THURSDAY, JUNE 29, 1905.

THE FACE OF THE EARTH.

The Face of the Earth (Das Antlitz der Erde). By Prof. Eduard Suess. Translated by Dr. H. B C. Sollas, under the direction of Prof. W. J. Sollas, F.R.S. Vol. i. Pp. xii+604; illustrated. (Oxford: Clarendon Press, 1904.) Price 25s. net.

ENGLISH-SPEAKING geologists will be grateful to Dr. Hertha Sollas and the Clarendon Press for this excellent translation of the first volume of the work which has probably had the deepest influence on geological thought since the publication of Lyell's "Principles." No higher compliment could be offered to such a book than that, twenty years after its publication, it should be worth while to issue a translation without amendment, comment, or other addition than the author's charming letter of introduction. This fact is all the more striking as this volume is mainly a description of the geology of the mountains of the world, and it describes areas of which comparatively little was known in 1884. As Prof. Suess remarks in his introduction, "the reader will meet here and there in the two first volumes with a description already antiquated." This matters the less since we have already an excellent French edition, which has been brought up to date by abundant references to recent literature, and been illustrated by an additional series of maps. The example of the French translators has not been followed, perhaps from the sentimental feeling that as this work is now one of the recognised classics of geology, it should be rendered into English exactly as it came from the hands of the master. This decision will no doubt increase the value of the Oxford edition to future geologists, though it may detract somewhat from its immediate educational usefulness. The absence of the extra maps is an especial drawback to British students, since many of the place-names used are synonyms or transliterations not usually adopted in British atlases. Anything that lessens the educational value of this edition is regrettable, as Suess's work is such magnificent educational material. Prof. Suess's method is to give the detailed evidence upon which he relies; and his readers have the pleasure of working up to the conclusions by the path the author trod. We see his mental process as well as read his results.

This volume opens with a brief statement of some of the geographical homologies which it is the object of the whole work to explain. Prof. Suess dismisses all geometrical plans of the earth, such as Elie de Beaumont's famous *Pentagonal reseau,* as misleading Wills-o'-the-wisp. He fully realises that the first essential to an explanation of the present distribution of oceans and continents is a competent comparison of the facts. As he says, a detailed comparison of observations is necessary before an attempt be made to formulate laws. Suess declines hints as to probabilities from geodesy, and he distrusts speculation as to the hidden parts of the earth. So he studies, with exquisite care, those deeper parts of the crust which have been brought to the surface in the exposed roots of mountains, or which are opened to view by the work of the miner. The two parts of this volume are devoted to a study of the movements in the crust of the earth, and to a description of the mountain system of the world, excluding Australia and some parts of other continents. Prof. Suess concludes from his synthetic study of this wide range of material that the earth's crust is disturbed by movements of two different kinds; firstly, the folding and crumpling of belts of the earth's crust by lateral pressure; and secondly, the foundering of the crust owing to the withdrawal of underground support, consequent on the radial contraction of the globe. Before Suess's time it was usual to regard the distribution of land and water as determined by the uplift as well as the sinking of wide regions. But according to Suess, regional uplifts have never yet been proved, and, excepting perhaps to some local extent, he regards them as impossible. An actual uplift of the surface of the western coast of South America was said to have resulted from the earthquakes of 1822 and 1835. The uplift of the latter was described by Darwin; but Prof. Suess discusses the evidence and dismisses it as wholly inadequate. Any horizontal uplift being, according to Suess, impossible where horizontal marine beds, beaches, or shore-lines occur above sea level, they must be explained by the lowering of the sea, and not by the uprise of the land. Prof. Suess does not hesitate to believe, on the evidence of the plateaus of the Rocky Mountains, that the sea level once stood 30,000 feet higher than at present. If Prof. Suess were to discuss the possibility of regional uplift at the present time, he would have to deal with much weightier evidence than any which he had against him in the year 1884. For the secular uplift of the lake regions of the United States is better established than any of the supposed earthquake elevations of Chili. Moreover, the doctrine of isostasy gives better reason to believe in its possibility. The pendulum work in the Rocky Mountains has rendered it at least possible, that isostasy may account for the horizontal deposits of the high plateaus, which Prof. Suess has described in one of the most brilliant chapters of this volume.

Regional uplifts, however, being dismissed by Prof. Suess, it follows that the main influence in shaping the continents has been the subsidence of wide tracts of the earth's surface beneath sea level. The great ocean basins, and those of the Mediterranean, the Black Sea, and the Caribbean Sea, represent sunken areas of the earth's crust; and foundering to a less depth has caused the rift valleys of Ethiopia, of the Rhine and of Australia, and the basins of Suabia and Franconia. The cause of such subsidences is deep-seated, whereas the crumpling of the long, narrow belts that form the folded mountain chains is due to comparatively superficial action. The two modes of movement may act in the same area at different times. Thus vertical subsidences may destroy the continuity of a folded mountain chain; thus the present form of the Basin Ranges of Utah and Nevada is due to the breaking up, by Cainozoic subsidences, of a series of ranges formed by earlier, post-Jurassic folds. Similarly the outlines of the continents, even when dependent upon the course of mountain chains, are embayed where the sea has flowed over foundered blocks. The vertical relief of the continents is determined mainly by subsidences, by the resistance of great blocks of strata which remain as plateaus high above the general level of the country, and by the crumpling of bands into mountain chains. The course of such crumpled bands is very sinuous, because they have to adapt themselves to the passive resistance of stronger blocks of the crust; they curve round the margins of the resistant masses, on to the edges of which they may be overthrust. Suess follows, for example, the course of the great Alpine mountain system from its western end in southern Spain, through the Atlas Mountains of Africa, along the the Apennines through Italy, across central Europe as the Alps and Carpathians, and then through the great curve around western Roumania and Servia into the Balkans. Its continuity eastward has been broken by the recent foundering of the Black Sea; but the Alpine system is continued through the Crimea and the Caucasus, and after another gap, caused by the subsidence that formed the southern basin of the Caspian, it is continued across Asia through the Himalaya and the chains of Burma into the islands of Malaysia. Suess explains the sinuous course of this folded band by tracing its dependence upon the unfolded blocks, against which it has been pressed.

The theory of the permanence of oceans and continents inevitably receives slight consideration from Prof. Suess. He does not trouble us with the *a priori* arguments on this question. He simply tells us the contemporary evidence as to the actual age of the continents. Thus he points out that in the Cretaceous period North America was not; but it had come into existence at the beginning of the Laramie period, and has lasted ever since. Similarly the Indian peninsula and Africa south of the Atlas are remnants of the Mesozoic plateau-continent of Gondwanaland, which has been severed into two by the foundering of the Indian Ocean in late Cainozoic times.

Consideration of Prof. Suess's work inevitably suggests a comparison with that of Lyell. Suessism is sometimes regarded as a rival school to Lyellism. But Suess's essential doctrines are a development of Lyell's views rather than being in direct opposition to them. Lyell, for instance, attacked the belief that volcanoes are craters of elevation; but, in the necessary darkness of the days before Sorby's ingenuity had rendered microscopic petrology possible, he retained his belief in an axis of elevation for the mountain chains. Suess has now taught us that the axes of elevation of mountain chains must follow von Buch's craters of elevation of volcanoes. Even in regard to what is sometimes considered as Prof. Suess's arch heresy—his acceptance of great variations in the ocean level—he is opposed to ultra-Lyellists and not to Lyell. The following passage from the "Principles" shows that, with Lyell, Ordnance Datum was not a fetish:—

"This opinion is, however, untenable; for the sinking down of the bed of the ocean is one of the means by which the gradual submersion of the land is prevented. The depth of the sea cannot be increased at any one point without a universal fall of the waters, nor can any partial depositions of sediment occur without the displacement of a quantity of water of equal volume, which will raise the sea, though in an imperceptible degree even to the antipodes. The preservation, therefore, of the dry land may sometimes be effected by the subsidence of part of the earth's crust (that part, namely, which is covered by the ocean), and in like manner an upheaving movement must often tend to destroy land; for if it renders the bed of the sea more shallow, it will displace a certain quantity of the water, and thus tend to submerge low tracts."

