THURSDAY, MAY 22, 1902.

SPACE PERCEPTION.

Studies in Auditory and Visual Space Perception. By Arthur Henry Pierce, Ph.D. Pp. vi + 361. (New York, London and Bombay: Longmans, Green and Co., 1901.) Price 6*s.* 6*d.* net.

THE larger and more interesting part of this book deals with the problem of the localisation of sound. We all know that we, in common with other animals having the sense of hearing, can, with considerable accuracy, determine the direction from which a sound comes to us. We hear a lark, and after a little feeling about, if we may use such an expression, we are certain that the bird is not far from a place in the sky to which we can confidently point, and examining with our eyes the region near that point we soon see the lark.

In all ordinary efforts to find out where the source of sound is, we move our head, either alone or with our body. If the necessary movement is angularly small, we may move the head without moving the body, if it is large we must move the body; so far as the result is concerned it is indifferent how the head is moved, with or without the movement of the body.

What we do is to turn to the side from which the sound comes and continue this movement until the median plane of the head is in such a position that the slightest movement of the median plane will put the source of sound into the right or left hemisphere; we then know that the source of sound is in the median plane and in front. Having thus found a vertical plane containing the source of sound, we have next (and experience seems to show that this is really the order followed) to determine the place of the source of sound in the semicircle in front from zenith to nadir. This *could* be done in a precisely similar way. We might turn our head so that its vertical axis became horizontal and our median plane coincided with the horizontal plane, and now rotating the head about its vertical axis (now horizontal) we could get the source of sound into the median plane of the head. The intersection of the two planes each of which contains the source of sound would, of course, be the line passing through the head and the source of sound. Put more generally, by inclining the head we could find two positions of the median plane of the head each containing the source of sound, and the intersection of these planes is the direction sought. Birds seem to use this method, and it is worthy of note that birds have no concha, but human beings find what may be called the altitude of the source of sound in another way.

If we look at a source of sound, such as a splashing fall of water or a fizzing steam-pipe, the more complex the sound the better, and rotate the head about its right and left axis, so as to look now up, now down, now forward, we find that a very notable change of sound takes place just at the position of the head when we are looking straight at the source of sound. This rather abrupt change of quality of the sound seems to be caused by the acoustic shadow of the tragus. This shadow is, of course, not analogous to the black shadow to which we are accustomed when comparatively large bodies intercept a beam of light, but rather to the coloured shadow due to diffraction, and therefore does not diminish the intensity of the sound, but changes its quality. It may be noted that the tip of the tragus is almost exactly in front of the external meatus. Whether this explanation of the mechanism is correct or not, it seems certain that in locating sounds we do really turn the head (with or without the body) about a vertical axis until we find the source of sound in front, and then look up and down until we are looking at the source.

Now what has just been described is not at all what Prof. Pierce, and most of the authors whose experiments and speculations he discusses, mean by the localisation of sound. What they investigate is the question how far we can, *without moving the head*, determine the position of the source of a sound. All are agreed that we can tell with certainty whether the sound comes from the right or from the left or is in the median plane, but some think this is all, while some, including Prof. Pierce, think a good deal more than this can be made out without moving the head.

One defect in the account of many of these experiments is that no indication is given of how errors arising from involuntary and unconscious movements of the head are guarded against. In the experiments described it is found that the accuracy of localisation is greatest when the source of sound is nearly in front or nearly behind the observer. But these are exactly the positions in which a slight movement of the head gives the greatest help, so that unless care is taken to avoid any, however slight, movement of the head, we can gather little from the experiments as to the accuracy of localisation with the head fixed. There are three ways in which this source of error can be eliminated. First, by making the sound of such short duration that there is no time to turn the head during its continuance. This was the plan adopted by the present writer when he in 1874, at the meeting of the British Association in Belfast, recommended the snapping of two coins as the source of sound, and he is pleased to learn from Prof. Pierce that this form of the experiment is still used as a parlour amusement in America. Second, by mechanically fixing the head. It is difficult, though not impossible, to accomplish this without the introduction of apparatus which will interfere with the uninterrupted access of sound to the ears. Third, by recording any movement of the head which may take place by means of tapes placed round the head, the ends of the tapes being connected with a recording apparatus, so that the movement of the head may be noted. Experiments in which such movement occurred might then be excluded. It is well known that such involuntary and unconscious movements do occur. Most of us have heard of the device by means of which a famous French army surgeon used to detect feigned deafness in unwilling conscripts. He led the supposed deaf man along a stone-paved passage and secretly dropped a coin. The conscript jerked his head a little, on which the surgeon said, "My friend, you are not very deaf, you heard that franc fall." So unless we have some means of ensuring fixity of the head we cannot be certain that the greater accuracy of localisation in some positions is not, partly at least, due to involuntary and unconscious movement of the head.

The experiments on the spatial perception of two simultaneous sounds of similar quality are of special interest. Such sounds coalesce and give rise to a resultant or, as Prof. Pierce aptly calls it, phantom sound. As a rule this phantom sound is located at a position intermediate between those to which the observer would refer the two real components. These experiments with two coalescing sounds, not being liable to the same extent as those with one sound to the error introduced by unconscious movements of the head, may be of use to check such errors and to show that they exist. A very curious case, or set of cases, is examined by Prof. Pierce, who gives very fully the results of his own experiments and of those of other investigators. When the two component sounds, one on each side, are produced near the ears (4 cm. or less from each ear), the phantom is heard *within the cranium* and can be made to move inside the head towards the one or the other ear by varying the relative loudness of the components. When the distance of the two sounds from each of the ears is 8 cm. or more, the phantom is extra-cranial.

What seemed the most interesting points discussed in this essay have been noted; but the whole of it is interesting, and physicists and physiologists will find it well worth careful reading. The fairly complete bibliography annexed to it greatly adds to its value.

The second part of the book deals with some optical illusions, which are discussed with great critical acumen.

ALEX. CRUM BROWN.

THE MORPHOLOGICAL VALUE OF THE CENTROSOME.

Das Problem der Befruchtung. Von Dr. Th. Boveri. Pp. 48. (Jena: Gustav Fischer, 1902.) Price Mk. 1·80.

PROF. BOVERI is so well known as a cytologist that anything from his pen will be read with interest. He is concerned in the little work before us in presenting in a non-technical fashion the main morphological peculiarities connected with fertilisation, and he also discusses the meaning of the processes involved. The appendix will probably be regarded by many as the most interesting part of the whole, as he there critically examines the results which have been obtained by Loeb on artificial parthenogenesis, and which have been confirmed and further investigated by Wilson. It will be within the recollection of some people that Loeb discovered the important fact that it is possible to induce normal development in *unfertilised* eggs of certain marine animals by treating them for some time with a 12 per cent. solution of magnesium chloride in seawater, and then retransferring the eggs to normal seawater. Morgan and others had previously found that the addition of salts of various kinds to the water sufficed to produce bodies remarkably like centrospheres, but it was not until Wilson showed this also to occur in Loeb's experiments, and that they almost certainly initiate the process of segmentation, that the significance of the earlier results became apparent.

Now the egg is normally destitute of any centrosome, and it has been thought on many grounds that one of the chief uses of the sperm was to import this body into the protoplasm of the inert ovum. Boveri himself first put forward this view, and he now seems inclined to admit that it may demand some degree of modification. His original conception of the sperm as starting the cytoplasmic activities remains untouched, but obviously the nature of the mechanism involved is, as he says, open to a different interpretation from that originally assigned to it by himself. For it may now be fairly argued that it is not a centrosome as an *organised structure* which is introduced into the egg, and which there starts the segmentation processes, but rather a chemical substance which, in combination with the ovian cytoplasm, produces the body in question. Such a view would reconcile much that has hitherto been difficult of explanation in connection with the diverse behaviour of centrosomes in different organisms, and even in different cells and tissues of the same individual.

In cycads, for example, centrosome-like structures (blepharoplasts) are associated with the karyokinesis of the generative cell of the pollen tube, but they are absent from the rest of the antecedent cell-generations. Hence their morphological permanence can hardly be seriously maintained in such a case as this. Again, in many of the higher plants the spindle fibres which appear in the early prophases of karyokinesis (*e.g.* in pollen-mother cells of the lily) originate at many different spots in the cell, and this may probably be correlated with the extrusion of nucleolar substance which was described in this instance as long ago as 1893. Furthermore, such a conception of the possible nature of centrosomes enables one to harmonise the peculiar quadripolar spindles so characteristic of the lobed spore-mother cells of many liverworts.

It is clear, of course, that the acceptance of such a possible origin of centrosomes does not necessarily involve a denial of their possible permanence in other cases. But it does add another striking example to those cases in which a morphological character may be traced to physiological causes, the character itself only persisting for so long as the physiological stimulus continues to operate.

J. B. F.

ROSE CULTURE.

The Book of the Rose. By the Rev. A. Foster-Melliar. Second edition, with 33 illustrations. Pp. xiv + 352. (London: Macmillan and Co., Ltd., 1902.) Price 6*s*.

THE design of the author is "to show how roses may be grown in the best possible manner so as to produce the finest blooms"; and from his enthusiastic love and his long, successful culture of the flower, he has written such an exhaustive treatise that the reader who has the ambition, the energy and the means to follow his instructions cannot fail to achieve success. He gives clear and comprehensive details as to soil, situation, selection and treatment, where to erect a throne for the queen of flowers, and the homage which must be paid by those devoted subjects who would win her most gracious smiles. With a loyal service, which is never disheartened, the knight of the rose must be eager to maintain her supremacy against all comers. Without metaphor, he who would grow roses in their perfect beauty, and, like the author of this book, would be rewarded with medals and trophies, must obey the immutable law, must work for his wage, must train for the race if he would so run that he

may obtain the prize ; he must dig and drain and enrich the soil, must plant, protect and prune, and, like the husbandman, he must have long patience before the harvest comes. He must be prepared for failures and disappointments, for nipping frosts and scorching suns, hailstones and drenching rains, for blight and mildew, fungus and thrip, for aphis and grubs, spiders and beetles, suckers and weeds. The obstacles are many, and the enemies are fierce, as ever to those who would attain excellence.

But perseverance will prevail, and he who has an expert for his guide will reach the summit, however steep may be the mountain. He who has a productive soil, a situation sheltered but not overshadowed, an atmosphere not polluted by smoke or smut, who adds to these inseparable adjuncts of success a determination to succeed, and then follows, in strict obedience, the teaching of Mr. Foster-Melliar, will repeat his achievements ; the pupil will become a professor, and the entered apprentice will be a master-mason.

On the subject of "garden roses," roses which have not the perfect symmetry and fulness required for exhibition at our shows, the author declares that he is no authority, and he tells us little or nothing of their infinite variety and beauty in beds, borders and shrubberies, on pillars, pergolas and walls ; but as a manual for the production of those roses, which have been most admired by rosarians, in their loveliest form, his admirable essay is complete.

OUR BOOK SHELF.

The Birds of North and Middle America. Part i. "The Fringillidæ." By R. Ridgway. *Bulletin* U.S. Museum, No. 50. Pp. 715 ; 20 plates. (Washington, 1901.)

MR. RIDGWAY is such a well-known authority on the birds of North America that anything coming from his pen is sure to obtain a welcome at the hands of his brother ornithologists. The size of the present volume, which, as stated in its title, deals only with a single family, affords an index of the bulk and extent of the work of which it forms the commencement. The amount of labour involved in such a task is enormous and can only be properly appreciated by working naturalists. Preparations for the work, the author tells us, have been in more or less active progress for the last twenty years, and so long ago as the autumn of 1894 the task of putting together in proper form for press the vast accumulation of material was taken in hand. The labour of measuring specimens of more than 3000 forms of birds and making the necessary references to previous descriptions was, however, so vast that it has only been possible to issue the first part after this long lapse of time. It is hoped, now that much of the drudgery is accomplished, future progress may be more rapid.

The object of the work is to describe in detail every definable form of bird—whether species or subspecies—met with on the American continent, from the Arctic districts to the eastern end of the Isthmus of Panama, together with the West Indian and Galapagos Islands. Moreover, besides the indigenous denizens of the area, the accidental or casual visitors, as well as artificially introduced species, are included, so that the list is as full and comprehensive as possible. Needless to say, the work is written on modern American lines, so that the number of forms regarded as entitled to distinction is very great ; while the number of genera and subgenera is likewise unusually large. An especial feature of the work is the large number of forms which are relegated to the rank of subspecies.

As regards the description and keys to the different groups and species, the work appears to be admirably written, the number of specimens of which the measurements are given rendering it especially valuable. Perhaps it was somewhat unnecessary to give a general account of birds and their various orders, but this is a fault on the right side, and the work should prove invaluable to all zoologists on both sides of the Atlantic. In replacing the name "Central America" by the unfamiliar "Middle America" the author may be etymologically right, but if this be the reason of the innovation, it is somewhat curious to find such a change advocated by American naturalists, who are notorious for the contempt with which they treat the synthesis and orthography of scientific names. R. L.

The Lens. A Practical Guide to the Choice, Use and Testing of Photographic Objectives. By T. Bolas, F.C.S., F.I.C., and George E. Brown, F.I.C. Pp. vi + 176. (London : Dawbarn and Ward, Ltd., 1902.) Price 2*s.* 6*d.* net.

THIS is a useful book, not only for beginners in the use of the camera, but for many photographic workers who have never studied the optics of lenses. The elementary treatment of lenses is far in advance of that of most professed English text-books of optics, as from the outset it does not make the assumption of an infinite thinness of lenses, but treats them by the method of Gauss by means of principal planes and principal points. Unfortunately, the authors persist in calling the principal points "nodal" points, a confusion of language which will puzzle students if when they come to the eye they discover that the nodal points of that organ are not the same as the principal points. There are good discussions of the subjects of angle of view, inequality of illumination and "depth of focus." We are glad to see that the authors have summoned up courage to omit "indigo" from the tints of the spectrum. It has long been recognised that there is no indigo tint between the blue and the violet. It is a pity that the authors admit the vulgarism in chapter iv. of writing the aperture-ratios *f*/24, *f*/16, &c., as *f* 24, *f* 16, &c. On p. 49 they give the notation correctly. The lens diagrams would be improved by cross-hatching the sections of the lenses ; it is impossible by looking at the mere outline, for example, of the composite back lens of Fig. 104A, on p. 91, to tell whether it represents three lenses cemented together or two lenses separated by an air-space. The practical hints on focussing, copying and enlarging are excellent ; and we quite concur in the advice on p. 95 to avoid second-hand lenses. Some admirable examples of the performance of lenses are reproduced in half-tone blocks. That of King Henry VII.'s Chapel on p. 171 is really marvellous.

A Text-book of Geology. By Albert Perry Brigham, A.M., F.G.S.A., Professor of Geology in Colgate University. Pp. 477 ; illustrated. (London : Hirschfeld Brothers, Ltd., 1902.)

ALTHOUGH this work bears on its title-page the name of a London publisher, it is evidently prepared with a view to the requirements of teachers and students in the United States. It forms one of the "Twentieth Century Text-books" edited by Dr. A. F. Nightingale, formerly of Chicago. According to its author's preface, this text-book has been especially prepared as an elementary treatise for secondary schools in America, and it seems admirably adapted for this purpose. While modestly disclaiming any great originality in the plan of the work or novelty in the mode of treatment of geological problems, the author may be

congratulated upon having produced a very clear and readable introduction to the study of geology. The illustrations, many of which are new, are especially excellent, some being from original photographs taken by the author during his travels.

It is only fair to add, however, that while the earlier chapters may be read with advantage by all students of the science in every part of the globe, the part of the book which deals with "historical" or stratigraphical geology is quite unsuited for European students. The sequence of formation described is that of the American continent, and the fossils figured are, almost without exception, American forms. This, while fitting the work for students on the other side of the Atlantic, makes the work of little value, so far as its later chapters go, to English readers.

Elementary Plant Physiology. By D. T. Macdougal Ph.D. Pp. xi + 138. (New York and London: Longmans, Green and Co., 1902.) Price 3*s.* net.

WITHIN the pages of his elementary text-book Prof. Macdougal has collected together a very large number of experiments—so large, indeed, that forty-eight laboratory periods do not by any means exhaust the list. A certain number of these would be included in an ordinary anatomical course, *e.g.* the examination of sections of various parts of the plant, of mycorhiza, &c., while others are merely bionomical observations. The inclusion of these, however, is not so much deprecated, but rather the scant treatment which is meted out to some of the more important activities of the plant. Respiration is practically limited to a few experiments with seeds placed in a retort inverted over mercury; such apparatus precludes any but the roughest quantitative measurement. Again, no practical form of potometer is suggested, and absolutely no mention is made of the movement of protoplasm. Apart from the actual study of the movement, the streaming of protoplasm affords a simple indicator when investigating the action of anæsthetics or of neutral or poisonous gases upon the plant. These inhibiting effects are worked in by the author with growth, and this makes the experiments more complicated and less adapted to measurement.

These omissions are the more disappointing because Prof. Macdougal has the happy knack of giving explicit and full directions in a few sentences, and, further, he takes every opportunity of throwing out suggestions which should lead the student to think for himself and thereby obtain a fuller appreciation of the problems with which he is dealing.

Diagramme der electrischen und magnetischen Zustände und Bewegungen. By F. W. Wüllenweber. Pp. 64 + plates. (Leipzig: J. A. Barth, 1901.)

THIS book, consisting of ten plates and sixty diagrams and descriptive text, is put forward by the author as a contribution to the answers to the questions, What is electricity? and What is magnetism? The diagrams consist of figures representing the lines of force due to various distributions of electricity or magnetism; but in no case is there any quantitative representation attempted. All that we are given is a distribution of arrow heads representing the direction of the ether strains on a molecule. The diagrams being purely qualitative, there is really nothing in the book that a student could not put down himself easily, and frequently with greater accuracy than the author. The conception of lines and tubes of force as treated by Maxwell and Thomson can be most useful and instructive, but as they are given in the present book they can only result in confusion. We are afraid the questions What is electricity? and What is magnetism? are no more nearly answered after the appearance of this book than before.

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.*]

A Remarkable Solar Halo.

ON Sunday, August 7, 1898, being in Norway, I was climbing, with a friend, the upper slopes of the Horntind, above Skogstad, in the well-known Valders route between Christiania and Laerdal, lat. 61° 15′ 30″, long. exactly 6° E. We had reached a height of about 4000 feet above sea level when we saw the very remarkable halo of which I send you the photograph of the copy of a very careful drawing, made on the spot. I first caught site of the halo at 11.30 a.m., on lying down for a short rest on a large flat horizontal stone, but I have no reason to doubt that it had been visible for some time before. The early morning had been brilliantly fine, the air still, and the sun very hot; about 10.30 a.m. a very light breeze from almost due south began to blow, with intervals of dead calm. When the halo was seen, the sky was completely covered with a thin white haze. There was, however, no rain that day, though the weather on the next and succeeding days was not good. The sky outside the circles seemed everywhere brighter than inside them; the sun shone through the haze scarcely brightly enough to throw a distinct shadow, and his rays aroused no sensation of warmth. The inner edge of all the rings was fairly sharp, and of an orange-red colour, brightening into yellow, which

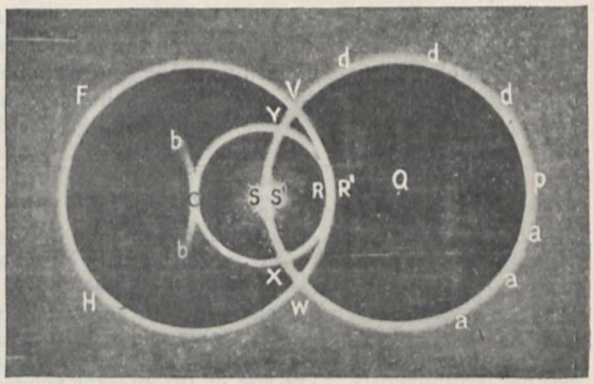


FIG. 1.

grew paler towards the outer rim, where it faded into a bluish-white radiance, which in turn became imperceptibly blended with the white misty sky. The width of the rings was from one-and-a-half to two degrees.

