question can only be as accurate as the data of that question. For the ordinary examination question in mathematical physics it is necessary and unavoidable to presuppose certain data which in real life are absurd and impossible. In the ordinary everyday questions of engineering there is nothing more misleading than to take for granted the data of the examination paper, and a very great deal of the disrepute into which mathematical work had fallen at one time among engineers was due to the fact that although the average student was able to use his methods rightly, he was unable to perceive whether they led him to a right result. I think it must be possible, even if it is not exactly easy, to point out to the student the extent to which the accuracy of his answers is influenced by the assumptions which he makes.

It is, I am afraid, too often presumed that the method of working out the answer is the chief thing; perhaps it may be from some particular point of view. But for our purposes, foolish as it may sound, the method of working out the answer is only secondary; the answer itself is the chief thing, and we really must have that answer right when it finds itself translated into steel or stone. We would much sooner have a right answer got by an imperfect method than a wrong answer got by the best method in the world. And an answer may be wrong in two ways; it may be wrong because the data are in themselves wrong, that is to say, inapplicable to the particular case, or it may be wrong by being stated in a form much more accurate than the real data will allow of, as when we find the indicated horse-power of engines given to six significant figures, when we know perfectly well that the fourth must always be doubtful.

It would be most useful if our scientific professors would discuss these points with their students and show them specially the extent to which the methods and theorems of the mathematician and the physicist may be properly applied when the only data available for the problems are such as actually are found in practice. It is hardly fair to leave the engineering professor to tell his pupils, or to leave the engineer to tell his assistants, that the methods they are using are quite inapplicable, and the results which they are getting obviously inaccurate. This is in every way inadvisable, and may lead the otherwise guileless student to discount all his teachers instead of only one. Every scientific experimenter knows that it is often the most difficult part of his work to say how alterations in data or want of knowledge of accuracy in data may affect the result, and I should like much to see this matter systematically dealt with by the teachers who have actually to do with the scientific or theoretical treatment of the questions concerned. If they have any doubt as to what is the general nature of the complex engineering questions which have to be solved, a letter addressed to any engineer in Westminster would bring them the fullest information. But happily most of the university colleges now have engineers on their Senates, so that the information can be had without going outside their own walls.

As to the more advanced part of engineering teaching in colleges, I want to put forward an idea that I have more than once had occasion to express. I should much like to see the development of some such connection between old and distinguished students of a college, who become later on older and more distinguished engineers, and the college at which they have studied or some other college, as exists in the similar case of the medical profession. My suggestion is that to get the full benefit from its best pupils, a college should, if possible, keep in touch with them after they have left it. A few years after they have left college, and when they have fairly got into the swim of professional work, but before they have so much lost touch with the difficulties of their college days that they no longer appreciate the student's point of view, they might be made to help in teaching by giving lectures on the special branches of engineering with which they were specially and actively familiar. They should do it before they have forgotten what they formerly learnt, or have had it driven out of their heads by the pressure of other ideas, and while college methods and points of view are still familiar. They would be men still making their way in their profession, still, let us hope, full of enthusiasm for their work, and certainly they would be daily finding out the differences between actual and academic problems. Teaching of this kind could in no way replace the general preliminary teaching of engineering subjects in the college, which must continue to be given, as it is given now, by a professor or professors, the bulk of whose time is spent at the college, and who are thoroughly in touch with all the students.

I confess that I hope a time will come when in any case professors of engineering will not remain permanently in academic harness, but will come out and take their place—a most important one—as colleagues among the active and leading engineers of the country, and will look upon such a position as that which they ought to reach rather than a solely academic position, however eminent. But, in addition to the work of the permanent professor or professors, I believe that old students coming back in the fashion I have indicated, not in one only, but in several branches of engineering, and giving short courses of special lectures to third year students, would very much help both the students and the rest of the teaching staff. The arrangement would also have the very great advantage of bringing about a closer and warmer connection between the men who are at work in their profession and the colleges where they were trained. It would also help to keep the colleges themselves in that actual and continual touch with engineering things and ideas which is so absolutely essential for their continued usefulness.

It will be noticed that the scheme I have outlined is closely analogous to the system already general in connection with medical training, where the lecturing and professorial staff on the technical side consists almost entirely of old students (occasionally from other colleges) who are beginning to make their way professionally, or who, by the time they have become professors, have actually made their way to the highest ranks of their profession.

HARVEY AND THE PROGRESS OF MEDICAL SCIENCE.[1]

AFTER some introductory remarks, Dr. Roberts referred to Harvey's work, and especially to his great discovery of what is commonly spoken of as the "circulation of the blood," though his published treatise is really on the "movements of the heart and of the blood." He re-affirmed their implicit belief in the absolute priority of Harvey's claim to this discovery, and spoke of its magnitude and far-reaching effects, which had been described in various and glowing terms, in no way exaggerated. Nor must they forget the formidable difficulties under which Harvey carried out his investigations; the profound errors which he had to combat and overthrow, and the confusion he had to clear away; his indomitable perseverance; and the masterly yet courteous manner in which he disputed and ultimately overcame the objections which had been raised against his views.

The orator then gave an outline of Harvey's career, dealing more especially with his association with the College of Physicians, where he held the position of Lumleian Lecturer from 1615 to 1656, in the very first course of lectures presenting a detailed exposition of his views concerning the circulation of the blood, which continued to form one of his subjects for several years. In the deed by which Harvey conveyed to the college his estate, he laid down three definite and distinct injunctions or instructions as to the subject-matter of the oration, which it was their duty to follow. The first injunction is that "there shall be a commemoration of all the benefactors of the said College by name and what in particular they have done for the benefit of the said College, with an exhortation to others to imitate these benefactors and to contribute their endeavours for the advancement of the society according to the example of those benefactors."

Dealing with this injunction, Dr. Roberts first mentioned individually Harvey himself; Thomas Linacre, the practical founder of the College of Physicians; and John Caius. He then considered generally as benefactors those who had held high office, alluding specially to that of President; those who had founded lectureships, or had given endowments for prizes, medals, or scholarships; those who had contributed to the library or to the general funds; and those who by their professional or scientific attainments and achievements, as well as by their high personal character, general culture and scholarship, and intellectual and moral qualities have shed unfading renown and lustre upon the College of Physicians.