One chief difference between Suess and Lyell is that Lyell was naturally inclined to exaggerate the importance of local earth movements. Prof. Suess, with the benefit of a much wider knowledge than was possible to Lyell, and equal intellectual insight, realises that the geological systems are defined, not by independent local movements, but by changes that are world-wide in scope. Suess's views are not essentially opposed to the uniformity, which Lyell established, in opposition to the preceding belief in catastrophes of extraneous origin. Suess and Lyell both teach us that geological changes are due to causes that are still in action. Geographical evolution, like organic evolution, has not been interrupted by external influences or unnatural catastrophes; but it does not necessarily follow that the rate of progress has been uniform. There have been periods of geographical revolution due to a rush of movements, that relieved stresses produced by long periods of slow change. Such disturbances affect the whole world; and it appears probable that the correlation of strata in distant regions will depend on palæontology only for general homotaxis, and on the events of physical geology for the determination of exact synchronism.

A second difference between Lyell and Suess is that the former attached a, perhaps, exaggerated belief to the importance of denudation in modelling the surface of the globe. His own studies lay in lands wherein denudation has been more powerful than recent earth movements. The sub-title of his "Principles"—"the Modern Changes of the Earth and its Inhabitants Considered as Illustrative of Geology"—shows his point of view. He taught men that the common geographical features of Europe and Eastern America were due to the long-continued operation of slow and still active forces; but he did not fully realise that, elsewhere, the major geographical features are the direct expression of recent disturbances of the crust.

As to the cause of the distribution of these disturbances Prof. Suess has not yet given us his full explanation, and in this volume he rightly held such questions premature. But it is now possible, mainly thanks to his work, to trace one controlling factor in the existing plan of the earth—the alternation of periods of spheroidal recovery due to the earth's rotation, with periods of deformation due to the shrinking of the earth's internal mass. This factor promises the clue to the periodicity of geological events, to the general world-wide correspondence in the geological formations, and to the distribution of the folded bands and foundered blocks of the earth's crust.

J. W. G.

THE "N" RAYS.

A Collection of Papers communicated to the Academy of Sciences, with Additional Notes and Instructions for the Construction of Phosphorescent Screens. By Prof. R. Blondlot. Translated by J. Garcin. Pp. xii+83. (London: Longmans, Green and Co., 1905.) Price 3*s.* 6*d.* net.

THE *n*-rays, so called because the first announcement of their existence came from Nancy, have attracted the attention of physicists and physiologists all over the world; but the peculiarity about them is that the phenomena said to be produced by these rays when they fall on a slightly fluorescing screen have been observed chiefly in France by Prof. Blondlot and others of his school, while many experienced observers in Germany, America, and England have wholly failed to obtain a satisfactory demonstration even of their existence. The reason is that the so-called proof of their existence depends, not on objective phenomena that can be critically examined, but on a subjective impression on the mind of the experimenter, who sees, or imagines he sees, or imagines he does not see, a slight change in the degree of luminosity of a phosphorescing screen. It is true that, more than once, a photograph has been taken of such a screen supposed to be unaffected and contrasted with a photograph of the same screen when it was supposed to be affected by the rays, with the result that the patch of luminous surface appears to be a little brighter in the latter case than in the former. Even this photographic evidence, however, is unsatisfactory, as a slight difference in the time of exposure or in the method of development would readily account for the apparent contrast.

Yet, in this little book, we have a reprint of Prof. Blondlot's original papers, in which experimental evidence is adduced, with a wonderful appearance of accuracy in detail, of the polarisation of the rays, of their dispersion, of their wave-length, and of other physical phenomena attributed to them. Prof. Blondlot's experiments are well contrived, and they give every appearance of being arrangements by which accurate data should be obtained; but in every case the ultimate test is the subjective one made on the mind of the observer as to whether a spot of slightly phosphorescent surface becomes more luminous or not. The *n*-rays, according to Prof. Blondlot, are a new species of light, light, however, which only affects the retina with the aid of a fluorescent substance. They traverse many metals, black paper, wood, &c. They cannot pass through sheet lead, but they pass readily through aluminium. They influence not only a fluorescent substance, but the spark of an induction coil. They can be reflected from a polished glass surface or from a plate of polished silver. They have a kinship with well known radiations of a large wave-length. They exist in solar rays. Produced from an Auer burner they can be focused by a quartz lens; the lens itself may even become a source of *n*-rays.

Calcium sulphide can store up the rays, while aluminium, wood, dry or wet paper cannot do so. Ordinary light, when it falls on the retina, causes a more luminous sensation when accompanied by *n*-rays. Bits of wood, glass, rubber, &c., emit the rays when compressed. Bodies in molecular strain, like Rupert's drops, hardened steel, &c., emit the rays. An old knife, found in a Gallo-Roman tomb, equally with a new knife, sends out rays. There are other rays also, which must be called n_1-rays, which are emitted from a Nernst lamp. These diminish the glow of an induction spark. Ethylic ether, "when brought to a state of forced extension," emits the n_1-rays, &c.

To see all these wonderful phenomena the eye must be not only kept in the dark for a considerable time, but it must be specially trained. A. Broca states that in his own case it required practice for six weeks before he could see the effect of the rays. The eye must be adapted not only to darkness, but to very feeble light. The mind must be free, so as to concentrate itself on the observation to be made. These seem to be admirable arrangements for obtaining an illusive subjective impression! It is said that MM. d'Arsonval and Mascart have also observed some of the phenomena. Many other French observers, with less weighty names, have also been cited as witnesses. The general body of men of science are doubtful, as they cannot receive evidence of such a strangely subjective character, while not a few, and the writer places himself in this category, are of opinion that while they do not for a moment reflect on the *bona fides* of the French observers, they hold that these observers have been the subjects either of an illusion of the senses or a delusion of the mind.

JOHN G. MCKENDRICK.

THE SCIENCE OF EDUCATION.

School Teaching and School Reform. By Sir Oliver Lodge. Pp. viii+171. (London: Williams and Norgate, 1905.) Price 3*s.*

THE science of education is as yet rudimentary and ill-defined. So little has it developed, indeed, that many schoolmasters deny its existence. An art of education they recognise, and that they claim to practise. Teachers, it is urged, are born, not made, and professional training is useless. Yet it is the possibility of the future existence of a complete science of education which is the inspiring belief of the best modern educators. These teachers are now approaching the problems of the class-room and the difficulties of school organisation as subjects for investigation and experiment by scientific methods, and there is every reason for hopefulness in the results which have been obtained in recent years.

The formulation of the fundamental principles of a complete science of education will probably be the work of some great educationist as yet unborn, who will be able from the educational material at his command to extract the essentials and to weave them into living generalisations round which the science will crystallise into an orderly and harmonious whole To the elucidation of such a science many workers must contribute, and to ensure success men both familiar with science and aware of the difficulties with which teachers have to cope must lend their aid. It is for this reason we welcome these lectures by Sir Oliver Lodge, representing as they do the experience gained by a man of science in many departments of work.

The lectures range over a great variety of topics, and the subjects are presented with but little arrangement. But informal and disconnected though they are, the chapters will cause earnest teachers to reconsider their methods, and strenuously to strive after the improvements adumbrated. Sir Oliver Lodge rightly affirms that the two most important questions for educators to-day are, "What subjects should be selected for teaching?" and "How should they be taught?" But these are precisely the problems teachers have had to face since the Renascence, and we seem little nearer solutions than were the educators of three hundred years ago. A complete answer to the questions propounded will remain impossible until psychology has demonstrated the precise stages in the growth of the immature human intelligence and determined what instruction will assist best each step of such development. For psychology to accomplish this task many carefully planned experiments, carried out by practical teachers imbued with the scientific spirit, are necessary, and the results arrived at must be chronicled and subjected to the most searching criticism.