I watched the halo until it had completely faded. First the ring SVPW faded, the other two complete circles remaining visible after it had completely disappeared. Next the ring FHWV slowly vanished, leaving the small ring CYRX quite perfect and bright, and also the luminosity at *bb*. This last looked like a small part of a fourth circle; certainly it was curved and convex towards the sun, but of what radius this small arc was I am uncertain, but suspect that it was either the same, or greater than, the radius of the two big circles. I had no accurate instrument with me at the time for measuring angles, but the disc of the sun was distinctly visible through my neutral-tinted snow glasses, and in estimating the distance S′R as subtending at the eye an angle of 19° I do not think there is an error of more than a few minutes of angle. The radius of each of the big circles must have been, therefore, nearly 44°, and that of the small circle about 22°.

In the illustration, the width of the rings is somewhat exaggerated. But by far the most remarkable thing about this halo is the asymmetric position of the sun with respect to the rings. With respect to the two large circles this is obvious, for the sun appeared to lie on the circumference of one of them, and at a point half way (subject to what is said below) between the centre and the circumference of the other; but, besides this, I could not persuade myself, though I exerted all my powers of

imagination to do so, that the sun was *exactly* in the middle of the *small* circle, and was forced, after repeated observations, to conclude that the sun's centre appeared to be about the ninth part of the distance SR to the west of the true centre S. I can only offer in explanation of this that it was due to some curious, perhaps subjective, effect caused by the part of the arc VYSXW, which was very bright, for *after this ring had vanished* the sun certainly appeared at S, without any alteration that I could see in the position of the two circles left.

There was no trace of any luminosity other than that of the sky at Q. The brightest part of the whole halo, apart from the sun itself and the part of the arc VSX near to the sun, was the arc VRW; but at C, V, Y, X and W, and especially at X and W, the light seemed decidedly brighter than in the other parts of the rings, though there were no proper "mock suns." Since the time when I saw this weird and magnificent display, I have often tried to deduce the observed curves from the known hexagonal forms of ice crystals, and even to produce them empirically by reflecting and refracting light from glass models, but so far without any success. It will be readily seen that the halo bears a certain resemblance to the lunar halo which was the subject of a letter to NATURE of May 1 by Prof. Barnard, but the two are in reality widely different. Probably the form I have just described is of *exceedingly* rare occurrence, for it presents far too grand and curious a spectacle to be visible without exciting attention, and I have never come across any mention or diagram of a halo like it. T. C. PORTER.

Eton, May 8.

Sun-pillar (?)

MISS HERSCHEL (a careful observer) has just called me out to see one. At 7.10 p.m. she saw the sun above a bank of clouds, in a somewhat hazy sky, but no clouds above it for a space of some 5 degrees. Above that was a light-fringed belt of clouds of great depth. From the sun a parallel-sided pillar of light, just like the reflection of the sun in a slightly rippled sea, stood upright into, and stopped at, the light-fringe; it was not so bright as the reflection spoken of would be, but markedly brighter than the background sky; colour yellow. Miss Herschel had to bicycle home three-quarters of a mile uphill to call me, and it was fading before she reached home.

I was prompt, but too late (7.25) to get a good view. The possibility of Martinique dust induces me to send you this. Sunset moderately red; temperature here 42°; air calm all day; with dark sky and damp mistiness. W. J. HERSCHEL.

Littlemore, May 13.

Palæolithic Implements in Ipswich.

ALTHOUGH in isolated cases implements of Palæolithic workmanship have occasionally been found in Ipswich, it is only during the last few weeks that a deposit containing abundant Palæolithic remains has been discovered.

On March 21 last, after long searching, I was fortunate enough to hit upon this interesting site, and the result has been a harvest of implements of very varied types. Mr. Clement Reid, whom I acquainted with the discovery, at once came down to examine the spot, and under his guidance it will be carefully studied.

The relations of the deposits remain to be worked out, but so far show some resemblance to those found at Hoxne and Hitchin.

Among the implements found, some have a thick, ochreous patina, while others are almost devoid of it. Most are very slightly rolled, but some are still sharp.

Pointed implements roughly worked at the butt predominate, but in one case the butt-end has been carefully sharpened.

A fine oval implement shows signs of having been worked for hafting, as also does a smaller chisel-like form. Implements corresponding to those described by Sir John Evans as "crescent like," a boring implement, a possible sling-stone, several ovoid forms flat on one side and raised on the other, triangular forms, some thick and heavy, one flat, and a delicate leaf-shaped implement, show the variety of purposes which these flints were made to serve.

The position occupied by the Palæolithic remains appears to be that of a silted-up channel cut through Glacial deposits. Some of the implements were found at a depth of 12½ feet, others considerably higher, which may account for the difference in their condition. NINA FRANCES LAYARD.

Brückner's Cycle and the Variation of Temperature in Europe.

WE now possess excellent long series of weather-observations for many places. It occurred to me lately to apply to several of the annual temperature series in Europe an averaging process which would tend to bring out the larger waves of variation, or at least to show how year-groups of a given magnitude compare with one another. I have accordingly considered in groups of ten years (1 to 10, 2 to 11, 3 to 12, and so on) the following (see diagram):—A. Annual mean temperature of Greenwich (from 1841). B. That of Geneva (from 1826). C. That of Bremen (from 1829). D. That of Vienna (from 1826).

[The Greenwich curve is drawn on a larger scale than the others. The degrees are Fahr., those of the others Cent. The position of the curves is simply contrived so that they should not cross one another. In the case of Vienna, the continuous curve from 1855 is for the Hohe Warte near Vienna; the previous dotted curve is *approximate* for the same place, deduced from data of the University Observatory in Vienna. The Bremen figures used extend only to 1895, the other series to 1900]

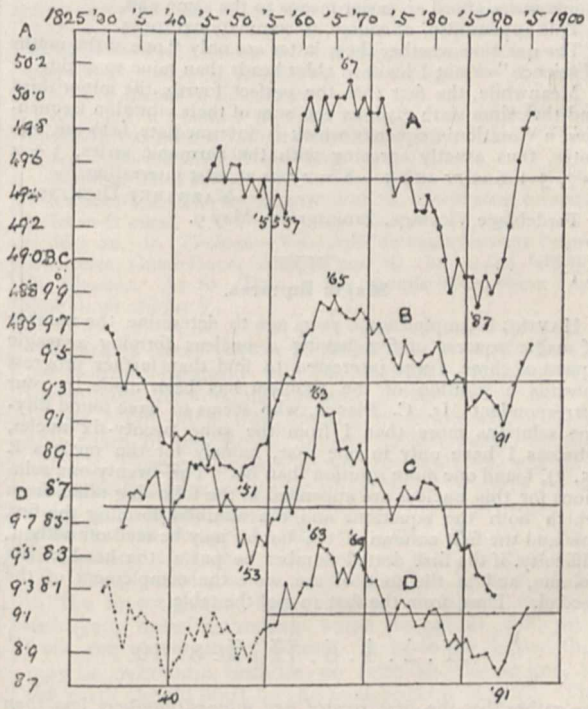


FIG. 1.—A, Greenwich; B, Geneva; C, Bremen; D, Vienna.

Taking the case of Greenwich, it will be understood that the first point, for 1845, indicates the average mean temperature of the ten years 1841 to 1850, the second that of 1842 to 1851, and so on.

The curves, it will be seen, all agree in showing a long wave with crest in the sixties, and extending from a minimum in the fifties (Vienna a little earlier) to another about the end of the eighties (or beginning of nineties).

The Greenwich maximum is reached in 1867, and minima are found at, say, 1855 and 1887. The temperatures prior to 1841 are in some uncertainty; but we should probably be safe in saying that an earlier minimum, of magnitude corresponding rather to the last, occurred about 1816. Thus we have 1816–55 = 39 years; 1855–87 = 32 years; which agrees very fairly with Brückner's cycle of about 35 years. As to previous maxima, we may probably reckon one in the later twenties. The curve (with final point in 1895) would appear to be now near a second maximum from that date (? 1902); and we might with some reason, perhaps, look for another minimum, or conspicuously cold group, in the early twenties of this century.

The minimum of 1855 for Greenwich is considerably less pronounced than that of 1887, and in Bremen, too, the earlier

minimum seems to have been less than the later; while in Geneva the earlier minimum is the deeper.

The facts above given may be usefully compared with Dr. Lockyer's recent important researches, pointing to a cycle of about thirty-five years in the sun-spot variations. It may be doubted if the annual mean temperature of these European stations shows any good evidence of being ruled by the eleven-year cycle of sun-spots; and if it did, the method of smoothing here adopted might even obscure such an effect somewhat. This, however, does not seem to affect the validity of evidence from other orders of data. ALEX. B. MACDOWALL.

Resultant Tones and the Harmonic Series.

IN reply to Prof. Thompson's criticism of the plan of recovering differential resultant tones by means of the harmonic series, may I say that my position is that of a road-maker, not a discoverer—a Macadam rather than a Columbus.

So long as authorities teach that resultant tones have a vibration frequency which is equal to the difference between the vibration frequencies of their generators, so long will the harmonic series afford an easier means to the same end.

This applies also, of course, to summational tones.

The question whether these latter are only "one of the myths of science" or not I leave to abler heads than mine to decide.

Meanwhile, the fact that the perfect fourth, the minor third and the minor sixth give, as the sum of their vibration frequencies, a vibration frequency which is intermediate between two notes, thus exactly agreeing with the harmonic series, $3 + 4 = 7$, $5 + 6 = 11$ and $5 + 8 = 13$, is at least interesting.

MARGARET DICKINS.

Tardebigge Vicarage, Bromsgrove, May 9.

Magic Squares.

HAVING attempted some years ago to determine the number of magic squares of five having a nucleus forming a magic square of three, I was interested to find that further progress towards a solution of the problem has been made by your correspondent Mr. C. Planck, who seems to have found fifty-one solutions more than I from the same twenty-six nuclei, whereas I have only in one case, namely for the nucleus R (5, 7), found one more solution than he. The twenty-one solutions for this nucleus are appended in the following table, from which both the equations and the numbers forming the first row and the first column of the border may be read off without difficulty, if the first dotted number be put at the head of the column, and at the foot of the same the complement of the second. Thus, from the first row of the table,

$$\bar{1} \,.\, \dot{2} \,.\, \dot{4} \,.\, \bar{6} \,.\, \bar{12} \mid \bar{3} \,.\, 8 \,.\, 10$$

we gather that the first row of five minors (numbers less than 13) may be converted into a normal row with sum 5×13 by replacing the three barred numbers by their complements, since $2 + 4 + 13 = 1 + 6 + 12$, whilst the remaining three minors, together with the dotted pair, furnish a normal column when 4 and 3 are replaced by their complements, since here again $4 + 3 + 13 = 2 + 8 + 10$. The border with nucleus, accordingly, when completed, is

	a	b		b'	a'
a	2	25	20	14	4
b	8	11	21	7	18
	10	9	13	17	16
b'	23	19	5	15	3
a'	22	1	6	12	24

1	$\bar{1}$	$\dot{2}$	$\dot{4}$	$\bar{6}$	$\bar{12}$	$\bar{3}$	8	10
2	$\bar{1}$	$\dot{2}$	$\dot{4}$	$\bar{8}$	$\bar{10}$	$\bar{3}$	6	12
3	$\bar{1}$	$\dot{2}$	$\bar{4}$	$\dot{6}$	10	$\bar{3}$	8	12
4	$\dot{2}$	$\bar{3}$	$\bar{4}$	$\dot{6}$	12	$\bar{1}$	8	10
5	$\bar{1}$	$\dot{2}$	$\dot{6}$	$\bar{8}$	$\bar{12}$	$\bar{3}$	4	$\bar{10}$
6	$\dot{2}$	$\bar{3}$	$\dot{6}$	$\bar{8}$	$\bar{10}$	$\bar{1}$	4	$\bar{12}$
7	$\dot{2}$	$\bar{3}$	$\bar{4}$	$\dot{8}$	10	$\bar{1}$	6	$\bar{12}$
8	$\dot{2}$	$\bar{3}$	$\bar{6}$	$\dot{8}$	12	$\bar{1}$	4	$\bar{10}$
9	$\bar{1}$	2	8	$\bar{10}$	$\bar{12}$	3	$\bar{4}$	$\bar{6}$
10	$\dot{2}$	$\bar{3}$	$\bar{4}$	6	$\dot{12}$	$\bar{1}$	8	$\bar{10}$
11	$\dot{2}$	$\bar{3}$	$\bar{8}$	10	$\dot{12}$	$\bar{1}$	4	$\bar{6}$
12	$\bar{1}$	$\dot{4}$	$\dot{6}$	$\bar{8}$	12	2	$\bar{3}$	$\bar{10}$
13	$\bar{3}$	$\dot{4}$	$\dot{6}$	$\bar{8}$	$\bar{12}$	1	$\bar{2}$	$\bar{10}$
14	$\bar{1}$	$\dot{4}$	8	$\bar{10}$	$\dot{12}$	$\bar{2}$	3	$\bar{6}$
15	$\bar{1}$	2	$\bar{4}$	$\dot{6}$	$\dot{10}$	$\bar{3}$	8	12
16	1	$\bar{2}$	$\bar{4}$	$\dot{8}$	$\dot{10}$	$\bar{3}$	6	12
17	$\bar{1}$	2	$\bar{6}$	$\dot{8}$	$\dot{10}$	$\bar{3}$	4	$\bar{12}$
18	$\bar{2}$	3	$\bar{6}$	$\dot{8}$	$\dot{10}$	$\bar{1}$	4	12
19	$\bar{3}$	4	$\bar{6}$	$\dot{8}$	$\dot{10}$	$\bar{1}$	2	$\bar{12}$
20	1	$\bar{2}$	$\bar{6}$	$\dot{8}$	$\dot{12}$	$\bar{3}$	4	$\bar{10}$
21	3	$\bar{4}$	$\bar{6}$	$\dot{8}$	$\dot{12}$	1	2	$\bar{10}$

When the number 603 is multiplied by 288 we get 173,664 for the number of such nuclear squares. When we proceed to inquire as to the number of all types of magic squares of five, we must begin by doubling the above number, since every magic square with odd root may be varied by permuting the rows above the mid-row, together with the rows below the same, and at the same time the columns on either side of the mid-column, so that the above square may be transformed by reversing the order of the marginal letters a, b and a', b', as follows:—

	b	a		a'	b'
b	11	8	21	18	7
a	25	2	20	4	14
	9	10	13	16	17
a'	1	22	6	24	12
b'	19	23	5	3	15

If now we add to the number 347,328 thus obtained the squares in which each row and each column contains all the units 1 . 2 . . 5 increased by the four increments 5 . 10 . 15 . 20 without repetitions of either, of which there are at least 21,376, we get 368,704 without considering other types, probably some hundreds of thousands in number, which would certainly bring the minimum to more than half a million.

Shipley, Yorks. J. WILLIS.

Mont Pelée and After-Glow.

MAY I point out that the after-glow following the eruption of Krakatoa was—as I wrote at the time—remarkably emphasised on the west coast of British India.

Following the letter of Dr. W. J. S. Lockyer in NATURE of May 15, the after-glow, now, after the eruption of Mont Pelée (and Soufrière?) should be as remarkably emphasised in central and perhaps the southern part of North America.

In Europe this eruption will not (?) cause the same effect as to after-glow as the former. F. C. CONSTABLE.

Wick Court, near Bristol, May 18.

THE VOLCANIC ERUPTIONS IN THE WEST INDIES.

SINCE we went to press last week further details have become available as to the volcanic disaster in the West Indies. We give a summary of the reports which have been published in the *Times* during the past week upon the sequence and character of the eruptions from the commencement of the disturbances, the particulars here given being supplementary to those in our last issue.

April.—In the last days of April smoke was noticed on Mont Pelée and rumbling sounds were heard.

May 3.—Mont Pelée threw out dense masses of steam. Next morning the sky was dark with clouds and ashes. Ashes fell on St. Pierre, which by evening was covered a quarter of an inch thick. The mountain was invisible.

May 4.—A sea-breeze swept the ashy fog from St. Pierre, but at evening dust and scoria fell again.

May 5.—A stream of lava 20 feet high suddenly rushed down the south-western slope of Mont Pelée, and, following the dry bed of the River Blanche, swept away buildings, plantations and people in a tremendous rush to the sea, five miles distant. It was all over in three minutes. The Guérin factory on the beach near the mouth of the river was embedded in lava; only the chimney could be seen. The sea then receded along the western coast a distance of 100 yards, and returning invaded St. Pierre.

May 5, *St. Vincent.*—The lake in the old crater of the Soufrière became greatly disturbed.

May 6, *St. Vincent.*—At 2 o'clock in the afternoon the Soufrière began a series of volcanic efforts. Severe earthquakes accompanied these. Terrible noises and detonations succeeded quickly, and at 7 p.m. an immense column of steam issued from the crater, continuing until midnight.

May 7, *St. Vincent.*—Terrific explosions occurred, and at 7 a.m. there was another sudden violent escape of steam. This ascended for three hours, when a quantity of material matter was ejected. At noon three craters appeared to open and began to vomit lava. Tremendous detonations followed in quick succession, rapidly merging into a continuous roar. The thundering was heard throughout the Caribbean Sea.

A huge cloud in dark dense columns charged with volcanic matter rose to a height of eight miles from the mountain top, and darkness like midnight descended. The sulphurous air was laden with fine dust, and black rain followed the rain of scoriæ, rocks and stones.

May 8, *Fort de France.*—St. Pierre was within ten minutes annihilated by a terrible volcanic torrent from Mont Pelée and by a combination of suffocating heat, noxious vapours, a shower of burning cinders, and a discharge of burning stones, which reached even to Fort de France.

May 13, *St. Vincent.*—The Soufrière is still in eruption. The reports of the explosions, resembling a terrific cannonade, can be heard at a distance of 100 miles. Following the explosions are columns of steam, which rise miles in height, and immense luminous bombs also issue from the crater. Lightning is playing fiercely in the upper sky.

May 15, *Fort de France.*—Mont Pelée continues in a state of eruption, but the wind is now carrying the smoke and the greater part of the matter thrown out to the north, thus relieving the parties of workers at St. Pierre.

May 15, *Kingston, Jamaica.*—For some days past the atmosphere here has been peculiarly hazy and sombre and the temperature very high, which was thought to be due to dust brought by winds from the volcanoes. This is now proved to be the case, dust being detected falling on the hills, which on microscopic examination is shown to be volcanic ash.

May 15, *St. Vincent.*—The entire northern part of the island is covered with ashes averaging 18 inches in depth, and varying from a thin layer at Kingstown to 24 inches or more at Georgetown. The streets of Georgetown are encumbered with heaps of ashes like snow-drifts, and several roofs have fallen in from the weight of the deposits upon them.

May 15, *Fort de France.*—At intervals Mont Pelée and Lacroix, 1350 metres high, are visible. Now that all the points of eruption can be discerned, seven craters can be seen which seem still active. Yesterday a flow of lava 400 metres wide descended as far as White River, its foaming sound being audible to a great distance. A new crater is perceptible near the shore, pouring out blinding steam. The sea, affected by the disturbances of all the streams, seems itself troubled, invades Prêcheur, and, undermining several houses, adds the ravages of inundation to those of fire. On the other hand, the flow of lava drives back the bay 20 metres and increases the area of devastation.

May 17, *St. Vincent.*—The bed of the lava in the windward district is still hot. An abyss 500 feet deep by 200 feet wide, which existed between Langly Park and Rabacci, is filled with lava, and the physical features of the mountain side are apparently more beautiful than before the eruption. A curious feature is that the earthquakes were not general. While at Château Belair there were, before the eruption, continuous convulsions every few hours, in Kingstown and Georgetown there were only sixty shocks in four hours.

Although it resulted in fewer fatalities, the eruption of the Soufrière was no less violent than that of Mont Pelée. Sixteen square miles are covered with lava.

May 19, *St. Thomas.*—A further serious eruption of Mont Pelée occurred. The search parties at St. Pierre were compelled to leave at once.

May 20, *St. Thomas.*—Very loud detonations were heard in Dominica, Guadeloupe, Antigua and St. Kitts, and faintly in St. Thomas. At St. Thomas the sounds heard were louder than those of May 7.