In discussing the second injunction, namely, to "exhort the Fellows and Members of this College to search and study out the secrets of nature by way of experiment," the orator made a passing allusion in favour of vivisection, claiming for this method of investigation the cordial support of the medical faculty as a whole, with comparatively few exceptions. After referring to what the College had done as a body in advancing scientific research, he enlarged upon the great activity and promising aspects of modern research, more particularly in relation to subjects connected with the medical profession, and expressed his belief that Harvey would be amazed and fully satisfied were he to come on the scene at the present time, and realise the extent and thoroughness with which his exhortation is being carried into effect in all directions. Dr. Roberts then gave an abstract of what he had prepared for the oration with reference to the progress of knowledge and practice in connection with the circulatory system since Harvey's time, and the methods by which it had been brought about. He also directed attention to some of the more prominent examples of the beneficial results on an extensive scale of scientific and practical research, and alluded specially, as being closely connected with the circulatory system, to the "brilliant victories" which had been achieved against malaria in various parts of the world, many of them forming an integral part of this vast Empire. While paying a tribute of respect and admiration to all those who at the risk of life and health have gone forth to dangerous climates to study and fight against this and other tropical diseases, Dr. Roberts mentioned specially Dr. J. E. Dutton, the latest "martyr of science," as he had been aptly called, whose lamented death recently occurred on the Congo, where he had gone to study sleeping sickness on behalf of the Liverpool School of Tropical Medicine. He expressed on behalf of the college their deep sense of the great services which Dr. Dutton had rendered to the medical profession and to humanity, their profound regret at the premature cutting off of such a valuable life and promising career, and their heartfelt sympathy with his bereaved family and friends.

The orator concluded as follows:—The last and most agreeable duty laid upon me by Harvey's direction is to "exhort the Fellows and Members, for the honour of the profession, to continue in mutual love and affection among themselves, without which neither the dignity of the College can be maintained, nor yet particular men receive that benefit by their admission into the College which they might expect, ever remembering that *concordia res parvae crescunt, discordia magnae dilabuntur.*" With regard to the future position and reputation of this college in relation to scientific research and the progress of medicine, there can be no doubt or misgiving when we see amongst our younger fellows and members so many who are endowed with great abilities, who are full of energy, intellectual vigour, and enthusiasm in their work, and whose achievements have already brought them into conspicuous prominence and, in some cases, into the foremost ranks of our profession. May we not confidently hope that they will also ever keep in mind Harvey's last exhortation, and unflinchingly strive to maintain the high standard of character and conduct which he has placed before them? But should they at any time feel the need of an example, a stimulus, or an inspiration, let them steadily fix their attention and thoughts upon the personality, the life, and the work of our "immortal and beloved Harvey," whom it is our privilege and pride and happiness to commemorate on this anniversary.

[1] Abstract of the Harveian Oration delivered at the Royal College of Physicians on June 21 by Dr. Frederick T. Roberts.

HIGH TEMPERATURE RESEARCH ON THE FELSPARS.

AN elaborate investigation of the melting points of the felspars, devised and carried out by Messrs. Day and Allen in the physical laboratory of the United States Geological Survey, is described in a memoir just received.[1] The geological importance of laboratory research at high temperatures was strongly urged by the late Clarence King and Dr. Becker, and the well known work of Dr. Carl Barus has already furnished petrologists with a number of valuable data. The laboratory, discontinued in 1892 for want of funds, has been re-established by the exertions of Dr. Becker, and the piece of work before us has been in part subsidised by the trustees of the Carnegie Institution.

The authors describe in detail, for the benefit of other experimenters, the thermoelectric method by which they have been enabled to measure high temperatures with an error of not more than one degree. It was also found necessary to adopt some method of determining the instant of melting (where such exists) independently of the personal judgment of the operator. It appears that in

[1] "The Isomorphism and Thermal Properties of the Felspars." Part i. Thermal Study. By Arthur L. Day and E. T. Allen. Part ii. Optical Study. By J. P. Iddings. With an introduction by George F. Becker. Pp. 95; xxvi plates. (Washington, 1905.)

such minerals as the felspars the viscosity of the fused substance may be of the same order as the rigidity of the solid crystal approaching fusion, so that there is to the eye no abrupt change. The discordance between the results of different experimenters is largely attributable to this fact. The method followed was therefore to plot as a curve the relation between temperature and time, and to note the place where a change in the shape of the curve indicates an absorption of latent heat. To avoid the disturbing influence of impurities, the several felspars to be examined were prepared artificially. Thin slices of the crystallised products were studied optically by Prof. Iddings, and they are illustrated in the memoir by a series of beautiful plates.

FIG. 1.—Tabular Crystals of Bytownite from Middle of Crucible. From "The Isomorphism and Thermal Properties of the Felspars."

Anorthite was the felspar most easily crystallised, and its curve gave a sufficiently sharp melting point at 1532°. Other varieties examined had the compositions Ab_1An_5, Ab_1An_2, Ab_1An_1, Ab_2An_1, Ab_3An_1. These gave progressively lower melting points; but it was found that, in passing from anorthite towards the albite end of the series, viscosity rapidly increases and obscures the phenomenon of fusion, the break in the curve of heating becoming for Ab_3An_1 a barely perceptible deviation. For albite, and also for orthoclase, the method fails to give any result, and in a certain sense it may be said that the alkali-felspars have no melting point. In this connection, a special series of experiments gave some remarkable results. A small fragment of crystalline albite, embedded in albite glass, was heated to 1200° and slowly cooled. Thin slices showed that the crystal had melted to a glass only along cleavage and other cracks. The experiment was repeated with higher temperatures of heating up to 1250°, and it was found that, though the lanes of glass encroached more and more upon the crystal, considerable relics of the latter were still left, preserving undisturbed their original orientation. It thus appears that a mineral like albite, which melts to an ultra-viscous liquid, may be maintained for half an hour at a temperature well above its normal melting point without being completely fused. It seems doubtful whether the crystalline substance at such a temperature is to be regarded as a superheated solid or as a liquid crystal, in which deorientation is prevented by extreme viscosity.