Mere expressions of opinion will not greatly assist the coming of the new science. What is wanted is investigation. If the man of science will cooperate with the practical schoolmaster, there is no reason why it should not be possible to answer the two vital questions re-stated by Sir Oliver Lodge. But it is imperative that we formulate, after exhaustive discussion, clearly defined problems to be put to the test of experience in schools, and that when we have agreed upon the results we act upon them. It is in this direction that the most fruitful work for education is to be done.

It is unnecessary to summarise the contents of the lectures before us. It is sufficient to say they touch upon the whole field of education. Sir Oliver Lodge is always suggestive, and his *obiter dicta* may be commended to the attention of men of science and school teachers alike. Of all the subjects calling for scientific study and research, the education of the young is the most important. This deserves pre-eminently to occupy the serious attention of all who desire the well being of the human race. A. T. S.

BRITISH BIRDS.

British Bird Life. By W. Percival Westell. Pp. xxxv+338. (London: T. Fisher Unwin, 1905.) Price 5*s*.

THE wearisome procession of books on British birds still drags on—a long train of volumes, all of necessity telling the same tale, and for the most part badly. The laboured apologies which most of these weaklings bring with them show, indeed, that their respective parents realise how slender is the chance of their finding favour even at the hands of a public proverbially long-suffering. Yet still they come.

The present volume endeavours to justify its existence on the plea that "there is need for a work *entirely devoted to those species which nest amongst us year by year* . . ."; and yet a number of species are included in this book which, on the author's own admission, do *not* breed with us year by year. Such are the Canada goose, little owl, golden oriole, hoopoe, and fire-crested wren. To these may be added the white-tailed eagle, spotted crake, roseate tern, and quail! On the other hand, there is reason to believe that the snow-bunting—included in this book—nests annually in Scotland, yet this fact is not even hinted at.

No more trustworthy are the author's statements as to "where our summer migrants spend the winter."

While we heartily agree with much that Mr. Westell has to say on the subject of the relentless persecution which of late years has been meted out to the birds of prey, we must protest against the hysterical notions of justice which he expresses in regard to a case wherein four men were fined thirty shillings apiece for taking a nest of young peregrines "A good dose of the cat," he contends, "or imprisonment without the option of a fine, would probably have had a better effect than a fine of a few shillings"!

As touching this same species, the author gravely assures us that falconry is "a very costly hobby, even the most ordinary Hawks used for falconry costing as much as 100*l*. apiece. They require the most careful attention, and it is difficult to get men qualified to take charge of them under a salary of, say 200*l*. a year."

The photograph purporting to be that of a sparrow hawk is really a picture of a kestrel.

At times Mr. Westell becomes ecstatic, and, blinded by the intensity of his emotions, rushes onwards regardless of obstacles—even of the rules of grammar—as witness the peroration which forms the concluding paragraph of his book:—

"For the good most birds do, for their cheery voices and winning ways, their charming forms and delicate colouring, their beautifully woven nests and exquisite eggs, their fairy-like flight, and other interesting characteristics, I appeal to my readers to study them with a bloodless intention, and to endeavour to learn practical lessons from their industry and devotion to their young; to study them as animate beings, and not as gazed upon as wretched caricatures of bird-life too often found in Museums and collections, and to endeavour to be of some service in specially inculcating and fostering within young and growing children an intelligent love for the bird life of our country"!!

This book is profusely illustrated, partly by photographs, some of which are very pleasing, and partly by "original" drawings, all of which are bad.

W. P. P.

OUR BOOK SHELF.

Riding and Driving. (American Sportsman's Library.) By E. L. Anderson and P. Collier. Pp. xiii+441; illustrated. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1905.) Price 8s. 6d. net.

IN almost all books on subjects connected with animals there is a growing tendency at the present day to introduce something concerning the natural history of the species under consideration. Too often in this country such remarks betray an insufficient knowledge of zoological science on the part of the writer, but this failing is seldom noticeable in American works. In the present volume, truth to say, there is some matter for criticism in Mr. Collier's remarks on the origin of the horse on p. 169, more especially in regard to the sense given to that much abused word "prehistoric." On the other hand, the author furnishes some very interesting information with regard to the early history of the European horse in America. In the first place he refuses to credit the theory that the horses seen by Cabot in La Plata in 1530 were indigenous. Secondly, he shows that the horses which have run wild in Mexico and South America are the descendants of Spanish barbs, and therefore of the same blood as the English thoroughbred. This is very important in view of a fact recently communicated to the present writer by Mr. Yearsley, the well known surgeon, namely, that an Argentine horse living some years ago had a functional "larmier," or tear-gland, on each side of the face.

To review the work before us from its own special point of view would obviously be out of place in this Journal, and it must therefore suffice to say that it appears, so far as we are capable of judging, to maintain the high standard of excellence set in the earlier volumes of the same series. Riding falls to the lot of the first-named of the two authors, while Mr. Collier is responsible for the section on driving. The numerous reproductions from photographs are almost life-like in their sharpness and definition, although it must be confessed that some of them do not convey by any means a pleasing idea of the manners and disposition of the American saddle-horse.

R. L.

Der Oeschinensee im Berner Oberland. By Max Groll. Pp. vi+78; illustrated. (Bern: Haller'sche Buchdruckerei, 1904.)

THIS pamphlet, an extract from the nineteenth volume of the Berne Geographical Society, is the result of a careful study of the Oeschinensee at intervals from 1901 to 1903. Nestling at the foot of the limestone precipices of the Blumlisalp group, about 5200 feet above sea-level, and reflecting like a mirror the snows of their highest peaks, its romantic beauty makes it a favourite resort of visitors to Kandersteg, on the northern side of the Gemmi Pass.

Herr Max Groll's memoir is a valuable contribution to physical geography. After some preliminary information about the position and surroundings of the lake, which lies roughly along the strike of Eocene and Cretaceous limestones, and about other matters of a topographical character, he describes its banks and basin, its dimensions and contents, its variations in level, the transparency, colour, and temperature of its waters, the amount of mud yearly deposited, and adds a note on the literature.

Of these topics, the form of its basin is, perhaps, of most general interest, and of that Herr Groll gives an excellent map and sections plotted from numerous soundings. Its dimensions, of course, vary somewhat with the season, the greatest length and breadth (in summer) being 1750 and 950 metres, when its greatest depth is 56.6 metres; in winter it is about 200 metres less one way and 100 metres the other, and shallower by 15 metres. Under the former conditions its cubical content is estimated to be forty million metres. Its bed deepens at first rather rapidly, a circular diagram of the progressive depth reminding us of an ordinary dinner plate. The ring in which the drop is from 0 to 50 metres is barely an inch wide; the radius of the remainder, which nowhere attains 57 metres, is almost an inch and a half, or, on a rough estimate, about half the lake bed is not less than 50 metres deep. The shallowing is rather more gentle on the western than on the eastern or Blumlisalp side. Near the middle part of this, the 50-metre contour comes rather near the cliffs, those less than 30 metres being closely crowded. This would be yet more conspicuous but for a fan of débris at the south-east angle. The lake, in fact, lies in a kind of corrie at the head of a mountain glen, and it is held up by a natural dam which has been formed by bergfalls from the rocky spurs about a mile below the cliffs at its head. Thus its history is to a considerable extent parallel with that of the Lago d'Alleghe, near Caprile, in the Dolomites.

Manual of the Trees of North America (exclusive of Mexico). By C. S. Sargent. Pp. xxiii+826. (Boston and New York: Houghton, Mifflin and Co., 1905.) Price 6 dollars.