There is great reason to hope that a small scientific party from England will be promptly despatched to investigate the terrible volcanic outbursts in the West Indies. The idea was mooted in conversation in the ante-room of the Royal Society at last week's meeting, and Dr. Tempest Anderson, who probably has examined and photographed volcanic phenomena in more regions than any other Englishman, at once expressed his readiness to undertake the journey. Strong hope is entertained that leave of absence may be granted to Dr. Flett, petrologist to the Geological Survey, to join in the investigation, the expenses of which might be defrayed, notwithstanding some technical difficulties, from the Government Grant. It is to be hoped these may be overcome, because no time should be lost, and the party should start by the next boat on May 28. They will naturally go first to St. Vincent and endeavour to obtain trustworthy accounts of the eruption of the Soufrière, to ascertain the changes which have been made in the physical geography of the district, and to collect specimens of the materials ejected, as far as possible in chronological order. But we may hope that they will not restrict themselves to the British Island. The eruption at Mont Pelée in Martinique has been, not only more destructive to life, but also, according to what has been published, more abnormal in its phenomena. So contradictory are the reports that it is at present almost impossible to say what really has happened, beyond the one melancholy fact that a paroxysm in an eruption of unusual violence has caused unwonted devastation and fearful loss of life. By examination on the spot, by conference with other scientific investigators, who may already have reached the island from America or France, rumours may be sifted and evidence obtained from examination of the materials beneath which St. Pierre has been buried. A good collection of them, and other ejectamenta of the volcano, will be of great value. A comparison of those from the two islands may throw light on some interesting

and important questions. The fact that the eruptions have been almost simultaneous suggests that the orifices are situated on the same fissure, but it is, of course, possible that they may indicate a zone rather than a line of weakness in the earth's crust, and so may not have tapped precisely the same source of supply. Again, both eruptions have been preceded by a long pause, during which a column of heated material may have been kept standing for several years in the "neck" of the volcanoes. If so that would be very favourable to magmatic differentiation, and this might be revealed on chemical and microscopic examination of the materials discharged during the successive stages of the eruptions. Dr. Tempest Anderson's wide experience as a traveller, especially in volcanic districts, with his skill as a photographer, and Dr. Flett's intimate knowledge of all sides of petrology, will ensure, by their working in combination, that nothing will be missed, and important accessions be made to our knowledge of vulcanology. The shortness of the time before starting is the main difficulty, but as the enterprise is said to be favourably regarded by the Colonial Office and the officers of the Royal Society, and is heartily backed by several London geologists, technical difficulties should not prove insuperable.

There are various signs that the eruptions in the West Indies are connected with the occurrence of other terrestrial and cosmic phenomena. A report in the *Daily Mail* states that the mineral spring waters at Teplitz, Bohemia, turned brown suddenly last week. A similar phenomenon was observed before the great earthquake at Lisbon in 1755, and a repetition of the disaster is feared.

Telegraphic communication between Karachi and the rest of India has been interrupted for four days by the occurrence of the most severe and destructive storm ever known in Sind. Upwards of 40 miles of the Sind Railway have been washed away, bridges and embankments have disappeared, and the telegraph line for 50 miles either completely vanished or hopelessly dismantled.

There has been a great storm in the United States. A telegram from Goliad, Texas, states that on May 18, at 3.45 p.m., a tornado, preceded by heavy hail, swept over the town and caused great destruction. The storm lasted only five minutes. It came from the south-east without warning, and travelled as far as Kentucky, traversing four States.

Also from the United States news has been received of a great mining disaster. On May 19, at 7.30 a.m., the Fraterville and Thistle coal mines at Coalcreek, Tennessee, exploded, causing the death of about three hundred men at work in them. Rescue parties have been unable to penetrate far into the mines on account of stifling smoke and gas and extreme heat.

Mr. W. Eddy, of New York, reports that on May 15 a slight earth tremor affected three of his seismographs, the wave coming from the south-east.

All these disturbances are possibly related to a common cause, as suggested by Sir Norman Lockyer in the following letter, which appeared in Monday's *Times* :—

THE WEST INDIAN ERUPTIONS AND SOLAR ENERGY.

Sir,—In 1883, in connection with the eruption of Krakatoa, you were good enough to allow me to appeal through your quickly and widely circulated columns for early information to enable me to test an idea connected with the spread of the glorious sunsets round the world which followed the event.

Because the terrible catastrophes in Martinique and St. Vincent occurred at a well-defined sun-spot *minimum* I was led to inquire whether similar coincidences were to be traced in the past. I did not know then, but I know now, that Wolf, exactly half a century ago, had suggested a connection between solar and seismic activity; in his time, however, the record of solar changes was short and imperfect.

In my own inquiry I have used our most recently compiled tables, which are now complete for the last seventy years, and I have only considered seismic disturbances within that period. I find it beyond question that the most disastrous volcanic eruptions and earthquakes generally occur, like the rain pulses in India, round the dates of the sun-spot *maximum* and *minimum*. More than this, the 35-year solar period established by Dr. Lockyer, which corresponds approximately with Bruckner's meteorological cycle, can also be obviously traced, so that, indeed, the intensification of the phenomena at the *minimum* of 1867 is now being repeated.

In 1867, Mauna Loa, South America, Formosa, Vesuvius were among the regions involved; in the West Indies it was the turn of St. Thomas. The many announcements of earthquakes in the present year before the catastrophe of St. Pierre will be in the recollection of everybody.

In the *maximum* in 1871–72, to name only West Indian stations, Martinique first and then St. Vincent followed suit; in the next *maximum*, in 1883, came Krakatoa.

At Tokio, in a country where the most perfect seismological observatories exist, we find that at times near both sun-spot *maxima* and *minima* the greatest number of disturbances have been recorded.

Very fortunately, the magnificent work of the Indian Meteorological Department enables us to associate the solar changes with pressures in the tropics, and obviously these pressures have to be taken into account and carefully studied.

This, Sir, brings me to the point of this letter, which is, through your kindness, to ask from meteorological observers in the West Indies and the surrounding regions the favour of copies of their barometrical readings, showing the departures from the local means for the two months preceding the eruption at St. Pierre. In this way one or two years may be saved in getting at the facts.

I am, Sir, your obedient servant,

NORMAN LOCKYER.

Solar Physics Observatory, May 17.

MOUNTAIN MASSES AND LATITUDE DETERMINATIONS.[1]

WHEN we take a comprehensive view of the information that has been collected in order to determine the mean figure of the earth, we must acknowledge the important part that has been played by a long succession of Indian geodesists. For practically a century, with greater or less vigour, according to the political conditions prevailing at the time, continuous measurements have been carried on, with the result that we have at least eight meridional and four longitudinal arcs available for the general discussion. The differences of latitude extend from roughly 9° to 20° north, and include the determination of the astronomical latitude of some 150 stations, while the amplitude of the longitudinal arcs embraces nearly 25°, necessitating the investigation of fifty differences of longitude. The vigour displayed is the more curious since it must have been anticipated that the results would be affected with systematic error, as the deflection of the plumb-line would be materially influenced by local circumstances. Not only are the evident masses of the Himalayan range and the Tibetan plateau exercising an effect, which may, perhaps, be allowed for satisfactorily on the assumption of a uniform distribution of density in the strata below the surface, but the presence of the Indian Ocean on two sides of the peninsula, with its varying and uncertain depths, emphasises the difficulties of adjustment and compensation.

Since, however, in order to obtain the full value of the admirable work that has been accomplished in India, it is necessary to eliminate the effect of local attraction, various attempts have been made by different authorities, with, it must be admitted, only partial success. It is a matter of ancient, but of interesting, history to recall the suggestions and the controversy between Archdeacon Pratt and the late Astronomer Royal, the views of neither authority now being acceptable in their entirety, though

[1] "The Attractions of the Himalaya Mountains upon the Plumb-line in India. Considerations of recent Data." By Major S. G. Burrard, Royal Engineers, Superintendent Trigonometrical Surveys. Pp. vii + 115. (Dehra Dun, 1901).

Airy, guided by the insufficiency of the Archdeacon's results to explain the numerical discrepancies, was fully justified in asserting that the magnitudes of attractions computed on the theory of gravitation would be too great. He was less happy in the reason assigned for this conclusion. Airy seems to have considered that the Himalaya Mountains were floating in a sea of dense lava, and that the bases of the mountains displaced a quantity of denser material, much in the same way that an iceberg displaces the water of the ocean on which it floats. The more legitimate explanation seems to be that the elevations are composed largely of an expansion of the matter in the immediately subjacent strata of the earth's crust, the masses above and below being mutually interdependent; where high elevations exist, therefore, the strata below are deficient in density, having parted with some of their contents. At low elevations the density is normal, since there is no appreciable upheaval of matter, while under the sea there is a contraction of matter and consequently an increase of density. These views have generally been supported by the pendulum experiments of Von Sterneck in the neighbourhood of the Alps and the still more recent measurements carried out near Kolberg in connection with the German geodetic operations. The misfortune, however, in all these inquiries is that it is impossible to detect the distance below the surface at which the excess or defect of matter may exist, and, therefore, the intimate connection between the unevenness in the earth's crust and the unequal distribution of subjacent material is not clearly demonstrated.

But in India, the very wealth of observation spread over a district so wide introduces new difficulties and taxes ingenuity to the utmost. The latest authority to struggle with the problem is Major S. G. Burrard, already well known to geodesists for the skill with which he unravelled the perplexities connected with the collimation of the transit instruments used in the longitude inquiries, and later for the very successful determination of the longitude of Madras, in which the circuit errors are reduced to a minimum. One therefore watches his attempt to deal with this old problem with a great deal of interest, and is inclined to treat his deductions with considerable respect.

The particular point at issue may be stated thus: How is the astronomical zenith situated with regard to the geodetic zenith at the principal station for reference of latitude in India? This station is Kalianpur, the astronomical latitude of which, after complete discussion, had been settled at 24° 7′ 11″·10, and from this quantity, by the aid of observed azimuths and the constants of Clarke's spheroid, the geodetic latitudes of all the fundamental stations have been computed. An examination of the results shows that the mean excess of the astronomical over the geodetic values of latitude is −2″·0, or, put in another way, it is shown that of the 148 astronomical latitudes available for geodetic investigation, there are 90 cases of negative excess to 58 of positive. It appeared, therefore, to the late General Walker, and his conclusion has been generally accepted, that the astronomical latitude of Kalianpur was too great by 2″, and that the plumb-line was not deflected to the north, under the influence of the Himalaya Mountains, but was in reality deflected to the south. With the view of settling the question, he recommended that the latitude of a number of subsidiary stations within a moderate distance of the central station should be derived, and the mean latitude be used for the central station, since it might be assumed that such a final result would be more free from the effects of deflection than the latitude of any single point. Such a view regards the deflection as arising from local causes operative over a small area, but Sir David Gill has since pointed out the very obvious objection that if local attraction is persistent in one direction over large continuous areas, group observations such as those recommended would be insufficient to eliminate the effects, and it is not the least important part of Major Burrard's investigation to show that the latent causes of disturbances must be sought over very extended areas.

This work of latitude determination has now been completed under the superintendence of Captain L. Conyngham, and Kalianpur has been surrounded by a chain of stations, of which four are situated at an average distance of nine miles and four at an average distance of thirty-five, and the unexpected result of the discussion is to show that local attraction causes a northerly deflection of the plumb-line to the amount of 0″·60, thus differing by 2″·60 from the value found by General Walker drawn from the whole of the Indian observations. The results in the prime vertical are not less contradictory, and in the following table is exhibited the amount of deflection in the two planes, at each of the group of latitude stations around Kalianpur, situated within the extreme parallels 23° 36′ to 24° 38′:—

	Deflection in the Meridian.		Deflection in the Prime Vertical.	
	The Group System.	Whole of India System.	The Group System.	Whole of India System.
	″	″	″	″
Daiadhari	+1·01 S.	+3·61 S.	+2·13 W.	+5·35 W.
Surantal	+0·82 S.	+3·42 S.	+3·04 W.	+6·86 W.
Sironj	+1·69 S.	+4·29 S.	+2·54 W.	+5·76 W.
Bhaorasa	+1·17 S.	+3·77 S.	+0·22 W.	+3·44 W.
Kalianpur	−0·60 N.	+2·00 S.	−0·22 E.	+3·00 W.
Losalli	−1·02 N.	+1·58 S.	−6·38 E.	−3·16 E.
Tinsia	+0·98 S.	+3·58 S.	—	—
Salot	—	—	−4·49 E.	−1·27 E.
Kamkhera	−2·15 N.	+0·45 S.	+0·04 W.	+3·26 W.
Ahmadpur	−2·49 N.	+0·11 S.	+2·27 W.	+5·49 W.

The stations in this table proceed regularly from the north towards the south, and, confining attention solely to the deflections in the plane of the meridian, it is clear that north of Kalianpur we get a southerly deflection, while on the southern side the plumb-line tends to the north. Clearly, then, the Himalaya chain, which has been so frequently invoked to explain inconvenient discrepancies, will not avail here. And the insufficiency of such a hypothesis is still more clearly shown if the deflections be examined at stations nearer to the mountains. At Dehra Dun, the most northerly, in latitude 30° 19′, the deflection is 38″; in latitude 29° 31′, the deflection is reduced to 7″, and disappears entirely in latitude 27° 51′; while south of Kalianpur we meet with northerly deflections diminishing in amount as Cape Comorin is approached. Major Burrard clearly puts the dilemma thus: "If Himalayan attraction is capable of producing a deflection of 38″ at Dehra Dun, its effects must be felt at Cape Comorin; on the other hand, if Himalayan attraction exercises no effect on plumb-lines south of latitude 29° 31′, it cannot produce a deflection of 38″ at Dehra Dun."

We cannot follow Major Burrard through the various steps by which he seeks to remove the anomalous results, but his method is as exhaustive in theory as it is laborious in practice. He considers the effect of the surrounding ocean on the derived longitudes, and shows that these results stubbornly enforce the necessity of admitting the entire compensation of the ocean. He also asks whether it is possible to introduce any admissible alteration in the dimensions and ellipticity of Clarke's spheroid, and the answer is not less certain. He finds that Clarke's major axis is the most suitable for the Indian longitude arcs, and that, as concerns latitude, while one belt of negative maxima requires an ellipticity greater than 1/289, the large sub-Himalayan deflections demand an ellipticity smaller than 1/311. He therefore concludes that the accepted spheroid is not a source of serious error, and that the Indian observed latitudes favour the Clarke spheroid.

Finally, the author is driven to the conclusion that the undiscovered cause of disturbance is traceable to a great invisible chain of excessive density, traversing India from Balasore, near the mouth of the Hooghly, to Jodhpur in Rajputana, and underlying Mandla and Bhopal, or roughly running parallel with the Himalayan chain. This hypothesis is supported by the observation or detection of the opposite effects on either side of the hidden chain. Between the parallels 24° and 26°, the plumb-lines are deflected southwards, while between the parallels 21° and 18°, the deflections are north and large. This view is further confirmed by the arc of longitude between Amritsur and Mooltan, for the plumb-line at these stations is deflected inwards towards the low-lying alluvium and away from the mountain masses.

The author gives a table in which is shown the amount of deflection due to the Himalayas, to the Tibetan plateau and to the underground chain, and the algebraical sum of these three effects agrees very closely with the observed discrepancies throughout the whole range of latitude, from 30° 19′ in the north to 8° 9′ at the southern end of the arc. It is assumed in this calculation that the northern and southern slopes of the underground chain are inclined at the same angle to the vertical—a somewhat improbable hypothesis, as the author is aware—but it seems not unlikely that further discussion will disclose the contour of this subterranean chain. The particular claim that Major Burrard has on our gratitude is that he sweeps away the accidental and local attractions that have too frequently been put forward to explain isolated discordant instances, and substitutes one general central cause, which can be confirmed or displaced by further investigation.

SCHOOLS AND SCHOLARSHIPS.

THE receipt of a copy of the new issue of "The School Calendar" (London: Whittaker and Co.) suggested the idea that it would be useful and interesting to extract some information from its pages as to the present position of science at the older universities in regard to the awards of scholarships. And it seemed all the better worth while to attempt this because such statistics as have previously come under our notice distinctly suggest that science is now doing a good deal more for the colleges as a whole by helping to maintain their overflowing numbers, than the colleges do for science in distributing their scholarship funds.

Everyone who is interested in this subject knows very well that a generation or so ago the colleges at Oxford and Cambridge did much to promote the teaching of science in schools, and especially in certain schools, by offering science scholarships in numbers that, for the time being, were not only sufficient, but liberal, and that the results of this policy have been beneficial alike to the colleges and to the students of science who were thus attracted to the universities. This action has, in fact, been so successful that at Cambridge the science tripos is, if not the largest, at any rate substantially equal to its older rivals in numbers, and also in the quality of its members, as is shown by the army of able teachers and investigators which the university has produced during the last thirty years or so.

The experiment made in the nineteenth century then has certainly been a considerable success; it has encouraged many able students, stimulated the science work of schools, and extended the field of usefulness of the universities. But it is a long while since the experiment was begun, and perhaps the time has come to ask whether all is now well; whether the methods of selecting science scholars are satisfactory to the colleges and fair to the candidates, whether the examinations secure a sufficiently good standard in science without tempting the candidates to specialise unduly; whether this work, which was, we believe, initiated by some of the colleges only, is now being helped on by all; and, finally, whether the scholarships offered to those who desire to read in science at the universities are reasonably equal to those offered to students in classics and mathematics.

The little book before us does not afford answers to all these questions, but it contains a great mass of useful information, and within its pages will be found full details concerning the various scholarships that are to be awarded at Oxford and Cambridge during the current year. These, however, we are sorry to add, do not afford very encouraging reading.

Thus we find from the "School Calendar" that at Oxford no less than ten colleges out of twenty offer no scholarships or exhibitions for science at all, and that of the other ten, one important college, which disposes about twenty-eight scholarships and exhibitions, without counting those reserved for students of divinity, only encourages science to the very modest extent of dividing two scholarships between candidates in classics, mathematics, history and science, whilst the remainder are reserved for classics and mathematics. Some of these scholarships, doubtless, are on special foundations, but there are twelve which appear to be under the free control of the college, and all these are allotted to the older branches. At this college about 1700*l.* are to be distributed between classics and mathematics, while classics, mathematics, history and science will have equal chances, may be, in the distribution of 160*l.*

Again, fourteen Oxford colleges offer their scholarships for definite subjects in advance. These offer fifty-nine scholarships or exhibitions valued at 4217*l.* for classics, ten of the total value of 790*l.* for mathematics, eight of the value of 585*l.* for science, and ten of the value of 670*l.* for history. Whilst if we take the grand total for the twenty colleges, and assume that Magdalen, Jesus and Corpus Christi will together devote as many as four scholarships or exhibitions to science, we find that out of one hundred and forty, or more, scholarships, &c., which have a total value above 10,000*l.*, only twelve, having a value of rather less than 850*l.*, are offered for science subjects. These numbers, it should be added, though near to the truth, are only approximations, as in certain cases the number and value of the scholarships offered are subject to modification. The former figure, however, is below and the latter above the actual result of our computation, and the latter would be smaller did we not make the liberal assumption that Magdalen, Jesus and Corpus Christi will give half as many science scholarships as all the remaining seventeen colleges taken together.

It may be added that several colleges, *e.g.* Lincoln, Keble, Oriel and Pembroke, unless our authority misleads us, offer no encouragement to mathematics, but one of these, Keble, offers a science scholarship.

Turning to Cambridge, we find, as was to be expected, that most of the colleges offer awards for science; still, even at Cambridge four colleges out of seventeen, or nearly 25 per cent., viz. Corpus Christi, Magdalene, Queens' and St. Catherine's, exclude this branch. Owing to the Cambridge custom not to allot scholarships to definite subjects in advance, it is impossible to put forward such particulars as are given above for the sister university. But it may be taken that at Cambridge, as a rule, science receives more favourable treatment than at Oxford. Still, even at Cambridge in certain years not long past, as has previously been shown in these columns, the treatment accorded to science has seemed wanting in liberality, as, for example, in December 1898, when, out of one hundred and one scholarships (value 5150*l.*) given by ten colleges, only sixteen (value 745*l.*) were awarded to science candidates.