Felspar	Melting Temperature	Specific Gravity: Crystals	Specific Gravity: Glass
Anorthite	1532°	2·765	2·700
Ab_1An_5	1500°	2·733	2·648
Ab_1An_2	1463°	2·710	2·591
Ab_1An_1	1419°	2·679	2·533
Ab_2An_1	1367°	2·660	2·483
Ab_3An_1	1340°	2·649	2·458
Albite	—	2·605	2·382

We reproduce in tabular form the chief numerical results obtained. The general conclusions arrived at are of great importance. The melting point curve for the lime-soda-felspars, as well as the curve of specific volume, is continuous, and not very different from a straight line, and we have almost conclusive proof that this group of minerals forms a truly isomorphous series. Further, it belongs to type i. of Bakhuis Roozeboom, the melting point falling steadily from one end of the series to the other. Here a further point of interest arises. According to theory, the crystals first formed from the fused mass should be richer in anorthite than the liquid from which they separate, and should contain an increasing proportion of albite as crystallisation proceeds. Day and Allen, however, verified in several cases that their crystals had the same composition as the mother liquid. This can only be due to undercooling, the beginning of crystallisation being deferred until the temperature had fallen below the range proper to normal crystallisation. Those natural rocks in which the felspar crystals show a zoned structure (the outer zones richer in albite) must have crystallised without undercooling, and, indeed, their felspars must have been formed within a certain range of temperature, which can be more or less closely determined. In this and other petrological applications the work of the authors affords a valuable supplement to that of Vogt.

A. H.

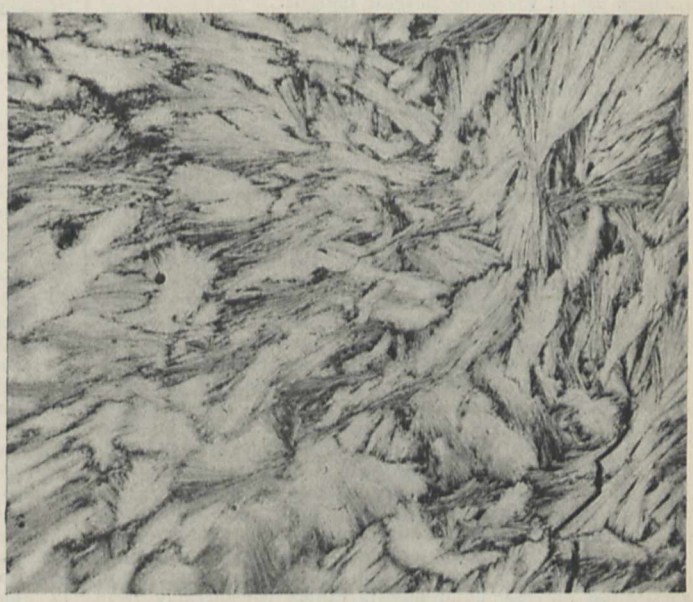


FIG. 2.—Spherulite of Plumose Bundles of Prismatic Crystals of Labradorite. From "The Isomorphism and Thermal Properties of the Felspars."

PRIMITIVE RELIGIOUS ART.[1]

WE have on several occasions directed attention to works by American ethnologists dealing with investigations on the meanings of the designs and patterns of aboriginal decorative art. This fruitful and interesting field of inquiry is by no means exhausted, and two papers on the subject have recently been published by the American Museum of Natural History which merit the careful attention of students. Dr. Clark Wissler has made a valuable study of the decorative art of the Sioux Indians which is a model of clear and concise expression and of adequate illustration. As he truly states, the investigation becomes psychological, because it is necessary to know what ideas the artists have of their designs, and what motives lead to their execution. The assumption that all primitive decorative designs are executed with consciousness that they symbolise some definite object or relation in nature is fairly supported by the facts so far accessible, but does it follow that these symbolic designs were produced by a gradual transition from the realistic representation? That some of them were so produced has been satisfactorily demonstrated; but is this the law of growth for decorative art? It appears, among the American Indians, that the more abstract the idea, the simpler and more geometric the design. On the other hand, it is obvious that a vigorous conventionalisation of representative forms must tend to reduce them all to a few simple geometric designs. In such an event, confusion as to the symbolic aspect of similar designs must arise in the minds of the artists, necessitating re-interpretation or creation of new symbols. Thus any given interpretation need have no certain relation to the origin of the design itself; indeed, the association of the symbol and the idea can be shown in some cases to be quite secondary. Amongst the Sioux there are two main kinds of decorative art—realistic painting and conventional bead- or quill-work; the former is done by the men and the latter by the women, and there is every reason for assuming that the pictographic mode is on the whole the older. One sex has often appropriated the designs used by the other to express divergent ideas, and thus we see how even within the same tribe two or more modes of expressing symbolic motives may make simultaneous use of the same graphic designs.

In a short paper of fifty pages on the decorative art of the Huichol Indians of Mexico, Dr. C. Lumholtz has managed to crowd some 350 figures, so that we have abundant material for study. All these designs, he says, are expressions of religious ideas that pervade the entire existence of these people; in other words, they are permanent prayers. Girdles and ribbons, inasmuch as they are considered as rain serpents, are in themselves prayers for rain and for the results of rain, namely, good crops, health, and life. All the designs on pouches, shirts, skirts, and so forth express prayers for some material benefit, or for protection against evil, or adoration of some deity. Thus the magic double water-gourd, even in its most conventionalised form, means a prayer for water, the source of all life and health. Animals like the puma, jaguar, eagle, &c., express prayers for protection, as well as adoration for the deity to which the creatures belong. The little white flower, *toto*, which grows in the wet, corn-producing season, is at once a symbol and a prayer for corn, and in all sorts of forms it is to be found woven in their costumes. Flowers play, and always have played, an important part in the religion of these Indians; with them flowers, like the plumes of birds, are prayers for rain and life. Dr. Lumholtz doubts if there is such a thing as ornamentation solely for decorative purposes among the Huichol, or, for that matter, among any primitive people. Prof. Boas points out that on the whole the style of decoration of ceremonial objects differs considerably from that of the ornamental parts of garments. The former are crude and pictographic, with slight tendency to conventionalism, while the latter are regular, well executed, and strongly conventionalised, and the general character of these designs much resembles that of similar designs found in other parts of Mexico and in Central and South America. These textile designs, which are of great variety and beauty, acquire much more interest from the suggestive interpretation of their symbolism which Dr. Lumholtz has afforded us.