THE manual under notice embodies the most recent, exhaustive, and detailed account of the trees of North America (exclusive of Mexico). It cannot fail to be of the greatest value to students of botany and forestry, as it brings into available form all the information concerning the trees of North America which has been gathered at the Arnold Arboretum during the last thirty years. As the author points out in the preface, there is probably no other region of equal extent where the indigenous trees are so well known as those of North America, but in spite of this fact much investigation yet remains to be done as regards their sylvicultural requirements, and also the diseases to which they may be liable.

The object of this volume is to stimulate further inquiry into the cultivation requirements and diseases of forest trees. The classification adopted is that of Engler and Prantl's "Die naturlichen Pflanzenfamilien." At the beginning of the book a synopsis of the families of the plants described is given. This is followed by a very useful analytical key to the families based on the arrangement and character of the leaves, which will enable the student readily to determine the family to which any North American tree belongs. In the text a full description of each family is given, and also a conspectus of the genera based on their more salient and easily made out contrasting differences. Under each genus a similar conspectus of the species is given by which the exact name of the tree may be finally determined.

The frontispiece consists of a map of North America showing the eight principal regions of arborescent vegetation, each of which is indicated by a letter, and in the conspectus above referred to a letter occurs after the name of each species, thus indicating the region in which the tree grows. This is a further aid in determining any given species provided the region from which it comes is already known.

A valuable feature of the book is the numerous illustrations, which number between six and seven hundred, from drawings by Mr. Faxon.

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.]*

Number of Strokes of the Brush in a Picture.

THE number of strokes of the paint brush that go to making a picture is of some scientific interest, so I venture to record two personal experiences. Some years ago I was painted by Graef, a well known German artist, when, finding it very tedious to sit doing nothing, I amused myself by counting the number of strokes per minute that he bestowed on the portrait. He was methodical, and it was easy to calculate their average number, and as I knew only too well the hours, and therefore the number of minutes, I sat to him, the product of the two numbers gave what I wanted to learn. It was 20,000. A year and a half ago I was again painted by the late lamented artist Charles Furse, whose method was totally different from that of Graef. He looked hard at me, mixing his colours the while, then, dashing at the portrait, made his dabs so fast that I had to estimate rather than count them. Proceeding as before, the result, to my great surprise, was the same, 20,000. Large as this number is, it is less than the number of stitches in an ordinary pair of knitted socks. In mine there are 100 rows to each 7 inches of length, and 102 stitches in each row at the widest part. Two such cylinders, each 7 inches long, would require 20,000 stitches, so the socks, though they are only approximately cylinders, but much more than 7 inches long, would require more than that number.

The following point impressed me strongly. Graef had a humorous phrase for the very last stage of his portrait, which was "painting the buttons." Thus, he said, "in five days' time I shall come to the buttons." Four days passed, and the hours and minutes of the last day, when he suddenly and joyfully exclaimed, "I am come to the buttons." I watched at first with amused surprise, followed by an admiration not far from awe. He poised his brush for a moment, made three rapid twists with it, and three well painted buttons were thereby created. The rule of three seemed to show that if so much could be done with three strokes, what an enormous amount of skilled work must go to the painting of a portrait which required 20,000 of them. At the same time, it made me wonder whether painters had mastered the art of getting the maximum result from their labour. I make this remark as a confessed Philistine. Anyhow, I hope that future sitters will beguile their tedium in the same way that I did, and tell the results.

F. G.

The Hydrometer as a Seismometer.

A SHORT time ago (NATURE, May 25) I directed attention to a misconception which seemed to prevail among seismologists as to the behaviour of a spirit-level. It may perhaps be useful to point out another fallacy, also of an elementary hydromechanical nature, involved in some of the unsuccessful attempts to record vertical motion.

It was first proposed by Dr. Wagener, we read,[1] to record vertical disturbance by means of a floating buoy free to rise and fall in a vessel of water. The buoy was to provide a steady point when the vessel suffered a vertical disturbance. The device was improved, we are told, by Prof. Thomas Gray, who gave the buoy the form of a hydrometer with only a slender stem projecting above the surface of the water. Prof. Milne experimented with both forms; but even with the hydrometer form, adjusted to a state of the most sluggish stability, several earthquakes left no record of vertical motion. The instrument was abandoned as not sufficiently powerful to be self-registering.

But the theory involved in these attempts is entirely fallacious. Any body, be it buoy or hydrometer, floating in liquid, suffers no displacement whatever relatively to the liquid when the containing vessel is moved vertically. The whole moves as one rigid system. More generally, it may be claimed that any system which is in statical equilibrium, and which would remain undisturbed despite a change in the value of gravity, may suffer a vertical displacement of its supports without any relative disturbance of its parts. The whole of such a system moves as if rigid when displaced vertically. Of such a kind is the hydrometer floating in the vessel filled with liquid; of the same kind, also, is a common balance with equal weights in the two scale-pans. These two systems present a true dynamical analogy, and are equally useless for detecting vertical disturbance. A spring supporting a load, on the other hand, or any form of apparatus the potential energy of which is partly elastic, is not of this class, and is available as a seismometer for vertical motion. It would seem as though a false analogy between the hydrometer and the spring balance had led to the fallacy in question.

The spirit-level (if my previous contention is conceded) is sensitive alike to each of two kinds of disturbance between which it was expected to discriminate. The hydrometer, on the other hand, is insensitive to the very disturbance which it was designed to record. The freezing of the water, indeed (contemplated as an inconvenient contingency with the proposed instrument), would, very precisely, make no difference at all in its behaviour. The instrument has, it is true, been long superseded; but the false principle involved remains as a source of grave confusion for the unwary reader of seismological writings.

It may be remarked that violent earthquakes have been known to damage the rigging of ships in a neighbouring harbour, and to jerk guns from the decks, without any visible movement of the water. Assuming the correctness of the view now urged, a sudden alteration of sea-level would completely account for this. The ship is not in any way spring-borne for such a displacement, but may be subjected to a vertical impulse of any degree of severity.

It should be added, also, that a severe shock of earthquake is credited[1] with having disturbed a hydrometer instrument to the extent of 1·1 mm. If the onus of explanation rests with me, I can only suggest that the effect (if really caused by vertical motion at all) may perhaps have been due to the elasticity of the walls of the containing vessel or of the hydrometer.

G. T. BENNETT.

Emmanuel College, Cambridge.

[1] Milne, "Earthquakes," p. 33; Milne, "Seismology," p. 65; *Trans. Seismological Soc. of Japan*, vol. i., p. 70, vol. iii., p. 54.

[1] *Trans. Seismological Soc. of Japan*, vol. iii., p. 55.

The Pressure of Radiation on a Clear Glass Vane.

IN an article on "The Elimination of Gas Action in Experiments on Light Pressure," read before the American Physical Society in December, 1904, and published in the *Physical Review*, May, the writer made the following statement:—"A thin vane of clear glass, accurately vertical and mounted radially, may be used to advantage to demonstrate light pressure. If the light has been filtered through several thicknesses of glass there will be but little absorption by the thin vane and its two surfaces will be warmed nearly equally. Consequently the radiometric effect will be small. The reflection of the radiation at the two surfaces will make a difference of about 16 per cent. between the energy in front of and behind the vane. Hence the light pressure will be about one-sixth of that due to the same light beam falling upon a black surface. The throws for such a vane had only about a ten per cent. variation in a range of air pressures from about 10 mm. to 200 mm. of mercury."

Although a large number of observations had been taken on both clear glass and silvered glass vanes, the data were not published at that time. It was then felt that the elimination of gas action was the important point, and the final statement in the paragraph quoted, that the throws for such a vane had only a 10 per cent. variation in a range of air pressures from about 10 mm. to 200 mm. of mercury, was considered sufficient experimental evidence that gas action had been eliminated.