Returning now for a moment to the "School Calendar," which has afforded us the above information, it seems, so

far as we can judge, to be a really useful compilation. It gives great masses of very varied data about all sorts of examinations; contains an excellent "Calendar of Examinations" and much general information such as masters and their pupils need, and it is provided with a useful index.

THE ROYAL SOCIETY CONVERSAZIONE.

A LARGE number of exhibits of scientific interest were on view at the conversazione of the Royal Society, held on Wednesday of last week. Following our usual course, we give a list and brief descriptions of the objects exhibited, abridged from the official catalogue:—

The Badische Anilin and Soda Fabrik, Ludwigshafen on the Rhine, had an exhibit of synthetic indigo, consisting of (*a*) specimens of the raw material (naphthalene) and the intermediate products formed in the manufacture of synthetic indigo, as well as of the latter in four different forms; (*b*) examples of various textile materials illustrating the application of synthetic indigo on loose wool, slubbing, military cloths of different nations, cops, cross-reeled bundles, cotton piece goods both dyed and printed.

Mr. R. L. Mond and Dr. M. Wilderman exhibited a new and improved type of chronograph, in which, instead of moving the heavy drum, the clock moves a very light spindle carrying the writing pen round the drum.

Dr. J. Mackenzie Davidson showed (1) stereoscopic X-ray transparencies and negatives in a Wheatstone stereoscope and in a revolving stereoscope; (2) X-ray photographs of a bullet fired from a revolver. Dr. Davidson also demonstrated that if an ordinary photographic plate be exposed to X-rays and then to ordinary diffused actinic light, a reversed negative is obtained on development in bright white light.

An improved form of Thomson coal-calorimeter was exhibited by Mr. W. Rosenhain.

Apparatus for natural colour photography, and examples of its applications, were shown by Messrs. Sanger Shepherd and Co., who also exhibited a new camera for securing the three negatives through one lens at one exposure, and a camera for photomicrographic work fitted with colour filters for natural colour photography.

By means of a three-circle goniometer exhibited by Mr. G. F. Herbert Smith, the determination of the symmetry and the interfacial angles of crystals is considerably simplified; the crystal needs to be only once adjusted for the whole series of observations. By means of the particular optical arrangements in this instrument, measurements may be made through more than 180° across the end of the crystal by rotation of the horizontal circle only.

The Department of Applied Mathematics, University College, London, showed (1) a curve-adder, made by G. Coradi, of Zürich, for Prof. K. Pearson, F.R.S.; (2) lecture models, illustrating graphical treatment of girder-deflections; (3) a circular slide rule and planosphere, made about 1670, the former on Oughtred's system; (4) a slide rule, designed by Prof. de Morgan, and believed by him to be first circular slide rule.

Notabilia of Gilbert of Colchester were exhibited by Prof. S. P. Thompson, F.R.S.

Prof. G. Forbes, F.R.S., showed his folding range-finder, which has already been described in these columns.

Mr. J. Stanley Gardiner showed photographs of natives of the Maldive Archipelago, and photographs of the coral reefs.

Coloured sketches of birds and fishes obtained during the voyage of the *Discovery* to New Zealand were exhibited by Mr. E. A. Wilson.

Mr. J. Gray exhibited cephalometric instruments and cephalograms specially designed for measuring and taking contours of the living head.

The director of the British Museum (Natural History) showed (1) models of deep-sea fishes (*Gastrostomus bairdi* and *Saccopharynx flagellum*); (2) three statuettes of horses and one of a Hungarian bull, one-fourth natural size, by G. Vastagh, of Buda-Pesth. These were exhibited with a view to direct attention to the desirability of having similar models made of the British breeds of horses and cattle.

Newly discovered fossil mammals and reptiles from Egypt were also exhibited by the director of the British Museum (Natural History). The principal mammalian remains exhibited were those of Mœritherium and Palæomastodon, from the Upper Eocene and Oligocene respectively, which seem to be the oldest known ancestral Proboscidea. Mœritherium is a comparatively small animal, still retaining the canines and all the incisor teeth in the upper jaw, though the second pair of incisors is much enlarged. Palæomastodon has nearly reached the stage of dentition known in Mastodon, but more teeth are simultaneously in use, and the third molar is simpler than in the latter. Barytherium, represented by a mandible and part of the upper jaw, is a large and massive animal of uncertain affinities. The vertebræ named Gigantophis indicate the largest known snake, probably 50 feet in length.

On behalf of Colonel Sir Edmund Antrobus, Bart., Mr. W. Gowland showed a number of stone implements, &c., from Stonehenge.

On behalf of Miss Breton, the Rev. H. H. Winwood showed some striking water-colour sketches, executed by her, of cañons, glaciers and waterfalls in the United States and British Columbia, illustrating effects of various agents in land-sculpture.

Mr. T. Andrews, F.R.S., exhibited photomicrographs of the crystalline structure of platinum and of the crystalline structure of large steel ingots. Prof. A. H. Church, F.R.S., showed series of zircons from Ceylon, illustrating range of density and colour. Dr. C. A. MacMunn showed (1) the spectrum of a zircon; and (2) spongioporphyrin, the colouring matter of *Suberites Wilsoni*, an Australian sponge. This name has been given by Prof. Ray Lankester to the above pigment. The pigment gives a very remarkable absorption spectrum, recalling to mind that of oxyhæmoglobin, of turacin, of carminic acid, &c.

Some successful attempts to reproduce polarisation effects by three-colour printing were shown by Prof. H. A. Miers, F.R.S. The pictures were collotype prints from photographs of the coloured interference figures produced by crystal sections in a polariscope.

The experiments shown by Prof. J. A. Fleming, F.R.S., to illustrate the effect of ultra-violet light on the electric discharge attracted much attention. Effects of ultra-violet radiation were also shown by Dr. Dawson Turner.

Sir Norman Lockyer, K.C.B., F.R.S., showed (1) metallic spark spectra in air and water. Photographs of spark discharges from poles of iron, magnesium, zinc and copper showing (*a*) broadened bright lines, (*b*) broadened bright lines with central absorption, and (*c*) broadened bright lines with non-symmetrical absorption (maximum of emission towards red); (2) spectra of meteorites on silver poles, showing the varying intensity of lines due to special constituents; (3) spectra of rocks and minerals on silver poles, showing distribution of vanadium, titanium, chromium, &c.; (4) spectra of plant ashes on silver poles.

A new temperature indicator (Whipple's) was shown by the Cambridge Scientific Instrument Company. This instrument is intended for use with a platinum resistance thermometer. The bridge-wire is wound on a cylinder in the form of a screw, and the sliding contact is moved until the resistance of the thermometer is balanced.

Mr. C. E. Stromeyer gave an experimental illustration of one cause of steam-pipe explosions.

A new and very effective electrical influence machine suitable for campaign work with Röntgen rays was shown by Mr. W. R. Pidgeon.

One of the most novel exhibits was a large prism of vitreous silica shown by Mr. W. A. Shenstone, F.R.S., and Mr. J. W. Gifford. The employment of vitreous silica in optical work has been delayed by the impossibility of building up very large and perfectly homogeneous masses of the material in the oxy-hydrogen flame. But this difficulty has now been overcome to a great extent.

Prof. Wyndham R. Dunstan, F.R.S., director of the scientific department of the Imperial Institute, exhibited (1) poisonous fodder-plants and food-grains, and their cyanogenetic glucosides. These illustrate an investigation of the cause of the hitherto obscure poisonous action of certain Indian and Colonial fodder-plants and food-grains. The plants shown have now been proved to furnish prussic (hydrocyanic) acid, and in the cases of

Lotus arabicus and *Sorghum vulgare* the poison has been shown to have its origin in cyanogenetic glucosides, which occur in the young plant, but gradually disappear as the seeds ripen; (2) Indian and Egyptian drugs and their constituents. (*a*) *Hyoscyamus Muticus* and *Hyoscyamine*. This remarkable plant, probably the "nepenthe" of Homer, grows both in India and Egypt, and has been long known as a constituent of narcotics under the name of "bheng" or "bhang." It has been found to contain the alkaloid, hyoscyamine, in larger proportion than any other known plant. As the plant is abundant in Egypt it is now being exported for the manufacture of this alkaloid, which is used medicinally. It grows abundantly in the sand of the desert, which analysis shows to be nearly free from nitrogenous compounds. The manner in which the plant obtains its nitrogen is being investigated. (*b*) Indian Aconites and their poisonous alkaloids. (3) India-rubber from Bahr el Ghazal and Zululand. Varieties of gutta-percha from Sarawak, Ceylon and West Africa; (4) coal, iron ores, mica, and other minerals from India, British Central Africa, Nigeria, Somaliland, Trinidad, and the Grecian Archipelago; (5) specimens of tobacco cultivated in Bermuda, with photographs of the crops; (6) specimens of Indian and Australian gums and resins. (*a*) *Cochlospermum gossypium* (India) and *Sterculia acerifolia* (Australia). These gums possess the peculiarity of generating acetic acid when exposed to the air. (*b*) *Callitris verrucosa* (Australia). This resin is remarkable in containing a volatile resin. The resin resembles sandarac in its properties, and is likely to be of commercial value.

Mr. W. M. Mordey and Mr. G. L. Fricker showed an electricity meter invented by them, and intended especially for consumers having a comparatively small number of lamps. It consists of an ordinary clock, deprived of its hair-spring, and carrying a few pieces of iron wire or strip on its balance wheel. This balance wheel is surrounded by a coil of wire conveying the current to be measured. With this arrangement the oscillations of the balance wheel are directly proportional to the current through the coil, with either direct or alternate current. The clock therefore goes at a speed proportional to the current, but does not go at all when there is no current. Geared to the clock is a counter which records the ampere-hours or (on constant pressure circuits) the kilowatt-hours or Board of Trade units.

Prof. W. Ramsay, F.R.S., had an exhibit to illustrate that many persons see the colour of a vacuum tube containing krypton as lilac, many as green. The phenomenon appears to be conditioned by the size of the yellow spot on the retina.

Film structures in metals and other plastic solids were shown by Mr. George Beilby. Metal surfaces are covered with a transparent lacquer-like film of their own substance. This covering film is formed by the welding together of minute reflecting films or "spicules." Spicules are visible in all metal surfaces, but are specially well seen in surfaces which have been frosted by the action of heat and chemical reagents. When the rounded end of a burnisher is drawn across a frosted surface, the separate films are welded into a transparent continuous film.

Prof. A. Schuster, F.R.S., exhibited (1) the spectrum of iron in the flame of the Bunsen burner; (2) a Rowland grating of one metre focus.

The scales of fishes as an index of age was the subject of an exhibit by the Marine Biological Association. The scales of many fishes show a series of parallel eccentric lines, which indicate successive increments of growth. These lines of growth have been found to be more widely separated in that part of the scale formed during the warm season of the year than in the portion formed during the cold season. The alternation of the two series gives rise to the appearance of "annual rings," which indicate the age of the fish in years. The markings are subject to individual variation, and Mr. J. Stuart Thomson has been engaged on their investigation in fish of different species captured at all seasons of the year. His results show that it is possible to determine the age of individual fishes of many species with considerable precision—a conclusion which will greatly facilitate the study of other points in the natural history of fishes, and has important practical applications.

Mr. A. C. Cossor showed (1) a "Braun" tube for kathode rays; (2) a new therapeutic X-ray tube. The object of the "Braun" tube is to permit of a wide range in the different experiments that can be made, showing the action of magnetic disturbances on the kathode rays. In this tube these magnetic effects are delicately and precisely shown.

Mr. J. E. Stead's exhibit consisted of (1) micro-structure of iron, and meteoric irons containing free phosphides and carbides of iron and nickel; (2) the micro-constituents of steel.

The Cambridge Observatory exhibited diagrams referring to preliminary results of the solar parallax, from observations of the planet Eros.

The Royal Astronomical Society showed photographs of the nebula surrounding Nova Persei, photographed by Mr. G. W. Ritchey, Yerkes Observatory, U.S.A.

Manuscripts relating to the discovery of Neptune, by the late Prof. J. Couch Adams, F.R.S., were shown by St. John's College, Cambridge, through Prof. R. A. Sampson. The manuscripts date from 1841, when, as an undergraduate in his second year, Adams first determined to attack the problem, to 1846, when the planet was discovered. In all, Adams made no less than six separate solutions of the problem, similar in method but largely independent, each advancing in some particular upon the last. Of these the earliest, though necessarily the least perfect, is perhaps of most interest. It was completed at the end of September, 1843, three years before the planet was observed with the telescope. The position assigned to Neptune by this first determination was some 18° from the truth. The solution dated April 28, 1845, departs from the subsequently observed position by 3°; that of September 18 and October of the same year by less than 1°; that of August, 1846, by about 1½°.

Mr. A. Vernon Harcourt, F.R.S., showed an apparatus for the regulated administration of chloroform.

Mr. J. E. Petavel and Captain J. Bruce-Kingsmill exhibited (1) a recording pressure gauge for artillery; (2) a recording pressure gauge for low-pressure explosions (suitable for gas-engine research and experimental physics), shown by Mr. J. E. Petavel. A description of the apparatus will be found in the current number of the *Philosophical Magazine*.

The National Physical Laboratory showed a plane mirror, given to the Laboratory by Dr. Common, F.R.S.

Living specimens of ovivorous parasites (Mymaridæ), together with larvæ and pupæ in the eggs of Liburnia (frog-hoppers), were shown by Mr. F. Enock.

Mr. W. E. Hoyle showed luminous organs in *Pterygioteuthis margaritifera*, a Mediterranean Cephalopod. The most striking feature of these organs is that they are concealed by the integument, and are only effective by reason of its transparence in the living condition.

Lieut.-Colonel Bruce, F.R.S., exhibited *Trypanosoma Theileri*, a new species of parasite discovered in the blood of cattle in South Africa. This new Trypanosoma was lately discovered by Dr. A. Theiler, who is in charge of the bacteriological laboratory of medical officer of health, Pretoria, Transvaal. The species can be at once distinguished from the Trypanosomas of Surra, tse-tse fly disease, or rat by its larger size, it being almost twice as large as any of the others. In general appearance it conforms closely to the others in possessing an oval protoplasmic body, a longitudinal fin-like membrane and a single flagellum. It only infects cattle. Horses, dogs, goats, rabbits and guinea-pigs are all immune, neither showing symptoms nor the presence of the parasites in the blood.

A specimen of a Trypanosoma found in the blood of man was shown by Mr. J. Everett Dutton on behalf of the School of Tropical Medical, Liverpool. The Trypanosoma was first discovered in the blood of a European in Government employ at Bathurst, West Africa. The presence of the parasite was associated with symptoms closely resembling those occurring in animals suffering from tse-tse fly disease. The parasite was again found in a preparation of blood taken from a native child at Bathurst (see p. 15).

Messrs. R. and J. Beck, Ltd., exhibited the "Imperial" microscope with mechanical adjustments for critical work, showing Grayson's micrometer rulings in realgar up to 60,000 lines to the inch.

A collection of ear-rings from British New Guinea was shown by Dr. A. C. Haddon, F.R.S.

Microscopic preparations of *Astrosclera Willeyana*, with specimens illustrating the determination of the mineral constituent of the skeleton by Meigen's method, were shown by Mr. J. J. Lister, F.R.S., and Mr. A. Hutchinson. Astrosclera was first collected by Dr. A. Willey in the Loyalty Islands, and has since been obtained at Funafuti in the Ellice group. It is regarded as the type of a distinct division of sponges, and differs from other known calcareous sponges in the structure of the soft

tissues and the skeleton, and in the fact that the mineral constituent of the latter is not in the form of calcite.

Mr. E. T. Newton, F.R.S., showed a series of otoliths, chiefly of living British fishes, both marine and freshwater, showing the various forms assumed in the different genera.

Prof. W. K. Huntington exhibited (1) a tilting stage for the microscope; (2) optical bench for metallurgical work.

Dr. A. Muirhead gave a demonstration of retransmission on submarine telegraph cables (cable relaying).

Kite and winding-in apparatus for raising meteorological instruments was shown by Mr. W. H. Dines.

The distribution of electric currents induced in a solid iron cylinder when rotated in a magnetic field was shown by Prof. E. Wilson.

During the evening, demonstrations, by means of the electric lantern, were given in the meeting room by Sir Henry Trueman Wood, on the application of photography to the production of pictures in colour, and Dr. R. D. Roberts, on lantern slides in natural colours of the Grand Cañon of the Colorado, the Sierra Nevada, California and the Yellowstone Park.

NOTES.

THE *London Gazette* announces that Sir William Turner Thiselton-Dyer, K.C.M.G., C.I.E., F.R.S., Director of the Royal Botanic Gardens, Kew, has been appointed Botanical Adviser to the Secretary of State for the Colonies.

DURING the first half of this month the weather over this country was very abnormal for the season. The reports issued by the Meteorological Office show that in the early part of the month a decided depression approached from the north-west, the centre advancing over Scotland, travelling to the south-east, and causing thunderstorms and hail in many places. The subsequent distribution of pressure, which was relatively high off our south-west coasts and over north and south-west Europe, while depressions lay in various parts of the intervening regions, occasioned persistent inclement northerly and north-easterly winds. These continued with little variation until May 14, by which time a great change occurred in the type of pressure, under the influence of which westerly winds and some rise of temperature subsequently occurred, but heavy and sudden downpours of rain continued between the bright intervals. For any comparison of the persistent cold spell it is necessary to go back to the year 1879, when, during the first half of May, the mean of the daily shade maxima at Greenwich was approximately 54° and the minim a 36°, against 53° and 37° in the corresponding period of this year. The maximum shade temperature on any day has not exceeded 57°·3, but in 1879 the maximum temperature exceeded 60° on three occasions and reached 66°·2 on May 5. On the night of the 13–14th, the exposed thermometer on the grass registered 22°·6 in the neighbourhood of London, and the maximum of the previous day was about 14° below the normal, while in May 1879 the lowest grass temperature was 24°·6. An examination of the Greenwich records since 1840 shows that there has been no year, except the present, in which the shade temperature has not reached 60° during the first half of May.

IN NATURE of February 20 (vol. lxv. p. 367), Mr. A. B. MacDowall pointed out that the Greenwich observations of the last thirteen years favour a connection between thunderstorms and the lunar phases, as has been found for other places. Investigation of the meteorological records of several observatories show that a larger percentage of thunderstorms occur about the time of new moon than about full moon, and in the two earlier phases than in the two later. M. V. Ventosa writes from the Madrid Observatory to say that he has obtained similar evidence of this relationship from an examination of observations made at that Observatory in the twenty years 1882–1901. Classified in four groups about four lunar phases, the results are as follows:—

	New Moon.	First Quarter.	Full Moon.	Last Quarter.
Thunderstorms ...	132	104	99	120
Percentage ...	29·0	22·8	21·8	26·4

Mr. MacDowall, to whom we have shown M. Ventosa's letter, remarks:—"The results are an interesting extension of the subject. While at none of the stations which have thus been compared are the differences between those weekly percentage numbers large, the general agreement, in showing, especially, more thunderstorms about new moon than about full moon seems remarkable, and may (I also hope) incite to further inquiries in the same direction, where the requisite data are available."

SEVERAL correspondents have sent us references to observations of peculiar lunar halos such as that described by Prof. Barnard in our issue of May 1 (p. 5). The singularity consisted in the moon being in the centre of one halo and on the circumference of another at the same time. Mr. H. W. Croome Smith directs our attention to a similar appearance observed on February 28, 1890, and described in the *Bristol Times and Mirror* of the following day. The moon was then nine days old, so that the conditions were very similar to those existing at the time of Prof. Barnard's observation.