The American Museum of Natural History is to be congratulated on possessing collections about which so much valuable information has been obtained, and students are to be congratulated on having these riches made accessible to them by means of such beautifully illustrated memoirs.

A. C. H.

[1] "Decorative Art of the Sioux Indians." By Clark Wissler. *Bull. Am. Mus. Nat. Hist.*, vol. xviii., pp. 231–278. (New York, 1904.)
"Decorative Art of the Huichol Indians." By Carl Lumholtz. *Mem. Am. Mus. Nat. Hist.* Whole series, vol. iii. Anthropology, vol. ii. part iii. (New York, 1904.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—An examination for a geographical scholarship will be held on October 12 next. Candidates, who must have taken honours in one of the final schools of the university, should send their names to the reader in geography, Old Ashmolean Museum, by, at latest, October 2. The value of the scholarship is 60*l*.

Dr. J. Ritchie, reader in pathology, has been constituted professor of pathology so long as he holds the readership in question.

AT the recent congregation of the University of Leeds a fellowship of the value of 100*l*. was awarded to Mr. Joseph Marshall, of the Victoria University School of Chemistry.

PROF. STEPHEN M. DIXON, holder of the chair of civil engineering in the Dalhousie University, Nova Scotia, has been appointed to the new professorship of civil engineering in the University of Birmingham.

IT was mentioned by the principal of King's College, London, at the recent distribution of prizes and certificates to the successful students that Prof. W. G. Adams, F.R.S., is about to resign his chair after forty-two years' work in the college.

THE Rogers prize of 100*l*. of the University of London has this year been awarded to Dr. B. J. Collingwood for his essay on "Anæsthetics, their Physiological and Clinical Action." The essay submitted by Dr. A. G. Levy was highly commended, and an honorarium of 50*l*. was awarded him.

A MOVEMENT is now in progress for providing the North Wales University College with new buildings at an estimated cost of 175,000*l*., of which 30,000*l*. has been already promised. The site has been given by the corporation, which has presented the deed of gift to Lord Kenyon, president of the college. The president has expressed the hope that the rest of Wales will follow the liberality shown at Bangor, and that there will be no more need for the best professors of the college to leave Bangor for more lucrative positions in other parts of the United Kingdom.

ACCORDING to the *Electrician*, a committee of the Liverpool City Council, instructed by the Finance Committee to report as to how far the educational methods employed at the Liverpool University were in the interests of the city and met its requirements, have reported that they are satisfied that the University is doing its best to ensure that its students shall enter into the business of life with their intellectual powers fully developed by providing the students with a wide range of duty and sound methods of instruction, and they have therefore recommended that the sum of 10,000*l*. should be granted during the present year upon the same conditions under which a similar grant was made for the first time last year. The report of the finance committee has come before the City Council and has been approved. Of the amount in question, 1000*l*. is devoted to scholarships for Liverpool men.

COPIES have been received of the *Johns Hopkins University Circular* containing the programme of courses for the session 1905–06, and of the Yearbook of the Armour Institute of Technology, Chicago, for 1905–06. The Johns Hopkins University will begin its thirtieth year of instruction next October. The work will be carried on

in three divisions:—The graduate department, in which arrangements are made for the instruction of advanced students in the higher branches of science and literature; the medical department, in which students (men and women) who have already received a liberal education are received as candidates for the degree of M.D., and in which doctors of medicine may attend special courses; the collegiate department, in which students receive a liberal education leading to a degree. The Armour Institute of Technology was founded in 1892, and the work of instruction was begun in September, 1893. Courses are now offered in mechanical engineering, electrical engineering, civil engineering, chemical engineering, fire protection engineering, general science, and architecture, and all lead to the degree of Bachelor of Science.

IN the course of an address on degree day, July 8, at the University of Liverpool, Lord Derby, the chancellor, said that since they last met they had several new laboratories, some complete and some in progress. Another building, to be opened in November, will be for the study of natural history. They had also an extension to record of the chemical laboratories, to provide accommodation for the department of physical chemistry, and an addition to the existing department. This had been provided at an estimated cost of 10,500*l.*, which the president of the council, Mr. E. K. Muspratt, had promised to contribute. Since they last met 10,000*l.* had been given by Mrs. Barrow, the borough of Birkenhead had given an annual grant of 500*l.*, and a grant of 10,000*l.* had been received from the Liverpool City Council, 1000*l.* from the county of Lancaster, from Cheshire 300*l.*, and from the borough of Bootle 500*l.* The sum of 1500*l.* had been given to endow a lectureship in memory of Sir William Mitchell Banks. Mr. E. Whitley had promised 1000*l.*, and under the will of the late Mr. J. L. Bowes the University would receive a legacy of 8000*l.* for the benefit of the department of chemistry and other purposes. The company subsequently proceeded to the new electrotechnical laboratory, and Sir Joseph Swan formally opened the building, which he described as eminently suited for the purpose for which it was intended. The cost of the laboratory has been defrayed by a sum of 12,000*l.*, drawn from the university fund, and the Lancashire County Council has contributed 1000*l.* towards meeting the more pressing demands for equipment.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 18.—"On the Chemical Mechanism of Gastric Secretion." By J. S. **Edkins.**

June 8.—"On the Application of Statistical Mechanics to the General Dynamics of Matter and Ether." By J. H. **Jeans.** Communicated by Prof. J. Larmor, Sec.R.S.