Since this paper appeared, the writer has learned that there is a difference of views among mathematical physicists concerning the pressure of radiation on a non-absorbing medium. On this account he has gathered together the original data in order to compare the light pressure upon a vane of clear glass with that upon a silvered surface.

The experiment may be here recalled. A torsion balance carrying a thin vertical glass vane, 14×10×0·1 mm., silvered on one side, was suspended in a bell jar, and the air was pumped out until the pressure was about 40 mm. of mercury. A beam of light was thrown upon this vane at a definite distance from the rotation axis, and by turns on each side of it. The deflections were read by a telescope and scale. A Nernst lamp was used as a source, the intensity being given by a precision wattmeter. The balance was then turned through 180° by the rotation of the external control magnet, and readings were again taken. The mean was proportional to the pressure of the incident and reflected beam. The mean reflection coefficient of air-silver and air-glass-silver for the radiation used has been found to be 85 per cent. The pressure, according to Maxwell's theory, should therefore be 1·85 times that due to the incident beam. The throw obtained (containing certainly less than 1 per cent. of gas action) was 22·8 divisions. Hence the pressure of the standard beam upon a black surface would be 22·8 ÷ 1·85 or 12·4.

The balance was then taken from the bell jar, the silver removed from the vane, and the glass surface cleaned. The balance was then replaced, and the air pumped out as before. The deflections were small, only about 2 mm., and therefore could not be read to a greater accuracy than 5 per cent. The throw obtained for standard lamp was 2·1 divisions (the mean of forty observations at four different air pressures).

The normal reflection coefficient of glass ($\mu = 1{\cdot}52$) for this kind of radiation is 4·1 per cent. The amount reflected from the two surfaces is approximately 8·2 per cent. Hence the energy per unit volume in front of the glass is about 1·082 times that of the incident beam, and that behind the vane (since the absorption is negligible) is 0·918 times that of the incident beam. The former quantity is greater than the latter by 16·4 per cent. of the energy of the incident beam. Assuming that the pressures on the front and back surfaces of the glass are proportional to the energies per unit volume, the pressure of the standard beam upon a black surface would be 2·1 ÷ 0·164 or 12·7. The agreement between this result and the similar result obtained from the silvered surface shows that light passing through a plate of glass exerts pressures upon the surfaces equal to the difference between the energies per unit volume in front of and behind these surfaces.

GORDON F. HULL.

Dartmouth College, Hanover, N.H., U.S.A.

The Habits of Testacella.

UNTIL reading Mr. Latter's letter in this week's NATURE I was unaware that it was not a matter of common knowledge that Testacella appears on the surface during heavy rains. My garden is liable to be flooded, as also, unhappily, is much of this neighbourhood, in spring and late autumn. After the water has stood for a few days the ground is covered by hundreds of these slugs, which leave their burrows and try to find dry quarters. They can survive, however, a week's immersion. In June, 1903, when much of the Thames valley was flooded, I collected a number of these slugs for various malacological friends. In normal circumstances they live at such a depth as never to be unearthed during garden operations.

Eton College, Windsor. M. D. HILL.

NATURE AND MAN.

PROF. LANKESTER in his Romanes lecture began by a statement of the theory of evolution, directing attention to unwarranted inferences commonly drawn by clever writers unacquainted with the study of nature. He described how the change in the character of the struggle for existence, possibly in the Lower Miocene period, which favoured an increase in the size of the brain in the great mammals and the horse, probably became most important in the development of man. The progress of man cut him off from the general operation of the law of natural selection as it had worked until he appeared, and he acquired knowledge, reason, self-consciousness, and will, so that "survival of the fittest," when applied to man, came to have a meaning quite different from what it had when applied to other creatures. Thus man can control nature, and the "nature-searchers," the founders of the Royal Society and their followers, have placed boundless power in the hands of mankind, and enabled man to arrive at spiritual emancipation and freedom of thought. But the leaders of human activity at present still attach little or no importance to the study of nature. They ignore the penalties that rebellious man must pay if he fails to continue his study and acquire greater and greater control of nature.

Prof. Lankester did not dwell upon the possible material loss to our Empire which may result from neglect of natural science; he looks at the matter as a citizen of the world, as a man who sees that within some time, it may be only 100 years, it may be 500 years, man must solve many new problems if he is to continue his progress and avert a return to nature's terrible method of selecting the fittest. It seems to us that this aspect of the question has never been fully dealt with before. Throughout Huxley's later writings the certainty of a return to nature's method is always to be felt. Prof. Lankester has faith in man's power to solve those problems that seem now to be insoluble, and surely he is right.

The dangerous delay now so evident is due to the want of nature knowledge in the general population, so that the responsible administrators of Government are suffered to remain ignorant of their duties. Prof. Lankester shows that it is peculiarly in the power of such universities as Oxford and Cambridge, which are greatly free from Government control, to establish a quite different state of things from that which now obtains in England. He says:—"The world has seen with admiration and astonishment the entire people of Japan follow the example of its governing class in the almost sudden adoption of the knowledge and control of Nature as the purpose of national education and the guide of State administration. It is possible that in a less rapid and startling manner our old Universities may, at no distant date, influence the intellectual life of the more fortunate of our fellow citizens, and consequently of the entire community." Considering Oxford more particularly, and speaking for others as well as himself, he says:—"The University of Oxford by its present action in regard to the choice and direction of subjects of study is exercising an injurious influence upon the education of the country, and especially upon the education of those who will hereafter occupy positions of influence, and will largely determine both the action of the State and the education and opinions of those who will in turn succeed them." As to Greek and Latin studies, he says:—"We have come to the conclusion that this form of education is a mistaken and injurious one. We desire to make the chief subject of education both in school and in college a knowledge of Nature as set forth in the sciences which are spoken of as physics, chemistry, geology and biology. We think that all education should consist in the first place of this kind of knowledge, on account of its commanding importance both to the individual and to the community. We think that every man of even a moderate amount of education should have acquired a sufficient knowledge of these subjects to enable him at any rate to appreciate their value, and to take an interest in their progress and application to human life." He points out that it is only in the last hundred years that the dogma of compulsory Greek and the value of what is now called a classical education has been promulgated. Previously, Latin was learnt because all the results of the studies of natural philosophers were in that language.

It is evident that Prof. Lankester includes in his study of nature the study of intellectual and emotional man through history, biography, novels, and poetry, but we think that he made a tactical mistake when he neglected to state this clearly. It seems to us that besides the study of nature, the most important thing in a child's education is to make him fond of reading in his own language, for this leads to a future power to make use of books and self-education for the rest of his life. When Prof. Lankester doubts the value of the study of history he is evidently doubting the value of that study as carried on at Oxford, and surely no person who has read the scathing criticism of Prof. Firth will disagree with him. When he speaks of a reform being possible, it may be that he is taking into account a movement of which but little is known outside Oxford itself, the growing indignation of the average undergraduate at being made to pay extravagant sums of money for tuition which is mischievous.

The readers of NATURE are well acquainted with the views put forward in this address. Huxley and many others, dwelling, perhaps, more upon material loss to our Empire, have published them over and over again, but we do not think that anybody has ever presented them with so much grace of style or so much of an endeavour to secure the goodwill of his audience as Prof. Lankester. But, alas! we fear that this fine address will share the fate of many others!

When, thirty-three years ago, Japan began her new career, there were a few people like Ito clever enough to see and say that the study of ancient classics alone, to the neglect of the study of nature, meant ruin to the country; but such ideas would never have been adopted had not Japan been in deadly peril. All the nations of Europe bullied and insulted her, and it was only their mutual jealousies which saved her from complete subjugation. In the presence of that peril the pedants held their peace, and everybody saw the necessity for an immediate, radical reform. In time nature was studied by every child in Japan, and in consequence scientific methods of thinking and acting have permeated the whole nation. All ancient and modern European literature is open to the Japanese who knows English, and English is the one language other than Japanese which every cultured man must know. In the matter of self-protection, anyone can see the result. Because the Japanese have studied nature their scientific officers and men have marched or sailed to victory in every engagement; their statesmen will do exactly what is best for Japan in the negotiations for peace; their country will quietly take its place as one of the first-class Powers of the world, and every person who knows anything about Japan is quite sure that ambitious, wrong-headed schemes of conquest are altogether impossible to the scientific minds of the Japanese.