THE last Report of Mr. W. Bell Dawson, C.E., on the survey of the tides and currents in Canadian waters contains an interesting account of the work that is being carried on in obtaining data as to the tides in the St. Lawrence and in the Bay of Fundy, and in the preparation of trustworthy tide-tables for Halifax, Quebec, St. John's and British Columbia. The part of the Report of most general interest is that relating to the tides in the Bay of Fundy. Further observations which have been obtained during the past year confirm the statement previously made by Mr. Dawson that the range of these tides has been greatly exaggerated. The range of spring tides in Noel Bay when they are at a maximum is 50½ feet and 43½ feet at neaps; at Horton Bluff, 48 feet and 40 feet; at Cumberland Basin, 45¼ feet and 38 feet. The difference between the level of the highest known tide, the "Saxby tide" of 1869, and the lowest point to which the water has been known to ebb out is 53 feet. The rise of this tide above mean sea-level was 29·24 feet, and the level of the lowest known low water below mean sea-level was 23·76 feet. The record tide of 1869 rose from 2 to 3 feet above the banks which protect the enclosed marshes and flooded the country.

IN our issue of February 13 (vol. lxv. p. 350), two new forms of electric resistance furnace suitable for laboratory work were noticed. The *Zeits. f. Elektrochemie* of April 3 contains details of a research carried out by Herr W. C. Heraeus with a modified form of this furnace relating to the melting point of manganese. The coil of platinum wire was replaced by a strip of very thin foil, wound spirally round the porcelain tube. A temperature of 1300° C. could be attained in three minutes with a tube 16 mm. in diameter having a spiral 15 cm. in length wrapped upon it, and by careful attention to the resistance, temperatures could be observed to within 5° C. of absolute accuracy. The tube employed in the observation of the melting point of manganese was provided with an alumina boat to carry the small piece of metal used for the determinations—with rubber connections by which hydrogen gas was passed through the tube during the observation—and with a small telescope by means of which the exact moment of melting could be noted. A Chatelier thermo-element was used for recording the temperatures. The mean of six determinations gave 1245° C. as the melting point of the metal. Attempts to use nitrogen and carbonic acid gas in place of hydrogen failed, since the former gas yielded a nitride with the manganese and the carbonic acid gas dissociated at 1000° C. The reducing action of the hydrogen

gas at the high temperature also caused difficulties with the thermocouple, and many determinations failed owing to the brittleness produced at the point of contact of the two metals.

PROF. H. A. MIERS, who paid a visit in 1901 to the Yukon gold-fields, has published a brief account of his observations, in a letter addressed to the Hon. Clifford Sifton, Minister of the Interior, Ottawa. His principal object was to study the mining methods and the auriferous deposits of the Klondike district. He describes the various methods of thawing the frozen gravel, the latest process being the forcing of water into the ground by means of a pulsometer pump. While admitting the enormous wealth of the district, he points out that it is ceasing to be a poor man's camp, and requires extensive capital and labour for its development. The failures connected with English capital have been disastrous, not necessarily on account of any want of judgment in selecting claims, but mainly because the representatives of English companies "in many cases lacked the judgment and the stability of character which were needed, or had not the interests of their employers sufficiently at heart." At present a comparatively small portion of even the Klondike district has been worked out, while the Yukon territory is auriferous over considerable areas and has been very imperfectly prospected. Moreover, there is nothing to indicate that the gravels and the gold which they contain have been transported any considerable distance, or have been derived from any rocks which differ from those now found in the district. The search for auriferous quartz is therefore hopeful.

THE Summary Report of the Geological Survey of Canada for 1901 (Ottawa, 1902, price 25 cents) extends to 269 pages, being considerably larger than previous reports. This increase has been made by the director, Dr. Robert Bell, in response to the general desire for early information on all points which may be of immediate value to the public. Prominence is therefore given to observations and discoveries which may have an economic bearing. Moreover, the amount of work recorded in this report is believed to have far exceeded that of any previous year. No less than thirty-one parties were engaged in explorations, including those conducted by a number of competent geologists, principally college professors, whose temporary services were secured during the summer season. Dr. Bell contributes an interesting statement on the aims and methods of the work in the field and at headquarters; and the reports of the members of the staff are published under their own names. The Yukon district naturally occupied attention, and mention is made of the occurrence of dendritic gold on a boulder found in one of the creeks, a fact which serves to show that some of the gold has been deposited from solution. Examinations have been made of the Cretaceous coal-fields of Crow's Nest Pass, where there is a vast amount of workable coal of excellent quality; of the oil-fields of Lambton county, Ontario, and of Westmoreland county, New Brunswick; of the natural gas in Essex and Welland counties; and of the Carboniferous Coal-measures of New Brunswick, in which water-worn coal-pebbles have been noticed. In an account of the Cambrian rocks and fossils of Cape Breton, reference is made to the solitary character of the Ostracods, which in other formations occur in profusion. Some remains of Trionyx from the Cretaceous rocks of Alberta are described and figured. The glacial origin of cirques or corries and of certain mountain tarns in western Canada is pointed out; and many other topics of general interest are dealt with in the various reports, such as agriculture, including fruit farming, water supply, &c. The occurrence of the mineral faujasite is mentioned as new to Canada.

IN the Report of the Selborne Society for 1901–2, the council emphasises the need of new members in order that the work of the association may be carried on with efficiency.

IN No. 1266 of the *Proceedings* of the U.S. National Museum, Messrs. Jordan and Snyder continue their account of the fishes of Japan, dealing in this instance with the wrasses and their allies. Several new forms are described.

JUDGING by the enlarged size of the April number, the Australian ornithological journal, *The Emu*, appears to be gaining a well-deserved popularity. Among the contents of this issue are a paper on various Tasmanian birds, by Colonel Legge, and a continuation of Mr. D. le Souëf's notes on protective coloration in Australian birds and their nests. Of several excellent illustrations, a group of gannets nesting calls for especial commendation.

A MOST remarkable instance of collateral budding in two annelids belonging to the genus Trypanosyllis is described by Dr. H. P. Johnson in the *American Naturalist* for April. Both species are inhabitants of the Pacific coast of America; and the sexual "zooids" they produce by this peculiar mode of budding are very numerous, and, with the parent animal, look like a bunch of fern-leaves. The most remarkable feature about the phenomenon is that the full-grown and detached zooids, although provided with generative organs, entirely lack any functional structures for alimentation. "The zooid is, therefore," as the author remarks, "as incapable of leading a prolonged independent existence as the famed palolo of the South Seas. It is no more than a living engine for the dissemination of the genital products which it carries, and that duty must be accomplished solely by the expenditure of the stored up energy which it had derived from the stock." Other members of the family are known to produce zooids by linear budding; but in this case the zooids are provided with digestive organs. The zooids of Trypanosyllis are regarded as an extreme specialisation of those of the linear type. But there is another curious circumstance. In the group producing zooids by linear budding the adult stock is sessile, or nearly so, and the object of having freely moving zooids is therefore apparent. But in Trypanosyllis the adult stock is not fixed; and the reason for the development of zooids thus remains to be discovered.

THE Austrian Meteorological Office (Dr. J. M. Pernter, director) has published its *Jahrbuch* for 1900. This valuable series of observations has been issued in practically the same form for thirty-seven years; the present volume contains monthly and yearly results at more than 400 stations, and daily observations at twenty-two stations, including, among a few foreign places, Port-au-Prince (Haiti) and Jerusalem. An interesting feature of this laborious compilation is the reduction and publication of the results obtained from the autographic records of several mountain observatories, including the Sonnblick (3106 metres), Obir (2144 metres) and Berghaus (2044 metres). Dr. M. Margules contributes a detailed discussion of the barometric pressure and wind conditions based on the results of a number of stations in Lower Austria.

DR. P. POLIS, superintendent of the Meteorological Observatory at Aix-la-Chapelle has contributed to the April number of the *Meteorologische Zeitschrift* an interesting paper on the daily period of rainfall. The paper is based chiefly on very careful observations at his own station, and the results have been compared with those obtained at several other European observatories. We can only refer to a few of the conclusions arrived at. He finds that (1) in northern and central Europe the summer and winter seasons have opposite daily periods. In summer the heaviest falls occur in the afternoon, and the lightest near noon and midnight. In winter the maximum occurs from 8h. to 10h. a.m. and from 4h. to 8h. p.m. (2) Maritime climates have a more marked daily period in the winter season, and continental climates in the summer season. (3) At his own

station the maximum amount in spring falls between 6h. and 8h. p.m., while the greatest frequency occurs between 8h. and 10h. a.m. ; in summer the maximum amount occurs between 2h. and 8h. p.m., and the greatest frequency between 2h. and 4h. p.m. In winter there are two maxima of quantity, 8h. to 10h. a.m. and 6h. to 8h. p.m., while the time of greatest frequency coincides with first period.

"SOLOID" microscopic stains prepared by Messrs. Burroughs, Wellcome and Co. are aniline and other dyes in a tabloid form easily dissolved in water or alcohol or both, as the case may require, and therefore most useful. They are easily preserved, always ready and portable. The list at present published includes a great variety of the most generally used dyes, as hæmatoxylin, eosin, eosin and methylenblue, fuchsin, gentian violet, thionine blue, &c. While admitting, from direct tests made with some of these soloids, their usefulness, it should not be forgotten that, like other short cuts, also the "Soloid" short cut should only supply a necessity, but should not, and cannot, supplant the recognised laboratory methods. The dye marked "Louis Jenner stain" (eosin and methylenblue) is a good eosin but a bad methylenblue stain, and cannot for a moment compare with Czinzinski's solution (eosin and methylblue.) Pages 3 and 4 of the leaflet issued with the soloids, containing descriptions of methods of staining bacilli and blood, may be safely omitted.

IN a series of five papers published during the last few months in the *Journal of Physiology*, Dr. H. M. Vernon has described numerous observations on the zymogens and enzymes of the pancreas. The method used for estimating the tryptic power of extracts depends on the digestion of measured quantities of finely chopped fibrin in small graduated centrifugal tubes. The process is completed in about half an hour, and the average error of experiment is only 5 to 10 per cent. The necessity of adopting a rapid digestion method is shown by the fact, hitherto not adequately recognised, that the tryptic ferment is an extraordinarily unstable body. Thus 70 to 80 per cent. of the ferment in a very active extract may be destroyed in an hour by ·4 per cent. Na_2CO_3 at 38°. If such extracts be kept for weeks they gradually deteriorate in activity, and the trypsin still remaining undestroyed is found to be a more and more stable body, till finally the last portions of the ferment left may be ten or twenty times more stable than the first. It was accordingly concluded that trypsin is not a single substance, but that there must exist series of trypsins of varying degrees of stability. There are likewise series of rennins, but not of diastases, though is was shown that the diastatic ferments of the pancreas, of saliva and of malt differ from each other considerably in their hydrolysing action on starch. As regards the zymogens, it was found that the rennet ferment has a zymogen very similar to that of the tryptic ferment, whilst the zymogen of the diastatic ferment is an insoluble body. The most energetic agent in the conversion of tryptic zymogen into enzyme was found to be active enzyme itself. Thus if even 1 per cent. of an active extract were added to a solution of zymogen at 38°, it might convert a third of it into enzyme in an hour. Curiously, the rennet ferment was likewise liberated from its zymogen by the tryptic ferment, and not by the rennetic.

MESSRS. BLACKIE AND SON have commenced the issue of a cheap edition of Kerner and Oliver's "Natural History of Plants," which is well known to all students of plant life. The work will be published in sixteen monthly parts at eighteen pence each, and is thus brought within the means of everyone who is interested in the study of botany. Used either as a guide or a reference book, the work is appreciated by all who know it, and it deserves a sphere of influence even greater than that it already possesses.

WE are glad to learn, from the *Bulletin* of the St. Petersburg Society of Naturalists, that the herbarium of "Flora Rossica," which was begun by the late M. S. I. Korzinsky, member of the St. Petersburg Academy of Sciences, continues to be issued by the Academy under the supervision of M. D. I. Litwinow. Six more fascicules (xiii.–xviii.) appeared lately, together with one fascicule of "Schedæ Herbarium Floræ Rossicæ." We also learn from the same source that M. P. V. Syuzev has undertaken the publication of a "Flora Uralensis exsiccata." This herbarium will comprise chiefly the flora of the province of Perm, but also of Ufa and Orenburg.

A WORK on "The Narym Region," by M. A. Th. Plotnikoff (*Memoirs* of the Russian Geographical Society, Statistics, vol. x. St. Petersburg, 1901), contains a valuable description of a very interesting portion of the province of Tomsk, namely, the portion on the water-divide between the Ob and the Irtysh, as also on the rivers Ket, Parabel and Vas'yugan, which represents mostly an immense marsh—to a great extent a lake during the period of high water in the rivers—and the surface of which is covered with a floating carpet of decayed grass and knolls of ground upon which low bushes of birch will grow. A general description of this wide region (about 100,000 sq. miles) and of its nearly 8000 inhabitants—Russians, Ostyaks and Ostyak-Samoyedes—is given by the author, who has for several years resided at Narym.

ABOUT seventeen years ago, Prof. Salvatore Sardo extracted from the siliquæ of *Bignonia Catalpa* an acid which he called catalpic acid, and to which he assigned the formula $C_{14}H_{14}O_6$. A reinvestigation of the products of the Catalpa fruit has now been made by Signor A. Piutti and Dr. E. Comanducci, whose results are described in the *Rendiconto* of the Naples Academy, viii. 3, Instead, however, of obtaining an acid with the formula assigned by Sardo, they obtained from the immature pods a substance corresponding to the formula $C_7H_6O_3$, which is shown by numerous evidence to be identical with *p*-oxybenzoic acid. In addition they have extracted what appears to be a combination of paroxybenzoic acid and protocatechuic acid, previously obtained in other ways by Hlasiwetz and Barth, having the formula $C_7H_6O_3$, $C_7H_6O_4+2H_2O$, but the attempt to separate the two acids has hitherto ended in negative results, although the other acid appears to have been isolated by Eykman from the fruits of *Illicium religiosum*. Many questions suggest themselves as to the state in which these acids occur in the Catalpa fruit, and whether they are free or in combination, and it is proposed to collect a quantity of the fruits for further observation.

THE additions to the Zoological Society's Gardens during the past week include a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, presented by Sir William Hoste ; a Mozambique Monkey (*Cercopithecus pygerythrus*) from East Africa, presented by Mr. J. Bolt ; a Common Viper (*Vipera berus*) European, presented by Mr. C. Spencer Bubb ; a Hartebeest (*Bubalis*, sp. inc.) from Angola, purchased ; two Japanese Deer (*Cervus sika*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

SATURN VISIBLE THROUGH THE CASSINI DIVISION.—An interesting circular has been issued by Mr. C. T. Whitmell, of Leeds, calling attention to the possibility of this phenomenon being observed. On July 17, 1902, at 13h. G.M.T., Saturn will be in opposition to the sun, and about 7h. G.M.T. on that day the earth and sun will be equally elevated above the ring plane, their Saturnicentric declination being about 22° 26′ 17″ N. Adopting Prof. Barnard's estimate of 2270 miles for the breadth of the Cassini division, and fifty miles for the thickness of the rings, Mr. Whitmell calculates that the effective opening of the division will be 820 miles, corresponding to 0″·20 in angular

measure at the earth's distance. Under these conditions a line from the sun to the earth will pass through the rift in the rings to the planet, and a terrestrial observer, suitably placed, may be able to view through the rift a portion of the planet's surface lit up by the sunlight. The effect will be that, of the arc of the Cassini division crossing the planet, a small portion will appear bright instead of dark, and may almost disappear; as the albedo of Saturn is less than that of the adjacent portions of rings A and B, however, it is likely that there will be sufficient contrast to show the phenomenon.

There appears to be no record of any previous observation of this kind, and it will obviously be one of great delicacy and difficulty. As the exact limits of time and place are not absolutely determinable, it is hoped that the planet will be watched for some time before the date given.

CATALOGUE OF NORTH POLAR STARS.—Prof. Pickering has issued a catalogue of 589 stars in the vicinity of the North Pole as a separate part, No. 1., of vol. xlviii. of the *Annals of the Harvard College Observatory*. The measures are from enlargements made from the central portions of four negatives obtained with the 11-inch Draper telescope on November 29, 1887, February 23, 24 and March 10, 1897, with exposures of 60, 120, 120 and 101 minutes respectively. Full details are given of the reductions employed, and in consequence of the arrangements made at the Astrophotographic Congress of 1900, the positions are published in rectangular coordinates, which plan is to be adopted in general for future issues.

THERMAL EXPANSIONS AT LOW TEMPERATURES.[1]

THE apparent specific gravities of boiling liquid oxygen which resulted from weighing in the liquid a series of metals and other substances were given in a lecture entitled "New Researches on Liquid Air," printed in the Royal Institution *Proceedings* for 1896. For instance, silver, calc spar, rock crystal and iodide of silver gave the respective apparent densities 1·1278, 1·1352, 1·1316 and 1·1372. On correcting the weight of liquid displaced by each substance for contraction to −182°·6—by calculating a Fizeau mean coefficient of expansion for the range of temperature employed, on the assumption that the parabolic formula might be legitimately extended to low temperatures—it was found that the real density of liquid oxygen so deduced for all the bodies used was, as a mean, 1·137.

The determination of the densities of substances at the temperature of the boiling point of oxygen—and hence of their mean coefficients of expansion between that temperature and ordinary temperatures—opens out a very large field of investigation, from which, if a sufficiently large number of observations were available, valuable deductions might be drawn. On account, however, of the expense and trouble of producing quantities of liquid oxygen, its use for this purpose is not likely to become general, although, when available, it is the easiest body to use in conducting such experiments, especially when the vacuum vessel containing it is immersed in a larger vessel containing the same fluid or well-evaporated air. The ease with which liquid air can now be obtained in many laboratories suggests that its application to work of this kind would in some cases be a convenience, and the present investigation was undertaken with the desire of ascertaining what accuracy could be attained, and how the method could be applied to inorganic or organic substances which occur in the form of fine crystals.

The use of a mixture of varying composition and density like liquid air necessitates a determination of its density with accuracy and rapidity before and during the course of the experiments. For this purpose, in the experiments about to be detailed, the liquid air that had been allowed to evaporate for twenty-four hours in advance was used in large silver-coated vacuum vessels of some 3 litres capacity. In order to ascertain the density of the liquid, a polished silver ball, which had been weighed once for all in liquid oxygen, was weighed in the sample of liquid air, and from the relative weights thus found the density of the liquid air could be approximately determined, assuming that of liquid oxygen to be 1·137.[2] To prevent any disturbing ebullition in the liquid-air flask in which the weighings took place, and to reduce the rate of its evaporation to a minimum during the course of an experiment, the substance to be used was previously cooled in a supplementary vessel containing liquid air and then transferred to the large flask. To avoid as far as possible the formation of cracks in the bodies during the process of immersion in the liquid air, it was found advisable to cool them slowly in the air of the vacuum flask first, and then to lower them into the liquid.

In this way, with proper care and attention, results were obtained comparable in accuracy with the density taken in liquid oxygen. Substances like solid carbonic acid and ice were weighed in the cool, gaseous air of the vacuum vessel, and their weights subsequently corrected for buoyancy. The temperature of the densest and lightest samples of liquid air was ascertained by the hydrogen thermometer, and that of the others deduced by graphic interpolation. As the entire range of temperature through which the bodies were cooled amounted to about 200°, a degree or two up or down has no real influence on the results; the extreme range of temperature in the air samples was from 83°·8 to 86°·1 Abs.

When the body to be examined was a salt, it was employed in the form of a compressed block. One experiment was, however, made in a section of a large crystal of chrome alum. The salt, previously reduced to a fine powder, was moistened with water and compressed in a cylindrical steel mould under great hydraulic pressure. During compression the saturated salt solution drained away, and finally a cylindrical block of some 50 grammes of the salt was obtained free from porosity and hard enough to allow its surface to be polished. In this form salts and other materials similarly treated are especially adapted for accurate specific gravity determinations. After such treatment it was found that all the mechanically attached water was got rid of in the case of hydrated salts, and also in such as did not combine with water. In order to get cylindrical blocks of the salts showing no porosity, the presence of water, or rather the saturated salt solution, was found to be essential during the application of pressure. In the same way it was found to be an advantage in compressing such a substance as solid carbonic acid to moisten it with a fluid like ether before applying the hydraulic pressure.