The object of the paper is to apply the methods of statistical mechanics to questions connected with radiation and the energy of the ether. An attempt is made to examine whether or not the modern theory of thermodynamics of radiation can be regarded as resting on sound dynamical principles. The result arrived at is that the use made of the second law of thermodynamics in this theory, in particular in the proof of Stefan's law, is one which cannot be justified, and hence that those parts of the theory of thermodynamics of radiation which are based upon the use of the second law must be regarded as unsound.

The problem is obtained in its simplest form by considering either a finite universe, or else a finite portion of an infinite universe, enclosed within a perfectly reflecting boundary. Let the number of degrees of freedom of the matter inside this boundary, neglecting the interaction with the ether, be N, so that there are 2N coordinates of the aggregate system which very nearly represent motion of matter only. The number N is known to be actually finite, although it may be supposed to be so large that the error involved in treating it as infinite will be negligible. Let the number of degrees of the ether be M, giving 2M coordinates to the aggregate system. If we suppose the ether to have an absolutely continuous structure, the number M will be absolutely infinite.

The energy of the 2M coordinates of the ether is expressible as a sum of 2M squares. The energy of the 2N material coordinates may, again neglecting small terms, be divided into kinetic and potential energy. The kinetic energy is expressible as a sum of N squares, namely, the sum of the three components of energy of each electron of which the matter is composed. Thus the total energy is expressible as the sum of 2M+N squares, plus an unknown potential energy of electrons. It now follows, as in the proof of the well known theorem of equipartition of energy, that after an infinite time the sum of any p of these squares stands to the sum of the remaining q squares in a ratio which is equal to p/q, subject only to the condition that p and q are large enough to be treated as infinite without appreciable error. Since 2M and N satisfy these conditions, it follows that the system tends towards a state in which the energy of the ether is infinite in comparison with the kinetic energy of the matter. In other words, there is a general tendency for the ether to gain energy at the expense of matter.

It is, however, obvious that our own universe is at present far removed from its final state, so that the study of this final state is of less interest than the study of the stages through which the final state is being reached.

In discussing the transition to the final state, a principle proved elsewhere ("The Dynamical Theory of Gases," chapter ix.) is of service. Suppose that a vibration of any dynamical system is influenced by an external agency. Then the principle in question asserts that the ultimate effect of this influence is infinitesimal, except when the external agency changes to a considerable extent in a time comparable with the period of the vibration. If the time of change in the external agency is n times the period of the vibration, where n is large, then the ultimate change in the energy of the vibration vanishes to the same order as e^{-n}, a quantity which soon becomes negligible as n increases.

Thus, if θ is some small interval of time, so small that the material system may be regarded as perceptibly unaltered through a time θ, then the change produced in the energy of ether vibrations of which the period is less than θ will be very slight. The energy of such vibrations may therefore be treated as though it were incapable of change, so long as our consideration of the system does not extend over a very long period.

The total number of modes of vibration of any enclosed or unenclosed piece of ether is, as has been said, either very great or infinite, but the number of vibrations of an enclosed piece of ether *of which the frequencies are below an assigned value* is finite. Thus, we can now suppose M replaced by some small number M′, and the value of M′ will be finite. So long as we limit our consideration of the system to a finite time, say a million years, we may regard the energies of the remaining modes of vibration as constant and very small. The ratio of ethereal to material kinetic energy is now $2M'/N$, a quantity which cannot be infinite and may be very small.

If θ is a small time satisfying the conditions specified, then the rate at which an ether vibration of high frequency p gains energy will involve a factor $e^{-p\theta}$, so that the time required for the vibration to acquire a perceptible amount of energy will involve a factor $e^{p\theta}$. This is, of course, only true when $p\theta$ is large. The energy of those vibrations for which $p\theta$ is not large is rapidly adjusted, and a state will soon be reached in which these vibrations have the share of energy allotted to them by the theorem of equipartition of energy. With the progress of time the energy of the remaining vibrations gradually becomes perceptible, until ultimately the final state is reached.

We cannot, however, realise in nature the boundary impervious to all forms of energy, so that it is important to consider whether these predictions have to be modified if the boundary, instead of being perfect, is simply as perfect as we can make it.

It is found that there is no longer any tendency for the energy of the matter, even after infinite time, to vanish in comparison with that of the ether inside the enclosure; the two tend to assume a finite ratio, although neither of the actual energies can be permanent, as the system

inside the enclosure is no longer a conservative system. This definite ratio between matter and ether, however, lends a meaning to the expression "radiation at a given temperature," at any rate so long as we are concerned with the same enclosure and the same enclosed matter.

Stefan's empirical law states that the radiation is proportional to the fourth power of the absolute temperature, and Bartoli and Boltzmann have attempted to raise the law to the level of a theoretical law.

Their argument rests fundamentally upon the application of Carnot's principle to the working of a heat engine, in which the working substance is the ether.

Carnot's principle is, in effect, identical with the second law of thermodynamics, and this in turn is a special case of a special proposition in statistical mechanics. In the present investigation the most general methods of statistical mechanics are used, and the conclusion arrived at is different from that of the second law. The general investigation ought, of course, to take precedence over the attempted extension of the special case. It is, moreover, easy to find the exact point at which the general argument parts company with that used in the special case. In the special case, we are dealing only with forms of material energy such that there is an easy and rapid transfer of energy to the final state. The increase of entropy indicates simply the tendency to move towards this final state, and Carnot's principle is seen to be a special case of this general tendency in which it is supposed that the working substance is at every instant in the final state appropriate to its energy at that instant. When the ether is in question, it is found that the transfer of energy to vibrations of short wave-length, instead of being infinitely rapid, is, in point of fact, extremely slow, so that we never have to deal with a final state at all.

Moreover, it has to be assumed for Bartoli's argument that the energy of the working substance is a function of only two independent variables, *e.g.* the temperature and the density. This is not true in the case of an engine in which ether is the working substance; the ether energy is the sum of a number of vibrations of different wave-lengths, and the number of vibrations which have to be included in this sum will depend on the nature as well as on the temperature of the matter with which the ether is in communication.