If Japan had not been in great danger we know that she would not have taken to nature-study, and some of us think that it may need a state of danger in England to produce the necessary desire for reform. The South African muddle was worried through, and almost everybody seems to think that all such muddles may also be worried through, but some of us think that we may not always be so lucky. Danger is close enough even now, and we can only hope that if it becomes great it may grow slowly enough to let us learn something from the object lesson which is being given us day by day in the news from Russia and the Far East.

Fain would we hope that Oxford will pay attention to what has been said by one whom some of us regard as her cleverest son; but, alas! we have no such hope. Oh, Shade of Clough, how can we help saying that "the struggle nought availeth" when your own best admirers seem unable to think for themselves?

JOHN PERRY.

A LIFE'S WORK IN THE THEORY OF EVOLUTION.[1]

IN this elaborate and carefully written treatise the veteran biologist of Freiburg has brought together and presented in connected form the fruit of his life-long investigation of the principles and methods of organic evolution. It would be an easy matter to show—indeed, the author admits as much with perfect candour—that his present standpoint differs in many important respects from that adopted by him at former periods of his career. The fact that Weismann has more than once shifted his ground has often been brought against him as a kind of reproach—we think with scant justice; for in a subject like the present, where new facts come crowding upon us almost daily, it is unreasonable to expect that a far-reaching theory should at once attain finality. If the author of such a theory should be willing to recognise that some parts of it become untenable and others require modification in the light of fresh discoveries, this should be reckoned to his credit rather than otherwise. The practice of putting forward ill-considered and hasty views deserves severe condemnation; but it is characteristic of our author that even his boldest speculations rest for the most part on a basis of observed fact, and that he has always honestly striven to render his theory consistent both with itself and also with the new facts that have from time to time come under the observation of other investigators. Moreover, his plan of, so to speak, taking the scientific world into his confidence, and enabling his colleagues to follow the workings of his own mind, has not only added greatly to the interest of his contribution to the biological thought of our time, but has acted also as a powerful stimulus to fellow-workers in the same field. So much may fairly be said, whether his final conclusions meet with general acceptance or the reverse.

The first eleven chapters of the present book traverse familiar ground. Starting with a brief historical account of evolutionary theory up to and including the work of Darwin and Wallace, they proceed to a more detailed discussion of such branches of the subject as the coloration of animals, mimicry, instinct, symbiosis, protective adaptations in plants, the origin of flowers, and sexual selection. These are well-worn topics, but their treatment is interesting and by no means trite. Next comes a discussion of Roux's suggestion of the "Kampf der Theile" which strikes us as somewhat of an excrescence on the general structure of the treatise. The existence of a metabolic response to functional stimulus is undeniable, but we do not think that either Roux or Weismann has plumbed the matter to the bottom, and the latter author's use of the term "selection" in this connection appears to involve some overstrain of language.

[1] "Vorträge über Deszendenztheorie gehalten an der Universität zu Freiburg im Breisgau." By Prof. August Weismann. Second revised edition. 2 vols. Pp. xii + 340; vi + 344. (Jena: Gustav Fischer, 1904.) Price 10 marks.

"The Evolution Theory." By Prof. August Weismann. Translated with the author's co-operation by Prof. J. Arthur Thomson and Margaret R. Thomson. 2 vols. Pp. xvi + 416; iv + 405; illustrated. (London: Edward Arnold, 1904.) Price 32*s*. net

Chapters on reproduction and the process of fertilisation in both unicellular and multicellular organisms lead us on to a copious exposition of the author's theory of the germ-plasm and its constitution, with the building up of the assumed ultimate vital units or "biophors" into the successive complexes of "determinants," "ids," and "idants." After a discussion of the facts brought to light by the labours of the "Entwicklungsmechanik" school, and a fairly full notice of recent work on regeneration in its relation to the germ-plasm hypothesis, we come to what is in many respects the strongest part of the book, the refutation, namely, of the Lamarckian view of the transmissibility of functional modifications. Here Weismann has always been at his best, and to him undoubtedly belongs the credit of having awakened and sustained so fresh and vigorous a body of opinion in reference to this point as virtually to have created one of the most important epochs in the history of evolutionary doctrine. The two next chapters deal with the author's hypothesis of "germinal selection," as to which it may be sufficient to remark that, however ingenious and interesting the theory may be as an attempt to explain the chief phenomena of variation, it is as yet far from having reached the stage of verification. In the succeeding chapters, which deal with inbreeding, parthenogenesis, and reproduction, both sexual and asexual, it is interesting to observe that Weismann has considerably modified his standpoint with reference to amphimixis, his present view approximating in some degree to that advanced several years ago by Haycraft. This section is preceded by a discussion of the "biogenetic law" of Haeckel, and is followed up by chapters on the influence of the environment and of isolation in the formation of the specific type, together with the various causes of extinction.

The book concludes with some theoretical considerations on the subject of spontaneous generation, and a final vindication of the principle of selection, the dominance of which principle over all the categories of vital units may be taken as the key-note of the entire treatise.

It will be seen that the ground covered by this work is very extensive. Though most of the topics dealt with are considered by the author chiefly or solely with an eye to his theory, his treatment never lacks interest, and the result is worthy of his high reputation. There are some points as to which we should have welcomed a more thorough discussion, and others on which we confess to remaining unconvinced for reasons *quas nunc perscribere longum est*; but it would be ungrateful not to acknowledge to the full the immense services rendered to biological science by the stimulating labours in the domain both of theory and practice of which this book is a monument.

The illustrations are for the most part excellent. Of the two here reproduced, the first serves to illustrate the basis of one of the chief arguments brought forward by Weismann, as also by Strasburger and O. Hertwig, in favour of regarding the nuclear chromatin as the true hereditary substance, viz. the numerical equality of the chromosomes and the disparity in amount of the cell-protoplasm in the generative products of the two sexes. The second (from Fischer) supplies evidence of the possibility of certain external conditions, in this case temperature, influencing the germ-plasm even while contained within the body of the parent.

We have little space left for detailed criticism, but must point out that by some unaccountable oversight the letterpress of plates i. and ii. contains several serious errors—patent at once to the trained entomologist, but calculated to mislead the general reader. These mistakes appear uncorrected in the English translation, where also, as if to make confusion worse confounded, "die folgende Art" (plate ii., Fig. 20) is rendered "the *foregoing* species." Fortunately, however, the lapses in question are not of a nature to impair the value of the argument which the figures are meant to illustrate.