Recalling the work of Playfair and Joule,[1] which originated in a suggestion of Dalton's that the volume of a hydrated salt in solution was simply the volume of the water of crystallisation, ice and some hydrated salts were selected, as well as some other bodies the coefficients of expansion of which they had determined. Substances of special interest were included in the list, like mercury, sulphur, iodine and solid carbonic acid, the latter being particularly important as an example of a solidified gas.

In the further conduct of an experiment, the observations made on a substance were three, namely, (*a*) the weight in grammes of the substance and suspending platinum wire, either in air of about 17° C. temperature or in the gaseous air in the flask containing the liquid air; (*b*) the weight in grammes of the body and wire when immersed in the liquid air; and (*c*) the weight in grammes of the suspending platinum wire in ordinary (17°) air.

In the case of substances of less density than liquid air, a polished copper ball weighing about 38 grammes was used as a sinker.

Two experiments were made on compressed cylinders of solid carbonic acid. In the first of these the carbonic acid was compressed dry, in the second, after a few drops of ether were added. The specific gravities of solid mercury, iodine and sulphur were also determined in liquid air. The iodine was in the form of a compressed cylinder, but the sulphur was a piece of a crystalline mass of native origin.

The specific gravity of the actual portion of the substance weighed in the liquid air was, with one or two exceptions, determined also at the temperature of the laboratory, about 17° C. From the two sets of observations, the value of the mean coefficient of cubical expansion between 17° C. and the temperature of liquid air was calculated.

In calculating coefficients of expansion, various forms may be given to the formula employed, and correspondingly different results may be obtained from the same set of observations. For short ranges of temperature these results are practically identical, but this no longer holds for a range of temperature such as we

[1] "Coefficients of the Cubical Expansion of Ice, Hydrated Salts, Solid Carbonic Acid, and other Substances at Low Temperatures." By Prof. James Dewar, F.R.S. Abridged from a paper read before the Royal Society on May 1.

[2] As the correction due to the contraction of the silver ball between the temperature of boiling oxygen and that of the air sample is small, it may be neglected.

[1] "Researches on Atomic Volume and Specific Gravity" (*Chem. Soc. Journ.*, vol. i., 121).

have in these experiments. All that is possible in the present instance is to adopt a linear formula. The usual formula is $v_T = v_0(1 + \alpha T)$, where the value v_0 at 0° C. becomes v_T at T° C. when α is the coefficient of expansion. If we use densities (d) instead of volumes (v) this formula becomes

$$d_0 = d_T(1 + \alpha T), \qquad \text{or } \alpha = \frac{d_0 - d_T}{T d_T}; \qquad \alpha = 0{\cdot}000538.$$

Another formula, when T and T′ are the temperatures dealt with, is

$$d_{T'} = d_T\{1 + \alpha(T' - T)\}, \text{ or } \alpha = \frac{d_T - d_{T'}}{(T' - T)d_{T'}}; \quad \alpha = 0{\cdot}000595.$$

Again

$$d_{T'} = d_T\{1 - \alpha(T' - T)\}, \text{ or } \alpha = \frac{d_T - d_{T'}}{(T' - T)d_T}; \quad \alpha = 0{\cdot}000558.$$

Also we may choose a mean formula

$$\alpha = \frac{d_T - d_{T'}}{(T' - T)\frac{d_T + d_{T'}}{2}}; \qquad \alpha = 0{\cdot}000576.$$

The differences in the results of applying these formulæ are shown in the numerical values attached to each, which are calculated from the first experiment on solid carbonic acid, coupled with the specific gravity 1·53 of the solid at − 78° C.

Perhaps as a matter of general convenience, the first of these formulæ is the best; however, the second was chosen to conform with the old work of Playfair and Joule, and it is the results of this formula which are mentioned below.

The temperature range is taken from about − 186° C. to 17° C., unless otherwise stated.

Ice.—In determining the density at the temperature of liquid air of pieces of clear ice cut from large blocks, both the silver and copper balls already referred to were used as indicated. The true weight *in vacuo* of the silver ball was 132·2855 grammes, and that of the copper ball was 38·0802 grammes. The mean of the three densities obtained at − 188°·7 C. is 0·92999.

Recently Vincent (*Roy. Soc. Proc.*, 1901) has redetermined the density of artificial ice at the freezing point, and also its coefficient of expansion. He finds the density to be 0·916, or from his tabulated results 0·91599. Playfair and Joule find the mean of the densities given by eight observers previous to them to be 0·919, and they themselves get 0·9184; Bunsen found it to be 0·9167. If we take this most recent determination, namely, 0·91599 at 0°, and 0·92999 at − 188°·7, and use the formula

$$d_0 = d_T(1 + \alpha T)$$

we get $\alpha = 0{\cdot}00008099$.

Vincent refers to "only one" estimate for natural ice, namely, 0·0001125, adding that "the mean of three available results for artificial ice is 0·000160"; finally, he gives the mean of four determinations of his own, namely, 0·000152. Apparently, then, we may take 0·001551 as the mean coefficient of expansion of ice between 0° and (say) − 20° C. Thus the mean coefficient of expansion between 0° and − 188° C. is about half of that between 0° and − 20° C. The mean coefficient of expansion of water in passing from 4° to − 10° is − 0·000362, and from 4° to 40° C. it is 0·0002155. Hence the mean coefficient of expansion of ice between 0° and − 188° C. is about one-fourth of that of water between 0° and − 10° C., and half of that between 4° and 100° C.

If we had the densities of ice at still lower temperatures, the values of the coefficient of expansion thence determined would, there is every reason to believe, be less than what we have found. We shall therefore not be overstraining the argument if we use the value just found to determine an upper limit to the density of ice at the absolute zero. The result is 0·9368, corresponding to a specific volume 1·0675. Now the lowest density of water, namely, at the boiling point, is 0·9586 (corresponding to specific volume 1·0432), so that ice can never be cooled low enough to reduce its volume to that of the liquid taken at any temperature under one atmosphere pressure. In other words, ice molecules can never be so closely packed by thermal contraction as the water molecules are in the liquid condition, or the volume of ice at the absolute zero is not the minimum volume of the water molecules. It has been observed by Prof. Poynting ("Change of State, Solid, Liquid," *Phil. Mag.* 1881) that if we supposed water could be cooled without freezing, then taking Brunner's coefficient for ice, and Hallstrom's formula for the volume of water at temperatures below 4° C., it follows that ice and water would have the same specific volume at some temperature between − 120° and − 130°; applying the ordinary thermodynamic relation, then no change of state between ice and water could be brought about below this temperature. On the other hand, Clausius ("Mechanical Theory of Heat," p. 172, 1879) has shown that the latent heat of fusion of ice must be lowered with the temperature of fusion some 0·603 of a unit per degree. If such a decrement is assumed to be constant, then about − 130° the latent heat of fluidity would vanish.[1] Baynes discusses the same subject ("Lessons on Thermodynamics," p. 169, 1878) and arrives at the conclusion that at a temperature of − 122°·8 C. and under a pressure of 16,632 atmospheres there is no distinction between the solid and liquid forms of water. At temperatures below this limit, no amount of pressure would transform ice into water. We are thus relieved from a difficulty that would follow but for this demonstration of Clausius, namely, that the application of enormous pressures to ice, even at temperatures below that of liquid hydrogen, might cause the transformation of ice into water.

Carbonic Acid.—Two experiments were made with this substance, the masses in each case being about 20 grammes. These were compressed cylinders; the former was compressed dry, while the latter was slightly moistened with ether. The density at − 188°·8 C. was found to be 1·6308 and 1·6226.

The density of solid carbonic acid at its boiling point was formerly given as 1·5 (see *Proc. Roy. Inst.*, 1878, "The Liquefaction of Gases"), but the mean of my results at the time came to 1·53. Recently the same value has been found by Behn. Taking this value and 1·6267, the mean of the above results at − 188°·8 C., and using the formula

$$d_T = d_{T'}\{1 + \alpha(T' - T)\}$$

we get $\alpha = 0{\cdot}0005704$.

This is a very large coefficient of expansion, being greater than that of any substance recorded in the accompanying table, and comparable with that of sulphur between 80° and 100°, which, according to Kopp, is 0·00062. The coefficient of liquid carbonic acid at its melting point taken from the recent observations of Behn (*Chem. Soc. Journ.*, 1901) is 0·002989, so that the rate of expansion of the liquid at its smallest value is very nearly five times that of the solid.

Solid Mercury.—One experiment was made with solid mercury, and the result is given below.

Mallet determined with great accuracy the density of solid mercury at − 38°·85, his result being 14·193; coupling this with the density found for the liquid-air temperature, we find that the value of the coefficient of expansion between the melting point and − 189° C. is 0·0000887. For fluid mercury above 0° C. the mean value is about 0·000182, so that in the solid state this coefficient is about half of that in the fluid state.

The coefficients of expansion (α) obtained were as follows:—

	α 0·00
Sulphate of aluminium (18)[2]	0811
Biborate of soda (10)	1000
Chloride of calcium (6)	1191
Chloride of magnesium (6)	1072
Potash alum (24)	0813
Chrome alum (24), large crystal	0365
,, ,,	0478
Carbonate of soda (10)	1563
Phosphate of soda (12)	0787
Hyposulphate of soda (5)	0969
Ferrocyanide of potassium (3)	1195
Ferricyanide of potassium	2244
Nitro-prusside of sodium (4)	1138
Chloride of ammonium, sample i	1820
,, ,, sample ii	1893
Oxalic acid (2)	2643
Oxalate of methyl	3482
Paraffin	3567

[1] In my paper "On the Lowering of the Freezing-point of Water by Pressure" (*Roy. Soc. Proc.*, 1880), it was proved that up to 700 atmospheres the rate of fall was constant and equal to the theoretical value within the range of pressure if the difference between the specific volumes of ice and water remains constant; thence the latent heat of fusion must diminish just as Clausius had predicted.

[2] The figures in brackets refer to the number of molecules of water of crystallisation.

	α 0·000
Naphthalin	3200
Chloral hydrate	1482
Urea	1579
Iodoform	2930
Iodine	2510
Sulphur	1152
Mercury	0887
Sodium	1865
Graphite (Cumberland)	0733

Sodium, extending down to low temperatures, has a coefficient about the same as that of mercury at the ordinary temperature. The coefficient for sulphur is about half of that between 0° and 100°, being 0·0002237, and that of iodine is not far removed from the value 0·000285 given for the solid at ordinary temperatures. The rate of expansion of liquid iodine is about three times this value. Paraffin ought to have a value of 0·0004633 from Fizeau, but Rodwell's coefficient between 0° and 38° is 0·00035. The value found for naphthalin is about half that of the liquid near its melting point, viz. 0·000785. If the liquid coefficient be taken at a corresponding temperature to that of the liquid carbonic acid when comparing it with the solid, then its value is 0·001213, or the coefficient would be now in the ratio of 4 to 1. The graphite calculated from Fizeau should be 0·0000929, which is greater than my value; but the samples were different. My two specimens of chloride of ammonium gave nearly the same value, and the result is in agreement with that found by Playfair and Joule, viz. 0·000191. If a Fizeau coefficient for this salt is calculated, the value is 0·0000761, which in this case is far too small. The coefficient found for oxalic acid is again only a little smaller than that given by Playfair and Joule, viz. 0·0002748. As regards the hydrated salts, phosphate of soda, hyposulphate of soda and chloride of calcium, having the respective values 0·0001384, 0·0001516 and 0·0006887, as found by Kopp, the low temperature coefficients are much smaller in each case. With the exception of carbonate of soda and chrome alum, all the other hydrated salts have a coefficient of expansion not differing greatly from that of ice at low temperatures. Generally, the densities of the compressed blocks of different bodies agreed well with the results of other observers, but my potash alum had only a density of 1·614, whereas Playfair and Joule give 1·731. It will be noted that iodoform is a highly expansive body like iodine, and that oxalate of methyl has nearly as great a coefficient as paraffin, which is one of the most expansive solids. The correcting factor was used for paraffin, naphthalin, chloral hydrate, iodoform and sodium.

It will be possible by cooling the moulds with liquid air during the process of hydraulic compression to produce cylindrical blocks of solid bodies of lower melting-points than any given in this investigation, such as alcohol, ether, nitrous oxide, ammonia, chlorine, &c., and to ascertain their coefficients of expansion in the solid state between the individual melting points and the boiling point of liquid air.

This method, which works well with liquid oxygen or air, fails when applied to liquid hydrogen, as the density of the liquid is too small (apart from other difficulties) to give accurate values of the weights of fluid displaced. For temperatures about 20° absolute, recourse must be had to measurements of the coefficient of linear expansion, and such observations could only be applied with ease to metallic bodies and alloys.

THE RISE OF THE EXPERIMENTAL SCIENCES IN OXFORD.[1]

IN the Middle Ages, the scholars swept in flocks, like migrating birds, from school to school. What we now call a University was then no particular spot on the earth; but, like the ark in the wilderness, moved whithersoever a great teacher, such as Fulbert, the Anselms, Abélard, Peter Lombard, unfurled his standard. This mobility was, indeed, a guarantee of the freedom and the power of learning.

The "Civitas Philosophorum," as Saint Thomas called Paris, was engaged in 1209 in burning all the works imputed to Aristotle. This attack "on the Lehrfreiheit" of Paris, when the culture of the first renascence was streaming into Europe from the Arabian sources, drove its scholars abroad, and flights of them came to the comparatively unknown schools of Oxford and Cambridge. Oxford, already a centre of public affairs, sprang more suddenly than Cambridge into fame—on the scholastic side under the influence of the Friars Minors.

The Grey Friars, then breathing the humane spirit of their founder, stood for the people and for freedom, while the Friars Preachers were on the side of authority. Robert Grosseteste, who made Oxford as Abélard made Paris and Fulbert made Chartres, and his pupils, Adam Marsh and Roger Bacon, became Greek scholars of no inconsiderable attainment at a time when the potable gold of Greek tradition had virtually died out in the west, and with it the inspiration of natural knowledge. Adam Marsh, himself a Minor, was a statesman, a close friend of Simon of Montfort, and a champion of freedom of learning. Balliol was founded under Franciscan influences, and under this first temper in the next century, then in the teeth of the Minorites, Oxford was keenly Lollard; and with the suppression of Lollardism all intellectual life deserted her courts. Nevertheless, Oxford during the Middle Ages was a child of Paris rather than of Italy, whence Cambridge drew much of her nourishment, and was the picturesque stronghold of hierarchical traditions. Albert of Cologne, himself a Franciscan, vindicated against Paris the science of the Arab schools, and dignified the study of natural knowledge and experiment.

Pioneers of science may be divided into two kinds, into a group who, like Galileo, Boyle and Harvey, were themselves discoverers, and a second group, like Roger Bacon, Telesio, Patrizzi, Campanella, Francis Bacon, Ramus and Marsiglio, who did service rather as protestants and reformers of method. Whether Roger Bacon were more of a chemist than Albert of Cologne, or whether either got beyond the chemistry of Geber, whether Bacon advanced in optics, his special study, beyond Al Hazen, it is less important to ascertain than to declare that Bacon's title to fame is that he revived true methods of investigation. Many ancients had made experiments; Aristotle made many, Pliny made many; Bacon first declared that it was not experiment, but the experimental method, which was to regenerate science. We must not suppose that Roger Bacon was alone, as one crying in the desert; with the Arab illumination, natural science was in the air. Many voices, such as that of Peter of Méricourt, to whom Bacon regarded himself as indebted, preached experiment and contemned authority in natural research. The works of Nemorarius of Borgentreich, who first advanced from the statics of Greek and Arab to dynamics, were known to Bacon. The parabolic mirror and its focus were known to Al Hazen. Grosseteste had larger views than either Hales or Albert, and was no inconsiderable geometer. He wrote a treatise, "de Iride et de Cometis," and was a keen inquirer into the new sources of knowledge, including the "Res Physica," or medicine. Thomas Bungay, the eighth Provincial of the Friars Minors, was engaged with Bacon at Oxford in natural investigation, and, like other such inquirers, was regarded as a wizard. In Italy natural science continued, even in some abundance of life; but in Paris on the Isis, as in Paris on the Seine, its rudiments were soon buried under the Aristotelian and Galenical cenotaph by that busy gravedigger, Duns the Northumbrian, and were not dug up again until the day of Abbot Maurolycus and Vesalius nearly three centuries later. Thus one of the most piercing intellects and one of the most progressive societies our land has produced founded no school.

The great experimenters of the thirteenth as well as of the sixteenth and seventeenth centuries could hardly obtain skilled craftsmen for the construction of apparatus. Many observers, however, were themselves ingenious constructors—such as Archimedes, Hero, Leonardo, Brahé, Gilbert, Galileo, Huyghens, Hooke, Papin and, in our own time, Faraday and Ludwig. Roger Bacon, in his expenditure of money and labour upon machines, preceded Boyle and Hooke. We are not to suppose that Roger's machines were clumsy and rudimentary. The Alexandrian and Byzantine Greeks, and after them the Arabs, had constructed apparatus of surprising elaboration and ingenuity, and Bacon's machines would be well abreast of their time. In the sixteenth century, again, the reappearance of Greek preceded a new birth of natural science; although, unless at Wittemberg or Basel, freedom of speech was more closely stifled in Europe than in the time of Abélard, for Calvin himself bowed before Aristotle. William Solling, Linacre, Grocyn and Colet were therefore forerunners of the brilliant scientific revival of which, in the seventeenth century, the establishment

[1] Abstract of the Boyle Lecture delivered at Oxford on May 13 by Prof. T. Clifford Allbutt, F.R.S.

of the great scientific societies, the Lincei, the Paris Academy and the Royal Society, were the organs and the witnesses. We find in the life of Bruno a vivid narrative of the Oxford of the sixteenth century. Bruno visited Oxford in June, 1583, with the French Ambassador Castelnau, the translator of Ramus. Of the disputations in the schools, of their pompous frivolity, he gives a very amusing description. The earth, said Aristotle, Paris and Oxford, is motionless; the universe is finite and moves. Bruno, in the name of Philolaus and Copernicus, protested that the earth revolves and that the universe is infinite; and the dispute grew venomous. Bruno asked and was granted permission to teach in Oxford; but as *dormitantium animorum excubitor* he seems to have been even less successful in combating the physics of Aristotle than was Ramus in respect of his dialectic and Luther of his ethics.

Orthodoxy is the defensive weapon of society rather than of religion; when the needs of the two came into conflict it was religion which went to the wall. Happily "certain extravagant chemists," of whom more anon—and the Ramists, Paracelsians and Italian philosophers, were shrewdly assisted by new factors in the worlds of polite society and letters. As Petrarch and Boccaccio disarmed the academic coxcombs of Padua, now again in France the sceptical bonhomie of Montaigne, the revolutionary philosophy of Charron, the merciless raillery of the Mariage Forcé and the polished satire of Boileau did more to penetrate the armour of the Church than the hardier rebels to bruise it. By them the shabby Aristolelian effigy, battered by the weapons of Roger Bacon, of Galileo, of Harvey, of Telesio and Descartes, and bedaubed with the missiles of Patrizzi, of Ramus and of Verulam, was finally broken up and demolished. In the middle of the seventeenth century at Wadham, Warden Wilkins gathered about him a constellation of scientific men such as has perhaps never gathered together in any other time or place. Robert Boyle, Christopher Wren, John Locke, Robert Hooke, and, but little latter, John Mayow, all of them men of genius, were at the head of a society which was the foundation of the Royal Society, and among its lesser lights contained names no less than those of Seth Ward, John Wallis, Thomas Willis, Roger Lower and William Petty. The lecture concluded with a study of Boyle, not only as a scientific discoverer, but also as a philosopher and a reformer of method of far greater insight than Dr. Whewell admits, and, moreover, a man of charming temperament and an accomplished man of letters.