Again, in the proposed argument for Stefan's law, the piston of the pump forms a moving boundary for the ether. The action of such a pump would change the frequency of vibrations in the ether, and energy which at one instant belonged to a vibration of one period would, after passing through the pump, belong to a vibration of some entirely different frequency. The energy of the vibrations of high frequency no longer remains unaltered and very small, for there is a transfer of energy to these vibrations at every stroke of the pump. The system will rapidly assume the final state appropriate to the value of this total energy, and this is a state in which the energy of matter vanishes in comparison with that of ether. Thus Bartoli's proof might be applicable to a universe in which pumps of the kind assumed had an actual existence, but has no application to our own universe in which the vibrations of highest frequency do not come into play at all.

It now appears that in attempting to obtain a law of radiation in conformity with the analysis of the present paper, we shall not be able to use any method so general as that of the second law of thermodynamics. The whole question is not one of partition of energy, but of transfer of energy.

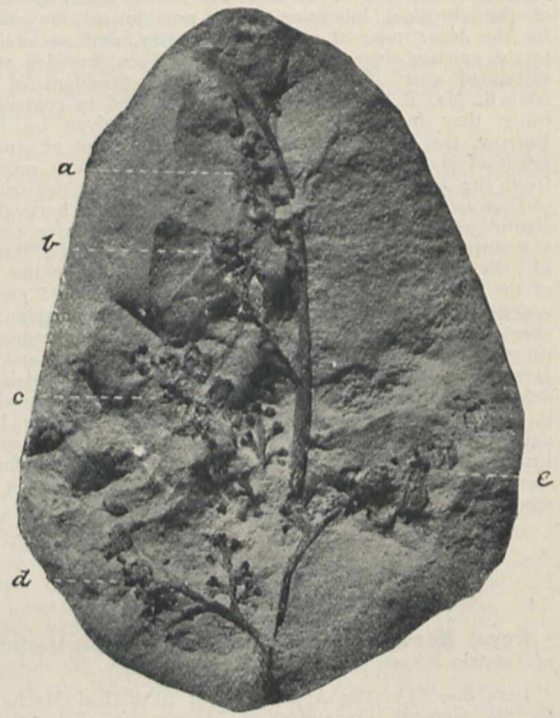
"The Microsporangia of Lyginodendron." By R. **Kidston**, F.R.S.

In a preliminary note a description was given of the microsporangia of *Sphenopteris* (*Lyginodendron*) *Höninghausi*, Brongt. It had been thought by some that the *Telangium Scotti*, Benson, might be the microsporangia of Lyginodendron, but the discovery of sporangia possessing all the characters of Crossotheca, Zeiller, in organic connection with the sterile foliage of *Lyginodendron* (*Sphenopteris Höninghausi*) shows that *Telangium Scotti* must belong to another plant.

The members of the genus Crossotheca (of which several species are known) had previously been regarded as *true ferns*, but now they must be classed with the Pteridospermeæ. The barren foliage of the species included in Crossotheca is very varied, and though the majority of the species possess sphenopteroid pinnules, one at least bears pinnules of the pecopteroid type.

In *Sphenopteris* (*Crossotheca*) *Höninghausi* each "fertile lobe bore six to eight broadly lanceolate sharply-pointed microsporangia. In the early condition the sporangia are bent inwards, and form a small hemispherical bunch with their apices meeting in the centre. At maturity the sporangia spread outwards, when they appear as a fringe hanging from the margin of the fertile pinnule, but are in reality connected for some distance to its lower surface. The microsporangia are bilocular, the parallel loculi being only separated by a narrow band of tissue. Dehiscence took place by a longitudinal cleft which passes down the inner surface of the sporangium in the line of the dividing wall of the two loculi."

The figure shows a penultimate pinna enlarged two



times. The ultimate pinnæ *c* and *d* bear sterile pinnules at their base, above which are some fertile pinnules. These latter, however, are better seen at *e*.

It has previously been shown by Prof. Oliver and Dr. Scott that the "seed" of *Sphenopteris Höninghausi* is the *Lagenostoma Lomaxi* of Williamson. *Sphenopteris Höninghausi* is thus the first pteridosperm of which the male and female organs are known.

The specimens described were derived from the 10-foot Ironstone-measures, Coseley, Dudley, which belong to the Westphalian series of the Coal-measures, and were communicated to the author by Mr. H. W. Hughes.

Royal Microscopical Society, June 21.—Mr. G. C. Karop, vice-president, in the chair.—Dr. **Lazarus-Barlow** exhibited and described a new form of warm stage, devised by him, that could be heated by oil or gas.—Mr. Cecil R. C. **Lyster** exhibited an improved form of warm stage, heated by electricity.—Mr. C. L. **Curties** exhibited an arrangement for obtaining dark ground illumination with high powers, which had been suggested to him by a contrivance made by Leitz for attaining this object. He showed *Pleurosigma angulatum* on a dark ground under a 1/12-inch oil immersion objective.—Mr. **Rheinberg** directed attention to an experiment showing that the ap-

pearance of a grating could be produced in the field of the microscope without there being anything on the stage. The lines seen were achromatic interference bands produced with the help of two of Thorp's gratings of equal pitch placed behind the objective.—Mr. **Rousselet** directed attention to a living specimen of *Plumatella punctata* (Hancock) sent by Mr. Hood, of Dundee. The rare freshwater polyzoon has apparently not been recorded in England since its discovery by Hancock in 1850. It differs from other species of Plumatella mainly in having a soft, transparent ectocyst.—A communication by Mr. E. M. **Nelson** on the tubercle bacillus was taken as read.—Mr. A. E. **Conrady** gave a *résumé* of his second paper on theories of microscopic vision. In his former paper he dealt with the formation of the image of a simple plane grating, showing that it could be fully accounted for on the basis of Abbe's theory. In the present paper he considered more complicated structures, such as dot- and cross-line patterns.