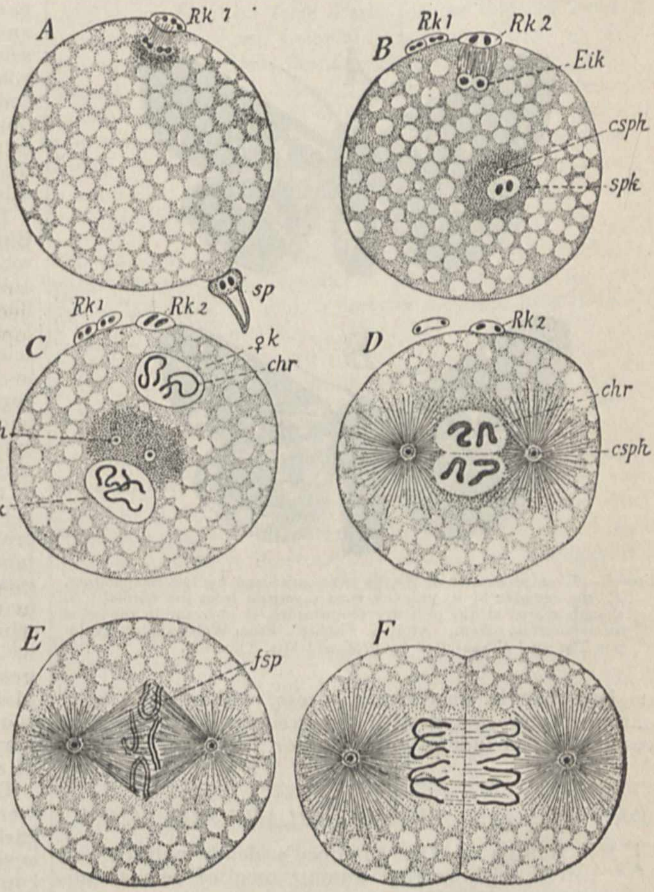

FIG. 1.—Process of fertilisation in *Ascaris megalocephala*. *Rk* 1, *Rk* 2, first and second polar body; *sp*, spermatozoon with two chromosomes, a protrusion of the egg-protoplasm is meeting it; *Eik*, reduced nucleus of the ovum; *spk*, nucleus of spermatozoon; ♂ *k*, ♀ *k*, sperm nucleus and ovum nucleus, each with two chromosomes (*chr*); only the male nucleus has a centrosphere (*csph*), which in *C* has already divided into two; *fsp*, segmentation spindle. From Weismann's "Evolution Theory." Translated by Prof. and Mrs. Thomson.

Other slips in the translation are plainly due to the fact that the translators are unfamiliar with portions of the subject-matter, as in vol. ii., p. 348, where the point of the argument is blunted by the rendering of "Nachtfalter" as "butterfly"; such imperfections, though they should be remedied in a new edition, are of little real importance. More serious is a mistranslation, or perhaps a misprint (vol. i., p. 290) by which the words of the original, "in welchem die eigentliche Chromatinsubstanz nur in vielfacher Zertheilung enthalten ist," are perverted into a statement which is almost grotesquely incorrect.

Again, on p. 304 of the same volume, an entirely wrong meaning is given to a sentence by the failure of the translators to make it clear that "wenn es nothwendig wäre" must refer, not to "fertilisation," but to the "limitation of polar divisions." On p. 136 (vol. ii.) the sense of the original is obscured by the inadequate rendering of "dann" as the enclitic "then." *Chaerocampa* (for *Choerocampa*) is found in the original; the translators, however, are responsible for "Cœnogenesis."

But in spite of these and other blemishes of a like nature, the translators are to be congratulated on having performed their difficult task with skill and success, the result being a work which, in its English

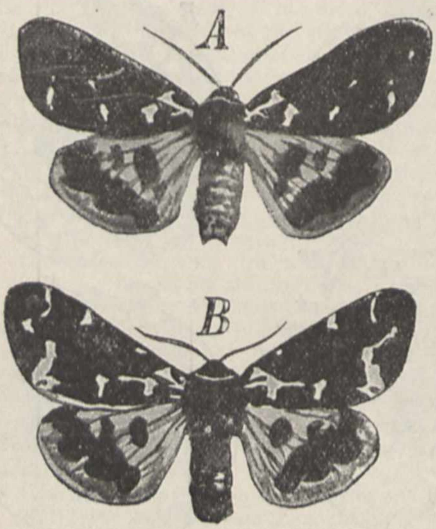

FIG. 2.—*A*, an aberration of *Arctia caja*, produced by low temperature. *B*, the member of its progeny most divergent from the normal. *B*, though reared at the ordinary temperature, is aberrant in the same direction as its parent. After E. Fischer. From Weismann's "Evolution Theory." Translated by Prof. and Mrs. Thomson.

no less than in its German dress, will be read with extreme interest and with the greatest sympathy and respect for its indefatigable author. F. A. D.

DR. WILLIAM THOMAS BLANFORD, F.R.S.

THE tidings of Dr. Blanford's death will be received with sorrow among men of science all over the world. His many-sided accomplishments had given him a notable place among geologists, geographers, palæontologists, and zoologists, and his gentle, kindly, unassuming nature had gained him an abiding place in the affectionate regard of all who came to be associated with him. Born on October 7, 1832, in London, he early developed a taste for scientific pursuits, and was accordingly sent to the Royal School of Mines, Jermyn Street, where he distinguished himself as a student, under De la Beche, Playfair, Edward Forbes, Ramsay, Smyth, and Percy. From London he passed to the famous mining academy at Freiberg. Having thus obtained an excellent training, he was, in 1855, appointed to the Geological Survey of India under its founder, Thomas Oldham. For some twenty-seven years he continued to devote his energies to Indian geology, making wide acquaintance with the rocks and scenery of the great Dependency, and enriching the publications of the Survey with maps and descriptive memoirs. Had he chosen to remain longer in the service, he would soon have been placed at its head; but in 1882 he resolved to retire on the pension which he had well earned, and to establish himself in London. Among the great services which he rendered to science during his stay in India, perhaps the most important was the preparation, in concert with his colleague, H. B. Medlicott, of a "Manual of the Geology of India." This invaluable treatise gave for the first time a succinct general view of the geological structure and history of the whole country. It has taken its place as one of the classic text-books of the science.

While attached to the Indian Survey, Dr. Blanford's proved ability led to his being employed in several missions or expeditions. Thus when, in 1867, preparations were made in India for the dispatch of an armed force against Theodore of Abyssinia, he was selected as geologist to accompany the Army. The wisdom of this selection was well proved by the excellent volume in which he gave the results of his observations during the march to Magdala and the return to the coast. Again, in 1872, he accompanied the Persian Boundary Commission, and his notes of this journey were embodied in another valuable book.

During his travels in India and beyond it, Dr. Blanford did not confine himself to the study of the rocks, but always kept a keen eye on the wild animals of each region. His published journals showed him to be as capable a zoologist as he was a geologist. Indeed, during the later years of his life his main scientific work lay amidst the fauna of British India, in regard to which his published memoirs were recognised as the chief authority on the subject. His wide experience as a traveller over the surface of the earth likewise enlisted his sympathies with geographical exploration, and made him a valued member of the council of the Royal Geographical Society.

In his writings there is often a suggestiveness or prescience that shows how keen was his insight, how far-reaching his grasp of scientific problems, more especially of those in which questions of zoology and geology were intermingled. Some of his papers in which he unfolded his views on these subjects are well deserving of attentive study. His address to the geological section of the British Association at the Montreal meeting in 1884, and his presidential discourses to the Geological Society in 1889 and 1890, may be cited as examples of his characteristic manner of treatment.

Dr. Blanford's high qualities as a man of science were fully recognised by his contemporaries. He was early elected into several of our leading scientific societies, and was chosen as a member of their councils. He received the Wollaston medal of the Geological Society and a Royal medal of the Royal Society. A few years ago, in recognition of his services to Indian science, he was made a Companion of the Order of the Indian Empire. Up to the end he continued to interest himself in the affairs of the societies with which he was connected. For years he had been treasurer of the Geological Society, and he attended the council meetings to within a few weeks before his death. His colleagues at the council board then saw with regret that his health was obviously failing, but they did not anticipate that they were never again to see his familiar face among them. A few weeks ago he was asked by the council of the Royal Society to write for them an obituary notice of his old friend and colleague, Medlicott, who had recently died. He complied with this request, and it proved to be his last piece of work. The printed proofs of his manuscript were sent to him, but before they could reach him he had become too ill to look at them. After a short illness he passed away on the morning of Friday, June 23, in the seventy-third year of his age. He was laid to rest on Tuesday last in Highgate Cemetery, every society with which he was associated sending representatives to his funeral, while among the mourners were some of his old colleagues in India.