ANTHROPOLOGICAL RESEARCHES IN INDIA.[1]

LIEUT.-COLONEL DR. WADDELL has been constrained to make a careful study of the savage tribes that live in the mountainous valleys of the upper waters of the Brahmaputra, as he realised that the unique mass of ethnological material which is stored in these mountain recesses is being allowed to disappear unrecorded. It is said to be no uncommon sight to see a Naga, who only two or three years ago was a naked head-hunting savage of the most pronounced type, now clad in a tweed coat and carrying a Manchester umbrella, taking his ticket at a railway station. Dr. Waddell states that one of the oldest European residents of Assam, Mr. S. E. Peal, urged at every opportunity in the public Press and in communications to the Asiatic Societies, the Royal Geographical Society and the Anthropological Institute of London, in the strongest terms possible, the necessity for action without further delay. In despair at the apathy displayed in the matter, he willed away at his death, a few months ago, to a museum in New Zealand all his collections of miscellaneous notes and specimens of the vanishing ornaments and primitive costumes of these wild tribes. Colonel Woodthorpe has emphasised the loss to ethnology if the many interesting tribes are not carefully studied soon. Mr. Wharry, adviser on Chinese affairs to the Government at Burma, says:—"The chance of studying these peoples to full advantage is fast slipping away."

The observations published by Dr. Waddell relate to about 600 individuals belonging to more than thirty tribes or groups. After briefly describing the influence of topography on the ethnology of the district and the racial elements, he gives a short account of a large number of tribes in alphabetical order. This section contains a great deal of very interesting matter which is of value alike to the ethnologist and to the student of comparative customs. Then follows the detailed anthropometric data and seventeen plates of portraits and groups. As the tables of indices and the "comparison of the results and the bearing of these on the question of the affinities of the tribes" are not given in this part, we assume they will follow in the next number of the journal, when it is to be hoped the equally bulky data for the tribes of Tibet and Burma, which the author has amassed, will be published for the benefit of his colleagues at home.

The laborious work accomplished single-handed and mainly at his own expense by Colonel Waddell deserves our warmest thanks, and we hope he will feel that anthropologists thoroughly appreciate his self-denying labours. It is quite beyond the power of the few students at home to help in supporting, save by encouragement, such workers as Colonel Waddell. To our shame be it spoken, there is no organisation by which the wealth of those who have abundance can be directed towards the pressing needs of field-work among primitive peoples, such as is so pathetically advocated by the author of this paper, and our Government also is apathetic to the study of native races; one can only hope that this negligence is due to ignorance.

Since Colonel Waddell wrote his paper, the Government of India has undertaken to conduct an Ethnographic Survey of India in connection with the census of 1901. This action was due to the initiative of the British Association at the Dover meeting in 1899; particulars of the proposed scheme of work will be found in *Man*, September 1901, p. 137. As Mr. Risley, the author of "The Tribes and Castes of Bengal," has been appointed Director of Ethnography for India, we may feel sure that the Survey will be wisely planned, and we sincerely hope that sufficiently skilled workers are employed and that the usefulness of the Survey will not be impeded through lack of funds. While we are thankful for this official recognition of the claims of anthropology, it is still necessary to repeat, what has so often been urged in the pages of NATURE, that there is an enormous mass of ethnological material in our Empire beyond the seas which is yearly decreasing at an alarming rate, or is rapidly becoming so modified as to lose its original value. The loss of this vanishing anthropological information is supinely permitted by our Government. What a contrast there is between the British Government and that of the United States is known only too well by those acquainted with the annual reports of the Bureau of Ethnology.

Mr. T. H. Holland, of the Geological Survey of India, has published a very valuable study on two well-contrasted human types found in a small district of southern India. The presentation of the data, their discussion, the comparative tables, diagrams and plates, render this a model paper.

In the little province of Coorg, which embraces a semi-isolated portion of the western Ghats, there is an interesting instance of the way in which a mountainous and jungle-covered country has been turned to totally different purposes by two distinct races. The agricultural Yeruva early retreated into the little mountain province before the aggressive invaders. At a later period the splendid Kodagas (Coorgs) found in the jungles of Coorg the means of satisfying their hunting propensities, whilst the narrow passes suited their highly developed instincts for predatory raids into the country of their wealthier but less warlike neighbours. The sporting and fighting proclivities of the Coorgs reveal themselves even in their festive and religious ceremonies. From his very birth, when a miniature bow and arrow made from the castor oil plant is placed in the hands of the baby boy, the Coorg male is, or was, regarded as a huntsman and a warrior whose pride was in his size and strength; hence this is the finest race in the south of India.

A comparison of the physical characters of these two tribes proves that the Coorg is on an average 3·9 inches taller than the Yeruva, and with a relatively shorter span he has a larger and broader head, a more perfect approach to orthognathism, his nose is longer and narrower. There is a marked contrast between the fair (light brown), straight-haired Coorg and the very dark-skinned Yeruva, whose hair is distinctly wavy. The features of the latter are generally of the stamp which we should characterise as distinctly low, the broad nose being accompanied by thick, slightly everted lips.

[1] "The Tribes of the Brahmaputra Valley: a Contribution on their Physical Types and Affinities." By L. A. Waddell, M.B., LL.D., Lieut.-Colonel, Indian Medical Service. (*Journal* of the Asiatic Society of Bengal, vol. lxix., part iii. 1900 (1901) pp. 1–127, pls. ii–xviii.)

"The Coorgs and Yeruvas, an Ethnological Contrast." By T. H. Holland, A.R.C.S., F.G.S., Geological Survey of India. (*Ibid*, vol. lxx. part iii. 1901, pp. 59–98, pls. i–v.).

The Coorgs and the Yeruvas belong to two distinct ethnic types. The latter tribe falls into a group with the Kurumbas, Irulas, Paniyans and Kadirs, who have been so ably studied by Mr. Thurston and are the South Indian cousins of the Kols and Gonds living on the central highlands. In all their physical characters the Coorgs differ from the Yeruvas, and, indeed, they possess more of the superior characteristics which are supposed to indicate an Aryan origin than do many of the South Indian tribes who claim a higher caste position, and fewer signs of aboriginal blood than even the Brahmans of the Madras Presidency. Their almost brachycephalic index of 79·9, however, leaves the question of their ethnic relationship an unsolved problem.

A. C. H.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Rolleston memorial prize for original research in morphology has been awarded to Mr. Francis J. Cole, Jesus College.

CAMBRIDGE.—The Balfour managers have made grants for zoological research in Africa to Mr. C. Crossland and Mr. J. S. Budgett.

An exhibition of astronomical photographs from the Yerkes and Lick Observatories will be given at the Cavendish Laboratory on May 29 by Sir Robert Ball.

Applications for tables at the Naples and at the Plymouth zoological stations should be addressed to Prof. A. Newton by June 5 next.

The complete degree of M.A. *honoris causa* is to be conferred on Mr. T. H. Middleton, the new professor of agriculture.

Mr. W. B. Hardy and Mr. F. G. Hopkins have been appointed examiners for the Gedge prize in physiology.

The Thurston prize for original research in physiology, pathology or practical medicine, open to members of Gonville and Caius College of not more than fifteen years' standing from matriculation, will be awarded this year. The prize is triennial and amounts to about 54*l*. Applications are to be addressed to the master on or before September 30.

A CONVERSAZIONE will be held at University College, London, on Thursday, June 19. A large number of friends and old students will be present, and exhibits will be arranged in connection with the various departments, to illustrate the work being carried on at the College.

THERE is every likelihood that another University will soon be added to the large number of such institutions at present existing in the German Empire. Frankfort a. M. is the city which is thus to be enriched. It already possesses the Senckenberg's Institute for natural sciences and medicine, and also an academy for the study of social and commercial science. To the former—at which, it may be mentioned, important scientific work is carried on—there has recently been added a laboratory specially constructed for the investigation of cancer. This department is richly endowed, partly, it is said, by the Emperor William, and is placed in the care of an eminent bacteriologist. The academy is very largely attended by foreign as well as German students, America in particular being well represented. And now it is announced that the trustees of the Karl Juegel's bequest have decided to devote the interest on the capital sum of 2,000,000 marks (100,000*l*.) to the erection in Frankfort a. M. of an academy for the study of history, law, philosophy and allied subjects. When this third institution is established, Frankfort will possess practically all the faculties, with the exception of theology, which go to form an University; and therefore the authorities have decided to draw up a Bill which, if passed by Parliament, will unite the three institutes of learning into one University. There is strong reason to suppose that no particular difficulty will be encountered in carrying out this plan, for Frankfort is in many ways eminently suitable for the position of being an University city.

NOW that the second reading of the Education Bill has been passed, efforts should be made in Committee to remove the permissive clause, especially in so far as it affects higher education. At present, as Mr. Henry Hobhouse points out in a letter to the *Times*, there is little more than a framework for legislation. "No statutory duty is laid on the local authority to aid education 'other than elementary,' and no permanent fund is appropriated for this object. The 'whisky money' is not safeguarded, despite the obvious danger that the ratepayers in certain localities will press for compensation out of this fund for the additional burdens necessitated for the purposes of elementary education. Nor are the objects of higher education in any way defined. The intention of the Government apparently is (though it is not expressed in the Bill) to impose on the new authority the provision of evening continuation schools, pupil teachers' centres, and even training colleges. The restrictions of the Technical Instruction Acts on aiding private profit schools and on teaching trades are swept away. In a word, under part ii., as it now stands, it would seem that a local authority may do anything and need do nothing. Surely Parliament ought to give more guidance than this to the new authorities, or there will be great danger that in certain localities most important developments of educational work will be wholly or partially neglected." As the Bill at present stands, there is a danger that the last case of higher education will be worse than the first.

AT the presentation day of the University of London, on May 14, Lord Rosebery was welcomed as the new Chancellor. Principal Rücker read his report upon the work of the University during the past year, and referred to the following points among others. The organisation of the University has been completed by the addition of a new department for University extension and the inspection of schools. Regulations have been passed for the admission of post-graduate students from other Universities to study for the doctorate in London, and it is satisfactory to be able to record that a considerable number of such students are, or are about to be, placed upon the books of the University. Two chairs of chemistry are to be established at University College, one for general chemistry, which will be filled by Prof. Ramsay, the other for organic chemistry. In no subject has the difference between the completeness of English and foreign educational equipment been more marked than in chemistry. Only two or three educational institutions in this country have more than one professor of chemistry, while in Germany even a University of the second-class usually has several professors in that department. It is hoped that the chairs now founded in University College will be the beginning of a great chemical department worthy of London. A very large scheme, which will have an important bearing on the future organisation of the University, has been set on foot in consequence of the munificent offer of the Drapers' Company to give 30,000*l*. in aid of the incorporation of University College in the University. The authorities, both of the University and of the College, have agreed in principle to the main outlines of a plan for incorporation, provided that an initial sum of 110,000*l*. can be raised. There is every reason to hope that this condition will before long be fulfilled. While the University has been engaged in entering into closer relations with the various schools, and in negotiations for the complete absorption of one of them, it has also been undertaking teaching on its own account. All the leading physiologists in London have banded themselves together to give courses of lectures on that subject for advanced and post-graduate students, and Mr. Walter Palmer has generously given a sum of 2000*l*. to enable the experiment to be tried as to whether such lectures would attract an adequate number of students. The University has contributed another 400*l*., and has also placed a suite of rooms in the University buildings at the disposal of the teachers as laboratories and lecture rooms. To obtain an idea of the research work being done in London, recognised teachers of the University were asked to supply a short statement as to the publications of themselves, their assistants and students during the past twelve months. Nearly six hundred memoirs, papers and minor communications to scientific and literary journals have been reported. As might have been expected from the large number of its members, the medical faculty takes the lead in the number of its publications, somewhat less than half the above total being communications to professional medical societies and journals. Teachers of the University, their assistants and students have made about 220 additions to general scientific literature. They have been the authors, or joint authors, of eleven papers in the *Transactions* of the Royal Society, or of about eighty papers which have appeared in the *Proceedings* of the Royal Society, and in the journals of the Chemical, Linnean, Physiological and other kindred societies. University College heads the list

with a total of about 100 memoirs and papers, while the Polytechnics have contributed about a score. In concluding his report, the Principal remarked: "It is time that London should realise that it is not the want of men, or a dearth of intellectual effort, which has hindered the University of London from taking its place as a great centre of teaching and research. Our needs are organisation, which shall make the results of the work of the teachers, their assistants and students more fruitful and better known as results of which London may be proud, and funds to supply them with the materials for their work."

SCIENTIFIC SERIALS.

American Journal of Science, May.—Notes on living Cycads, by G. R. Wieland. A study of *Zamia floridana*. Particular attention is drawn to the presence on one of the cones of a pinnule of normal form and structure which had grown out from beneath the outer hexagonal tip of one of the upper abortive sporophylls. As in a similar example described by Sir W. T. Thiselton-Dyer, this structure is regarded as a reversion, exhibiting evolutionary stages which may be found in fossilised forms. To speak of these growths as "monstrous cones" is regarded as almost misleading.—On crystals of Croconite from Tasmania, by R. G. Van Name.—Notes on unusual minerals from the Pacific States, by R. W. Turner. Among the phosphates found were pyromorphite, apatite and monazite, the latter occurring in abundance in the Idaho basin.—On the use of the stereographic projection for geographical maps and sailing charts, by S. L. Penfield. A continuation of previous papers on the same subject.—Note on the application of the phase rule to the fusing points of copper, silver and gold, by T. W. Richards. It has been found by Holborn and Day that gold gives a very constant melting point, copper two constant points at 1065° and 1084° C., whilst silver gives no fixed point. It is shown that all these results could have been deduced by the application of the phase rule.—The initiative action of iodine and other oxidisers in the hydrolysis of starch and dextrins, by F. E. Hale.—Note on the possibility of a colloidal state of gases, by C. Barus.—Some glacial remains near Woodstock, Connecticut, by J. W. Eggleston.

American Journal of Mathematics, vol. xxiv. No. 2, April.—L. E. Dickson, on the canonical form of a linear homogeneous transformation in an arbitrary field of rationality. In a previous paper (*A. J.* xxii. p. 121) the author obtained a reduction to a canonical form for transformation in a Galois field; it is here proved that the same process applies when the field is arbitrary.—H. B. Newson, a new theory of collineations and their Lie groups. A geometrical theory of collineation in the plane, independent of Lie's analytical method of transformation-groups.—L. P. Eisenhart, infinitesimal deformation of surfaces. A discussion of the transformation $x'=x+\epsilon x_1$, $y'=y+\epsilon y_1$, $z'=z+\epsilon z_1$, with $dxdx_1+dydy_1+dzdz_1=0$, and ϵ a small constant, of which the square is neglected.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 6.—"On the Spark Discharge from Metallic Poles in Water." By Sir Norman Lockyer, K.C.B., F.R.S.

In this paper various modifications produced in the spectra of metals by alterations of the conditions under which the substances are volatilised are discussed and new observations made at the Solar Physics Observatory are described. The investigation was undertaken partly in consequence of a suggestion put forward by Dr. Wilsing, of Potsdam, to the effect that certain conditions, viz. the production of spark spectra in liquids, gave rise to the formation of structural peculiarities in the constituent lines which are characteristic of the spectra of new stars.

One of the chief characteristics of the spectra of Novæ is the occurrence of a series of double lines, each consisting of a bright and a dark component, the latter being always situated on the violet or more refrangible side of the bright line and in contact with it. The usual interpretation of this appearance has been to consider the composite spectrum produced by two bodies in relative motion, but the necessary velocity is greatly in excess of other known cosmical motions. Recent experiments dealing with the spectra of elements under pressure having shown that by this means the wave-lengths of the lines are altered, Dr. Wilsing suggested that if the pressure were sufficiently great, displacements might be obtained of equal magnitude to those observed in the case of new stars. As the direct application of high pressures is attended with difficulties, he utilised the fact that exceedingly high tensions are produced when electric sparks are discharged in liquids.

Using an induction coil, with jar and air break in the secondary circuit, a brilliant discharge is produced in water, giving a very intense continuous spectrum crossed by faint metallic lines. In this way Dr. Wilsing obtained the spectra of iron, nickel, platinum, copper, tin, zinc, cadmium, lead and silver, and from the examination of the photographs he arrived at the conclusion that displacements of lines and double lines occurred which were in every way similar to those in the spectra of Nova Aurigæ, and that therefore, in all probability, pressure is the cause of the duplication and broadening of the lines in the spectra of new stars.

On examining the first few spectra obtained under these special conditions, the appearances presented were so suggestive of many of the well-known effects of reversal that a further inquiry was advisable. It has long been known that in ordinary arc spectra many instances occur in which the absorption line is asymmetrical with respect to the emission line; and reference is made in the paper to communications by the author to the Royal Society more than a quarter of a century ago describing these peculiarities in certain silver and rubidium lines.

The experiments at the Solar Physics Observatory were made first with the large Spottiswoode coil, capable of giving a 42-inch spark in air, this being intensified by the insertion of a large glass-plate-condenser in the secondary circuit, so that the sparks obtained were about 3 mm. long in air and 0·5 mm. in water.

Later a 10-inch coil was used with a smaller condenser in circuit, and about the same sparking conditions. The photographs of the spectrum were taken on a large scale by means of a 6-inch Rowland concave grating of 21·5 feet radius, with 14,438 lines to the inch. The first-order spectrum was employed, arranged to photograph the region from λ 3800 to λ 4800, occupying a length of 18 inches on the plate. Distilled water was used in all cases.

Of the metals examined (iron, silver, lead, copper, zinc and magnesium) only iron, magnesium and zinc showed reversals, and those of zinc were extremely weak. In all cases the lines of the spectrum of the spark in water are much broader than the corresponding lines in the spectrum of the air-spark. From an examination of several plates of different intensity, however, it appeared that the broadening was, for the most part, of similar nature to that observed in the arc spectrum in air when an excess of material is introduced between the poles.

When the cases of non-symmetrical absorption were considered, it was noted that very different appearances were presented according to the exposure of the spectrum. For example, in the best exposed plate of iron, the line at λ 4260·64 is well reversed in the water-spark, with the part of the emission line towards the red several times stronger than the portion on the violet side of the absorption. An even diminution of the whole composite line, as shown by photographs of less exposure, results in the persistence of the less refrangible portion only of the emission line, which alone would suggest the presence of a line greatly displaced towards the red with regard to the original spark line in air. Several of the iron lines show the intermediate stage, where the violet component is on the verge of visibility, and in these cases the appearance is suggestive of a bright line with a dark companion on its more refrangible border. It is important to note, however, that in these cases the absorption line is usually normal with the position of the original line, the bright component being displaced towards the red.

In the water-spark spectrum of copper it is only with difficulty that any existing line spectrum can be distinguished from the intense continuous emission, and the few lines so recorded present the appearance of broad bands, displaced towards the red. The probability of their being produced in the manner suggested, however, is rendered feasible by the fact that, although no actual absorption is visible, their more refrangible edges are fairly sharply defined, while the other edges are quite diffuse.

A general classification of the phenomena which are thus presented under varying conditions is put forward, the grouping being as follows :—

(1) *Broadened bright line.* Examples of this stage are presented in the spectrum of copper and the under-exposed spectrum of iron.

(2) *Broadened bright line with central absorption line.* Well shown in the central line of the violet triplet of iron, λ 4063·76.

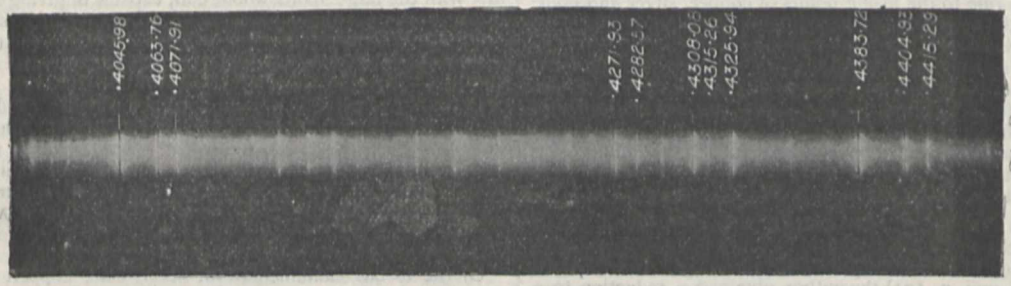
(3) *Broadened bright line with non-symmetrical absorption (maximum of emission towards red).* A good example of this is the iron line at λ 4260·64.