Geological Society, June 21.—Dr. J. E. Marr, F.R.S., president, in the chair.—The relations of the Eocene and Cretaceous rocks in the Esna-Aswan reach of the Nile Valley: H. J. L. **Beadnell.** At the meeting of the International Geological Congress held in Paris in 1900, the author brought forward evidence from the Baharia Oasis and Abu Roash to show that there was a marked unconformity between these two systems in the northern part of the country. The Jebel-Awaina succession shows that in the southern part of the country, where the Upper Cretaceous and the Lower Eocene occur in their fullest development, there is no sharp line of demarcation between the Cretaceous and the Tertiary, and no disturbances in the stratigraphical succession. This is confirmed by the succession in the Kharga Oasis, where there is no trace of an unconformity. Dr. J. Ball's conclusions to the contrary were mainly based on the supposed irregular variation of the Esna Shales; but, where this occurs, it is mainly due to the fact that, with a slight increase of carbonate of lime, these beds became almost indistinguishable from the overlying marls and marly limestones of the Eocene. The author finds in Jebel Nur el Ghenneiem some 180 feet of green clays between the *Echinocorys*-Chalk and the Eocene marls and limestones, and a perfectly conformable succession throughout. Near Ain Amur there is a considerable development of fossiliferous limestones at the summit of the Cretaceous rocks, and many of the fossils are hardly distinguishable from Eocene species. The author is of opinion that the Farafra succession falls into line with that which obtains in the southern part of the country. An important piece of confirmatory evidence is furnished by the discovery of a rich fauna in "ashen-grey clays" in the Esna-Aswan reach of the Nile Valley by Dr. W. F. Hume, in the clays above the *Pecten*-Marls in the neighbourhood of Esna.—A contribution to the study of the Glacial (Dwyka) Conglomerate in the Transvaal: E. T. **Mellor.** The survey of a district lying east of Pretoria and extending from near the diamond-fields to Middelburg has recently afforded much additional information with regard to the Glacial Conglomerate in this part of South Africa. The district lies on the northern edge of the principal area occupied by the Karroo system, and includes a number of outliers, the area between which affords information as to the source of the material of the Conglomerate and the character of the land-surface on which it was deposited. This surface is smoothed, grooved, and scratched by ice-action. The Karroo system is here only 400 or 500 feet thick, and the Conglomerate usually about 50 feet; but, where deposited in hollows, it may reach 200 feet or more in thickness. The fragments are usually from 1 to 3 feet in diameter, but may attain as much as 8 or 10 feet; they are often facetted and sometimes show striations. The majority of the boulders are of local origin. True bedding-planes are rare in the conglomerate, but there are included patches of sandstone, mudstone, or shale, some of which show ripple- or eddy-markings. The striæ are remarkably constant in direction, and they and the transport of boulders indicate an ice-movement from the north-north-west to the south-south-east. In the Prieska district Rogers and Schwarz found the movement to have been from north-north-east to south-south-west, and the same direction is given by Schenck from near the junction of the Orange and Vaal Rivers. During 1904 outliers of the Conglomerate were found farther north, near the junction of the Elands and Olifants Rivers.—On new Oolitic strata in Oxfordshire: E. A. **Walford.**—The causes of variegation in Keuper Marl and in other calcareous rocks: G. T. **Moody.** The author concludes that the variegation of the Keuper Marls and of other calcareous rocks has been brought about by the percolation of chalybeate water through the light-coloured mass, the more porous parts of which have in consequence become stained with ferric oxide, while the harder and more crystalline parts, being non-porous, have remained unchanged. The uniformity in distribution of ferric oxide in some red rocks, such as the New Red Sandstone, suggests that the iron contained in them has probably been derived from chalybeate water in a similar manner.

Challenger Society, June 28.—Dr. R. N. Wolfenden in the chair.—Dr. H. R. **Mill** exhibited the new chart of the world, recommended by the International Geographical Congress, and published at the cost of the Prince of Monaco. From 72° N. to 72° S. are sixteen sheets on Mercator's projection; each polar chart of four sheets is on a circular projection. The submarine contours and soundings are in metres, symbols indicating the bottom deposits. The land is black; the contours of the ocean are coloured in deepening shades of blue. Meridians (from Greenwich) and parallels are ruled for each degree.—Dr. W. T. **Calman** exhibited the two Decapoda brought from the Antarctic region by the *Discovery*, *Cranzon antarcticus* and *Chorismus antarcticus*, and explained their bearing on "bipolarity."—The **Secretary** showed a chart reproduced in line-process from one of the society's blank charts, in order to show the method of preparation.—On behalf of Messrs. E. W. L. **Holt** and W. M. **Tattersall**, Dr. Calman read a preliminary note on the Antarctic Schizopoda captured by the *Discovery*. The collection contained several new species of Euphausiidæ and Mysidæ, and the authors were able to show that *Euphausia superba* (Dana), Sars, *E. Murrayi*, Sars, *E. australis*, Hodgson, *E. glacialis*, Hodgson, and *E. antarctica*, Sars, are all referable to a single species.—The **Secretary** read a note on the probable time required by the larva of an epibenthic animal to cross the Atlantic, and made some remarks on the desirability of revising the nomenclature of ocean currents on an international basis.

PARIS.

Academy of Sciences, July 3.—M. Troost in the chair.—The theory of algebraic surfaces: **Émile Picard.**—The propagation of waves along a liquid compressible column, composed of strips of unequal velocities and filling an elastic horizontal tube, without longitudinal tension: J. **Boussinesq.**—On camphoacetic and β-camphopropionic acids: A. **Haller.** Methyl camphocarbonate heated with sodium methylate and iodoacetic ester gives methyl carboxymethylcamphoacetate, which, with alcoholic potash, furnishes camphoacetic acid. A corresponding compound is obtained by substituting ethyl β-iodopropionate for the ethyl iodoacetate in the original reaction, and from which β-camphopropionic acid is obtained.—On the existence in the black elder of a compound furnishing hydrocyanic acid: M. **Guignard.** The number of plants from which hydrocyanic acid can be obtained is increasing every year, and it has been suggested that it represents the first recognisable product of the assimilation of nitrogen in plants. In the elder, the fresh leaf furnishes the largest proportion of the acid, averaging 0·01 per cent.—Synthesis of the three tertiary dimethylcyclohexanols and of the hydrocarbons connected with them: Paul **Sabatier** and A. **Mailhe.** The cresols are converted into methylcyclohexanones by means of the reduced nickel reaction, and these are converted by methylmagnesium iodide into the corresponding tertiary alcohols, good yields being obtained. The preparation, physical properties, and reactions of the ortho-, meta-, and para-tertiary alcohols are described.—On the evolution of the tertiary mammals. A reply to the observations of M. Boule: Charles **Depéret.** A controversial note dealing more especially with the ancestry of the horse and bear.—M. P. Curie was elected a member

in the physical section in the place of the late M. A. Potier.—On the specific inductive power of metals in the case of the calorific and luminous waves: André **Broca.** The author concludes that the hypothesis of the existence of a considerable specific inductive power for the metals, although perhaps not sufficient to explain all the optical properties of metals in detail, is at least no more in contradiction with the facts than the hypothesis of Planck that this specific inductive power is zero.—An apparatus for measuring the factors, penetration, and quantity of X-rays, and a radiophotometric totaliser: G. **Contremoulins.** Silver plates of varying thicknesses are fixed on to rotating sectors, and the effect of interposing these in the path of the rays upon a phosphorescent screen is noticed.—The magneto-optical properties of ionoplastic iron: L. **Houllevigue** and H. **Passa.**—A method for establishing coloured screens, destined to isolate certain groups of special radiations: F. **Monpillard.** A given weight of a colouring matter is diluted to a certain volume with an aqueous solution of gelatin, and this poured on to a glass plate of fixed area, thus giving an invariable weight of colour per square centimetre. The author has succeeded in producing screens giving a maximum of luminosity in the green (λ 530), yellow orange (λ 588), yellow (λ 500), and red (λ 630).—The preparation of binary compounds of metals by thermochemical reactions: A. **Colani.** Some examples of the application of aluminium powder for reduction at a high temperature; the products are usually contaminated with aluminium and sometimes with iron.—The constitution and properties of the aluminium steels: Léon **Guillet.** So long as the percentage of aluminium is below 2 per cent., there is no marked change in the properties of the steel. Up to 15 per cent. the aluminium enters into solution in the iron, the iron-aluminium solution thus formed not dissolving carbon.—Combinations of ferrocyanides and sulphuric acid: Paul **Chrétien.** Hydroferrocyanic acid, dissolved in sulphuric acid without any gas being evolved, forms a sulphonic acid of the composition $H_3FeCy_6(SO_3H)$. With fuming sulphuric acid another compound is produced, $FeCy_6SO_2$, the decomposition and reactions of which have been studied.—A modification of the initial quality of iron and steel used in the manufacture of rivets consequent on the heating required in fixing: Ch. **Frémont.** It is found that the metal, after being heated and cooled under traction, is improved in quality mechanically.—On the acid γ-aldehydes: E. E. **Blaise** and A. **Courtot.** The authors have been successful in obtaining these aldedydes in a pure state for the first time. An unsaturated acid is treated with bromine, the dibromo-acid formed heated, a bromolactone being then formed by the loss of hydrobromic acid. Hydrobromic acid is then removed from this by boiling with quinoline, and the lactone thus produced, hydrolysed with an alkali, gives the acid aldehyde required.—The synthesis of the lactone of erythric acid: M. **Lespieau.**—A new method of synthesis of the monoatomic and polyatomic alcohols: V. **Grignard.** This important synthesis has been achieved by the author by acting with organometallic derivatives of the type RMgX on the halogen derivatives of the mono- or poly-atomic alcohols. The reaction takes place in two stages,

$$RMgX + ClCH_2.CH_2.OH = RH + ClCH_2.CH_2.OMgX,$$

and this on heating gives with a fresh molecule of a magnesium compound

$$R'MgX' + ClCH_2.CH_2OMgX = MgX'Cl + R'.CH_2.CH_2.OMgX.$$

The action of water on this last substance gives the alcohol $R.CH_2.CH_2.OH$. Several examples of the application of this synthetical method are given.—On β-decahydronaphthylketone and β-decahydronaphthylamine: Henri **Leroux.**—Some new derivatives of the mesoxalic esters: Ch. **Schmitt.**—The action of ethyl iodide on sparteine: Charles **Moureu** and Amand **Valeur.** The reaction gives sparteine iodohydrate and two isomeric iodoethylates.—The densities of carbonic anhydride, ammonia, and nitrous oxide: Philippe A. **Guye** and Alexandre **Pintza.** The results for the densities of nitrous oxide and carbon dioxide agree with those of Lord Rayleigh within the limits of experimental error, 1/6000 to 1/19,000. Special precautions were taken in the case of ammonia to ensure the absence of amines, the result being 1/700 lower than the figure of M. Leduc. The limiting densities for these gases were worked out, and the atomic weight of nitrogen deduced as 14·006.—The thermochemistry of neodymium: Camille **Matignon.**—The influence of the elements of brown flour on the extraction of the gluten and bread-making: M. **Lindet** and L. **Ammann.**—On the cause of the withering of the vines in Tunis, Algeria, and the Midi: L. **Ravaz.**—On the presence of a hydrocyanic glucoside in the leaves of the elder, *Sambucus nigra*: Em. **Bourquelot** and Em. **Danjou.** The elder leaf contains a glucoside containing nitrogen, which, under the influence of emulsin, gives glucose, hydrocyanic acid, and an aldehyde.—Modifications and *rôle* of the segmentary organs in some annelids: Louis **Fage.**—On the epipodites of the Eucyphote Crustacea: H. **Coutière.** On the discovery of coal at Abaucourt (Meurthe-et-Moselle): René **Nicklès.** A layer of coal, 2·65 metres thick, has been found at Abaucourt, near Nomeny. It is at a depth of 896 metres, and on chemical analysis proves to resemble the gas coal of Saarbrück.—Observations on the preceding note: R. **Zeiller.**—On the geology of the Pre-alps in the neighbourhood of Jaen: Robert **Douvillé.**—Contribution to the tectonic of the southern Carpathians: G. M. **Murgoci.**—On the origin of lactose. The ablation of the mammæ in lactation: Ch. **Porcher.**—The fixation of chemical substances on living cells: MM. **Charrin** and **Le Play.**

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