An additional feature of the water-spark spectrum is that many of the lines show inversion of intensity with respect to the air spark spectrum. This is well shown in the lines of iron at λλ 4422·74 and 4427·48.

From these considerations it appears that, if suitable exposures are given, lines may be photographed in the spectrum of iron, say, which show all the phenomena described by Dr. Wilsing, but so related to each other and the complete stage—that of reversal, symmetrical or unsymmetrical—that it is impossible to regard them as anything abnormal.

Again, when these appearances are contrasted with the structure peculiar to the spectra of Novæ, many divergences of vital importance are found.

In the water-spark the position of the absorption undergoes little if any change of position, while in the case of non-symmetrical reversals, a bright line may be observed greatly displaced towards the red. In the new stars, on the other hand, the absorption lines are greatly displaced, the accompanying



bright lines occupying in comparison normal positions. Thus, in the case of Nova Aurigæ the emission lines had practically normal wave-lengths, but the displacements of the dark lines at H_ϵ were about 10·7 tenth-metres towards the violet, indicating a velocity of approach of about 500 miles per second. The recent new star in Perseus exhibited the same normal positions of the bright lines, and indications of even greater displacements of the dark lines, at one time amounting to 15 tenth-metres at H_ϵ, representing a velocity of approach of the body producing the dark-line spectrum of more than 700 miles per second. These values differ enormously from those produced by pressure.

It appears then that the known direct effect of pressure on the radiation or absorption lines is the same, in quality, in water as in air, that is, displacements are obtained in the *opposite* direction to those the dark lines are observed to occupy in the spectra of Novæ ; moreover, the amount of shift observed in the spectra of new stars differs, not only in this respect, but also in degree, thus :—

	Spark in water.	New stars.
1.	Absorption lines least shifted.	Absorption lines most shifted.
2.	Radiation lines most shifted.	Radiation lines least shifted.
3.	Absorption shift small.	Absorption shift enormous.

It would thus appear that the pairs of bright and dark lines shown in the spectra of new stars do not arise from the cause, presumably pressure, which produces the appearances presented in the spectrum of the spark discharge in water.

Royal Astronomical Society, May 9.—Dr. J. W. L. Glaisher, president, in the chair.—Mr. H. C. Plummer read a paper on the accuracy of photographic measures, in which he criticised M. Lœwy's recent memoir on the subject. Mr. Plummer doubted the possibility of expressing by a single formula the probable error of measures of stars on photographs, and considered the question of personality in estimating the centre of star photographic images. The paper gave rise to some discussion, in which Mr. Hinks, Prof. Turner and others took part.—Father Cortie read a paper by Father Sidgreaves on the spectrum of Nova Persei from September 6, 1901, to February 12, 1902, and showed photographs on the screen. During the period mentioned, the lines of the spectrum had remained very broad and preserved their relative intensities.—Father Cortie read a paper on visual and spectroscopic observations of the sun-spot group of May and June 1901. It appeared that the disturbed area of the corona of May 18, as shown on the eclipse photographs, corresponded with the region in which the spot group had its origin, and marked the time of the outburst, though the region had been disturbed quite a solar rotation before the birth of the spot. In this case of the only great sun-spot in an otherwise quiet year there appeared no correspondence between solar storms and terrestrial magnetic disturbance. The most widened lines in the red end of the spectrum of sun-spots are always faint lines, chiefly of vanadium and titanium. The author concluded that the level of sun-spots is that of the upper, more diffused gases, which give the flash spectrum in solar eclipses. In the discussion which followed, doubt was thrown upon the presence of vanadium in the flash spectrum.—Mr. Dyson described the Greenwich photographic observations of the satellite of Neptune, and also gave an account of a paper by Mr. Cowell on a method of reduction of extra-meridian observations. The method was a general one, suitable for observations at any azimuth, and the computation was facilitated by tables.

Linnean Society, May 1.—Prof. S. H. Vines, F.R.S., president, in the chair.—Mr. J. E. Harting exhibited photographs of a living specimen of the African shoe-bill (*Balaeniceps rex*), forwarded from Cairo by Sir William Garstin, K.C.M.G., and gave some account of the bird and of the different views which had been expressed by zoologists regarding its affinities and systematic position.—On the cerebellum of the lemurs, by Dr. Elliot Smith. In this paper, to be published as an addendum to that on the cerebrum read on March 6, the author introduces a revised terminology. Resolving the cerebellum into three main lobes—anticus, medius and posticus, he discards the term "fissura horizontalis magna," since the fissure so named is found to be inconstant and sometimes absent, and substitutes for "preclival" the term *prima*, regarding the fissure thus named, which divides the lobus anterius and medius, as the deepest and as constant for all mammalian forms. The detailed characters of the lemuroid cerebellum are described, and the cerebellum of Notoryctes is incidentally shown to be the simplest for all mammals.—On the brain of the elephant shrew (*Macroscelides elephantopus*, Shaw), by Dr. Elliot Smith. The brain of Macroscelides is shown to be marsupial in the existence of a dorsal fornix commissure of crescentic type, unique in the coexistence with this of a distinct and independent callosum, equal in extent to that of the higher Primates. Comparison is drawn with the cerebrum of those higher Metatheria in which the fusion of callosum and fornix commissure (psalterium) is the rule ; and the author concludes that the examination microscopically of well-preserved material, of which he is expectant, will reveal a connection between these two which may not necessarily contain nerve-fibres, and may thus realise a condition he has previously described for the Hapalidæ.—On the early condition of the shoulder-girdle of the polyprotodont marsupials Dasyurus and Perameles, by Dr. R. Broom. The author shows that in the mammary fœtus of the native cat of Tasmania and Victoria

(*Dasyurus viverrinus*), the cartilaginous coracoid reaches the sternum, as he has previously proved to be the case in the fœtal Trichosurus. At a later stage, an elongation of the spine and clavicle is all conspicuous, with accompanying withdrawal of the coracoid. In the mammary fœtus of the bandicoot (*Perameles obesula*) described, the coracoid is found to exhibit no connection with the sternum, and the scapula to be essentially similar to that of the adult, the clavicle reduced.

Geological Society, April 30.—Prof. Charles Lapworth, F.R.S., president, in the chair.—Mr. J. E. Marr exhibited some specimens from a metamorphosed metalliferous vein several inches wide, which he had discovered in the basic andesites near the Shap Granite, in a quarry close to the high road, north of the spot where it crosses Longfell Gill.—Mr. H. W. Monckton exhibited a flint implement which he had himself found on a heap of gravel, in a pit 278 feet above Ordnance-datum, at Englefield (Berkshire). The gravel is part of an elongated patch mapped "Plateau-Gravel." Mr. O. A. Shrubsole remarked that the implement was of Palæolithic type, and of an advanced form of that type, as it had a cutting-edge all round. It had not been greatly rolled, and was probably made not far from the spot where it was found. Its patination showed that it belonged to the gravel in which it was found.—The origin and associations of the jaspers of south-eastern Anglesey, by Mr. Edward Greenly. Red jasper and jaspery phyllite are widely distributed in the southern and south-eastern parts of Anglesey, in the districts of Newborough, Pentraeth and Beaumaris. They are associated with limestones, diabases, serpentines, and with grits and shales. They have been much modified by earth-movements, which have produced brecciated and schistose structures; but where original structures have survived, the true relations of the rocks can often be seen. The diabases have the same characters as the pillowy and variolitic rocks so often associated with radiolarian cherts and jaspers in many parts of the world, and at several different geological horizons; and the relationships of the jaspers and igneous rocks resemble those seen in the radiolarian cherts of southern Scotland. It is inferred that the jaspers are altered radiolarian cherts.—The mineralogical constitution of the finer material of the Bunter pebble-bed in the west of England, by Mr. H. H. Thomas. Specimens were collected at intervals, from Budleigh Salterton, in Devon, to Fitzhead, near Milverton, in Somerset, and other sands, for comparison, were taken from the red rocks above and below. The sands, on the whole, contain a very small percentage of minerals with a specific gravity of more than 2·8; while the proportion of material over, to that under, 2·58 is about 70 or 80 to 30 or 20 per cent. A list and description of twenty minerals found in the sands is given, with, in some instances, the chief characters by which they were identified. The gradual decrease in the percentage of heavy minerals from Budleigh Salterton to Uffculm indicates the carriage of sediment by a southerly current, and this view is strengthened by the decrease in staurolite and a gradual diminution in the size of the tourmaline-grains. The increase in proportion of heavy grains from Uffculm to Milverton, and the further decline northward, together with the incoming of an assemblage of minerals markedly different from the normal southerly type, indicates an additional source of supply, perhaps a westerly current. The mass of material seems to have been furnished by a highly metamorphosed area, differing widely in its character from any now exposed in the south-west of England. The most probable source of much of the material is the Armorican massif of Triassic times.—Revision of the Phyllocarida from the Chemung and Waverly groups of Pennsylvania, by Prof. C. E. Beecher. The specimens described in the paper, as well as those on which the original descriptions were based, were all obtained in the vicinity of Warren, Philadelphia. The chief horizon is in the shale-beds of the Upper Chemung group, about 50 feet above mean water-level in the Allegheny River. The deposits are called by the writer the "Phyllocarid-Beds" Additions and emendations to the original diagnoses of several genera and species are given.

MANCHESTER.

Literary and Philosophical Society, May 13.—Mr. Charles Bailey, president, in the chair.—A paper on the luminous organs in *Pterygioteuthis margaritifera*, a Mediterranean cephalopod, by Mr. W. E. Hoyle, was laid upon the table.—Prof. Boyd Dawkins, F.R.S., brought before the Society the collection of specimens discovered in 1901 in Crete by Mr. Hogarth in the course of the exploration of the Mycenæan remains of that island. The skulls exhibited belong to the oval-headed, well-developed type termed Mediterranean by Sergi and closely allied to the Iberic type of Spain and of Britain. They bear unmistakable marks of civilisation in the thinness of their walls and the extent to which the sutures are drawn out by the growth of the brain, as well as by the badness of their grinders and the small size of their canines. They probably represent a small, dark race, and were in the Bronze stage of civilisation. Among the remains from the Dictæan cave are the skulls of a goat and a hog, portions of those of the fallow-deer, and the forehead with two horn-cores of a domestic ox, for which Prof. Dawkins proposes the provisional name of *Bos buticus*, as it cannot be identified with any species on record.

PARIS.

Academy of Sciences, May 12.—M. Bouquet de la Grye in the chair.—Notice on the works of M. Lazare Fuchs, by M. Camille Jordan.—A study of lithium silicide, by M. Henri Moissan. The discovery of a silicon hydride of the constitution Si_2H_6 suggested the possibility of the existence of a series of corresponding metallic silicides, and in the present paper the preparation and properties of the lithium silicide, Si_2Li_6, are described. A mixture of silicon with lithium in slight excess is heated in a vacuum at a low red heat for two or three hours and the excess of lithium distilled off between 400° and 500° C. The silicide formed, the analysis of which gave figures corresponding to the formula Si_2Li_6, forms deep blue crystals. With a small quantity of water, this silicide reacts very violently, a spontaneously inflammable mixture of hydrogen and hydrogen silicide being given off. The slow decomposition with water furnishes only pure hydrogen. It was noted that although a solution of hydrochloric acid gas in dry ether was without action on the compound, the addition of a small quantity of water caused a rapid decomposition.—On the earthquake of May 6, 1902, by M. Michel Lévy. Two records from seismographs show earthquakes on May 6, one at Grenoble at 3h. 4m. 40s., and the other at Floirac at 3h. 5m. 30s. On the supposition of a velocity of transmission of 3 kilometres per second, the epicentre should be in the Mediterranean, east of Murcie and south of Minorca.—On viscous compressible fluids, by M. P. Duhem.—The black coloration of the rocks forming the cataracts of the Nile, by MM. Lortet and Hugounenq. The specimens of granite and porphyry at the cataracts of Ouadi-Halfa and Assouan present a uniformly black and highly polished surface, facts difficult to explain from the composition of these rocks. The polish is attributed to the scouring action of the sand brought down by the water, the black colour to black oxide of manganese. The latter does not exist in the rock mass and must have been formed from the manganese silicates present.—On a project for the organisation of a service of scientific exploration in Indo-China. The committee appointed to consider this question recommend the appointment of a permanent commission under the control of the Academy, the subjects of geology (with mineralogy), botany, zoology and anthropology being represented.—Remarks by M. Janssen on presenting to the Academy photographs of the solar corona taken at the Isie of Reunion during the total eclipse of May 17, 1901, by M. Jean Binot. The photographs from this station were of especial importance on account of the want of success due to climatic conditions at the other places of observation. A whole-page reproduction of this photograph accompanies the note.—The influence of instrumental errors on the rectilineal coordinates of star photographs, by M. Ch. Trépied.—On some orthogonal systems and their application to the problem of the deformation of the paraboloid of revolution, by M. de Tannenberg.—On a class of transformations of partial differential equations of the second order, by M. J. Clairin.—On the prediction of the minimum yield of the sources of the Vanne, by M. Edmond Maillet. If the rainfall of a given winter season is plotted as an abscissa against the yield of the springs for the second quarter following, the results for a number of years fall on regular curves, which can thus be applied to the prediction of the supply for the coming season.—On the continuous spectrum of electric sparks, by M. B. Eginitis. The spectrum of ordinary electric sparks between metallic electrodes is usually accompanied by a continuous spectrum, the intensity of which is usually very small compared with the intensity of the line

spectrum. The intensity of this continuous spectrum varies in different places, and also varies with the self-induction of the circuit. It is very intense in the case of certain metals such as magnesium, iron, cobalt, nickel and manganese. For all the metals examined, the continuous spectrum can be completely eliminated by choosing particular values for the self-induction.—On a magnetic perturbation observed on May 8, by M. Th. Moureaux. A magnetic disturbance, affecting chiefly the horizontal component, was recorded at the Observatory of Val-Joyeux, near Saint-Cyr, at a time corresponding to the catastrophe of Martinique.—On a rain of ink on May 7, 1902, by M. Th. Moureaux.—On the conditions of formation and stability of the hydrides and nitrides of the alkaline earths, by M. Henri Gautier. In the case of the hydrides of barium and strontium, certain phenomena were observed which appeared to point to the possible existence of a higher hydride than BaH_2 or SrH_2, but on further examination these results were found to be due to the simple absorption of hydrogen by the hydrides without the formation of any definite compounds. Calcium hydride does not possess this property. The nitrides were found to be much more stable than the hydrides, commencing to form only at temperatures above 600° C., and remaining undecomposed at 1000° C., a temperature at which the hydrides are strongly dissociated.—On some derivatives of anthraquinone obtained by the action of sodium peroxide upon the aloins and their halogen derivatives, by M. E. Léger.—On a new dimethylglutaric acid, by M. E. E. Blaise.—The synthesis of menthone, by M. Georges Leser. The synthesis was effected by the action of potassium dissolved in absolute alcohol upon a mixture of isopropyl iodide and acetylmethylcyclohexanone.—On the composition and age of the metamorphic rocks of Crete, by M. L. Cayeux. The metamorphic series of western Crete belongs to the Trias of the Mediterranean type, probably to the Upper Trias.—On certain chromatic reactions of the red corpuscles in the blood of diabetics, by M. J. Le Goff.

NEW SOUTH WALES.

Linnean Society, March 26.—Mr. J. H. Maiden, president, in the chair.—The president delivered the annual address.

Ordinary meeting.—Note on two species of Astralium from Port Jackson, by Mr. H. Leighton Kesteven. The author finds that *Astralium fimbriatum*, Lamarck, and *A. tentoriforme*, Jonas, have, in Port Jackson, been united under the latter name. He finds that in the nepionic stage the former is very depressed, almost discoidal, and perspectively umbilicate; whilst the latter is trochiform and not umbilicate, at the same stage. They present the anomaly of two species easily separable in the nepionic stage, becoming so alike in the adult condition that only by their opercula can some specimens be identified.—Studies on Australian Mollusca, part vi., by Mr. C. Hedley. Material from tropical Queensland furnishes two genera, Congeria and Mecoliotia, new to Australia, as well as sundry small forms of Pyrgulina, Crossea and Liotia, new to science.

DIARY OF SOCIETIES.

THURSDAY, MAY 22.

INSTITUTION OF ELECTRICAL ENGINEERS (Society of Arts), at 8.—Annual General Meeting.

FRIDAY, MAY 23.

ROYAL INSTITUTION, at 9.—The Ethical Element in Shakespeare: Rev. Canon Ainger.

PHYSICAL SOCIETY, at 5.—On the Ebullition of Rotating Water; a Lecture Experiment: T. C. Porter.—The Conservation of Entropy: J. A. Erskine.—Rational Units of Electromagnetism: Sig. G. Giorgi.

MONDAY, MAY 26.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Anniversary Meeting.

VICTORIA INSTITUTE, at 4.30.—Annual Meeting. Address by Sir Chas. W. Wilson, K.C.M.G., K.C.B.

TUESDAY, MAY 27.

ROYAL INSTITUTION, at 3.—The Laws of Heredity, with Special Reference to Man: Prof. K. Pearson, F.R.S.

SOCIETY OF ARTS, at 8.—Pageantry and the Masque: May Morris.

ROYAL STATISTICAL SOCIETY, at 5.

WEDNESDAY, MAY 28.

CHEMICAL SOCIETY, at 5.30.—Taxim: T. E. Thorpe, C.B., F.R.S. and E. Stubbs.

GEOLOGICAL SOCIETY, at 8.—(1) On the Red Sandstone Rocks of Peel (Isle of Man); (2) The Carboniferous, Permian and Triassic Rocks under the Glacial Drift in the North of the Isle of Man: Prof. W. Boyd Dawkins, F.R.S.—The Plutonic Complex of Central Anglesey: Dr. Charles Callaway.

THURSDAY, MAY 29.

ROYAL SOCIETY, at 4.30.—*Probable papers:* The Effect of Daylight on the Propagation of Electro-magnetic Impulses over Long Distances: G. Marconi.—The Minute Structure of Metals and other Plastic Solids: G. Beilby.—The Influence of Varying Amounts of Carbon Dioxide in the Air on the Photosynthetic Process of Leaves and on the Mode of Growth of Plants: H. T. Brown, F.R.S., and F. Escombe.—On the Influence of an Excess of Carbon Dioxide in the Air on the Form and Internal Structure of Plants: Prof. J. B. Farmer, F.R.S., and S. E. Chandler.—On the Structure of the Gills of the Lamellibranchia: Dr. W. G. Ridewood.

SOCIETY OF ARTS, at 4.30.—Western Australia: its Progress and Resources: Hon. H. W. Venn.

INSTITUTION OF MINING ENGINEERS (Geological Society), at 11.—Working Coal under the River Hunter, the Pacific Ocean and its Tidal Waters, near Newcastle, New South Wales: A. A. Atkinson.—Lead and Zinc Deposits of the Mississippi Valley, U.S.A.: Prof. C. R. Van Hise and H. Foster Bain.—The Campbell Coal-washing Table: Clarence R. Claghorn.—The Mining, Concentration and Analysis of Corundum in Ontario: Dr. W. L. Goodwin.—Re-opening of Hartley Colliery: R. E. Ornsby.—Deposits of Hydroborate of Lime: its Exploration and Refination: Carlos A. Lynes Hoskold.—Remarks on Mr. M. Walton Brown's "Report on Mechanical Ventilators": Prof. A. Rateau.

FRIDAY, MAY 30.

ROYAL INSTITUTION, at 9.—The Progress of Electric Space Telegraphy: G. Marconi.

INSTITUTION OF MINING ENGINEERS (Geological Society), at 10.30.—The Training of Industrial Leaders: Prof. J. Wertheimer.—Smelting in British Columbia: W. Denham Verschoyle.—Treatment of Low-grade Copper-ores in Australia: J. J. Muir.—The Tarkwa Gold field, West Africa: A. R. Sawyer.—Gold-dredging: T. Ross Burt.—Gold-dredging in Otago, New Zealand: F. W. Payne.—Electric Traction on Roads and Mineral Railways: W. R. Cooper.—The Analytical Valuation of Gas-coals: G. P. Lishman.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

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