A. G.

NOTES.

THE Civil List Pensions granted during the year ended March 31 show more generous recognition of the claims of science than has usually been the case. The list includes the following pensions:—1904, August 8.—Mr. W. F. Denning, in consideration of his services to the science of astronomy, 150*l*. August 8.—Miss Elizabeth Parker, in recognition of the services rendered to science as an investigator by her late father, Mr. W. Kitchen Parker, F.R.S., 100*l*. August 8.—Lady Le Neve Foster, in consideration of the services rendered to mining science by her late husband, Sir Clement Le Neve Foster, F.R.S., and of the fact that his death was due to the effects of poisoning by carbonic oxide gas while carrying out his official duties, 100*l*. 1905, January 17.—Dr. J. G. Frazer, in recognition of his literary merits and of his anthropological studies, 200*l*. March 22.—The Rev. Lorimer Fison, in recognition of the originality and importance of his researches in Australian and Fijian ethnology, 150*l*. March 22.—Dr. W. Cramond, in consideration of his antiquarian researches, more particularly in connection with the ecclesiastical and burghal history of Scotland, 80*l*. March 22.—Miss L. C. Watts and Miss E. S. Watts, in recognition of the services of their late father, Mr. Henry Watts, to chemistry, 75*l*. It is satisfactory to record these tributes of national regard for lives devoted to the advancement of knowledge; and we congratulate the Government upon the great improvement which this year's list shows as regards the acknowledgment of the services rendered to the State by scientific workers.

WE regret to learn that Prof. von Tomek, president of the Imperial Bohemian Academy of Sciences at Prague, died on June 12 in the eighty-eighth year of his age.

SIR JOHN WOLFE BARRY, K.C.B., F.R.S., has been elected to succeed the late Mr. James Mansergh, F.R.S., as chairman of the Engineering Standards Committee.

THE annual conversazione of the Society of Arts will be held in the gardens of the Royal Botanic Society, Regent's Park, on Tuesday next, July 4.

THE International Institute of Sociology has accepted the invitation of the Sociological Society to hold its next congress in London in the summer of 1906. A general committee has been appointed to promote the success of the congress. Lord Avebury is the chairman of the committee, and Mr. David Mair the secretary for the time being.

THE Guy medal in silver has been awarded by the Royal Statistical Society to Mr. R. Henry Rew for his work in connection with the preparation of the reports of the special committee appointed by the society to investigate the production and consumption of meat and milk in the United Kingdom, and for his paper entitled "Observations on the Production of Meat and Dairy Products."

AMONG those who lost their lives in the railway disaster at Mentor, Ohio, on June 21 was Mr. Archibald P. Head, a brilliant young engineer and senior partner in the firm of Messrs. Jeremiah Head and Sons, of Westminster. Mr. Head was the author of several valuable papers on mining and metallurgy contributed to the Institution of Civil Engineers, the Iron and Steel Institute, and the Society of Arts.

IT is announced in the *Times* that the Board of Trade and the Trinity House have concluded a contract with Marconi's Wireless Telegraph Company (Limited) providing for the equipment of lightships with Marconi wireless telegraph installations. This arrangement will enable the lightships to communicate with the shore and with one another by wireless telegraphy for the ordinary purposes of the lightship service, and also to report ships in distress.

A REUTER telegram from Paris reports that an International Congress on Colonial Agriculture was opened there on June 22, Great Britain, Holland, Germany, Italy, Portugal, the United States, Mexico, and Brazil being represented. The members of the congress decided to form an international committee for the study of all questions relating to agricultural science and colonial industries. An organising committee, with headquarters in Paris, under the chairmanship of M. de Lanessan, has been formed.

TOWARD the close of the fourth International Ornithological Congress, an account of which appeared in our issue of last week (p. 177), a party of members paid a visit on June 20 to Cambridge. They were received by Prof. Newton, who had arranged several exhibits for the benefit of the visitors. These included a case of great auks' eggs and a selection of letters, papers, and books from Prof. Newton's library. A catalogue of these documents and books, some of them belonging to the fifteenth century, was distributed among the visitors, as was a leaflet on Legaut's giant bird by Prof. Newton explaining its origin and species. A pamphlet by Dr. Gadow on the effects of insularity, illustrated by birds of (*a*) Madagascar and Mascarene Islands, and (*b*) the Sandwich Islands, was also circulated to explain the exhibits arranged in the lecture room of comparative anatomy. A visit to the museums having been concluded, a dinner was given to Prof. Newton in the hall of Magdalene, after which Dr. Fatio in a cordial speech referred to Prof. Newton as "the father of ornithology." The congress concluded on June 21 with a visit to Flamborough Head.

DR. J. CHARCOT gave an account of his expedition to Antarctic regions before the Royal Geographical Society on Monday. The general programme of the expedition was to survey the north-west coast of the Palmer Archipelago (Hoseason, Liége, Brabant, and the Antwerp Islands); to study the south-west entrance to the Gerlache Strait, wintering as far south as was practicable, to make excursions in spring, and in summer to continue the exploration of Graham Land, with the view of elucidating the Bismarck Strait, and follow the coast as far as Alexander I. Land; in a word, to continue the labours of the Gerlache and Nordenskjöld expeditions. The expedition left Buenos Ayres in the *Français* (245 tons) on December 23, 1903, reached Smith Island (South Shetlands) on February 1, 1904, and after coasting for a few weeks was compelled by ice to return to Wandel Island, where it wintered. The temperature varied much and suddenly; the lowest was $-30°.4$ F., but a rise from $-22°$ F. to $+26°.6$ F. in a few hours was not uncommon, and was always followed by violent gales from the north-east, which broke up the ice between Wandel and Hovgaard Islands, and so prevented any move being made, in spite of many efforts. In December, 1904, a channel was made, and the *Français* returned to Wincke Island, which had been visited before the winter set in. In January the vessel was turned north again past the Biscoe Islands, the expedition completing its survey as it went, and finally reached Puerto Madryn on March 4. Dr. Charcot expressed himself thoroughly satisfied with the results of the work of the expedition in hydrography, astronomy, biology, the measurement of tides, the analysis of colour and density of sea-water, and gravity, which was measured by means of one of M. Bouquet de la Grye's comparison pendulums. The exterior contour of the Biscoe Islands has been fixed and their breadth determined; the survey of the exterior coasts of the Palmer Archipelago completes the geography of that region, and the bearings of Alexander I. Land have been found by astronomical observation.

The International Congress of Mining and Metallurgy at Liége, which began on June 25, and will continue until July 2, is proving a most successful gathering. Nearly fifteen hundred members have registered, and an attractive programme of papers, visits and excursions, and social functions has been arranged. Mr. Alfred Habets was elected president, and the official representatives nominated by seventeen foreign Governments were elected honorary presidents. Great Britain, though not included in this list, was represented by a strong contingent of members of the Iron and Steel Institute, and by a number of leading mining engineers. The congress was divided into four sections, dealing respectively with mining, metallurgy, applied geology, and mechanics. In the metallurgical section the first paper read was by Mr. R. A. Hadfield, who gave an account of his recent investigations of the properties of steel at the temperature of liquid air. Papers were also read on the influence of arsenic and titanium on pig iron, on the use of coals poor in agglutinating material for the manufacture of coke, and on the cutting of metals by oxygen. In the mining section several papers on shaft-sinking were read, and in the applied geology section attention was chiefly devoted to the recent coal discoveries in the north of Belgium.

We regret to see the announcement in the *Times* that Sir Augustus Gregory, K.C.M.G., the Australian explorer, died a few days ago. Sir Augustus was born in Nottinghamshire in 1819, and entered the Civil Service of Western Australia in 1841. Five years later he began the series of explorations which were afterwards to make him famous. In 1846 he started with two brothers into the interior from Bolgart Spring, but their eastward progress was stopped by an immense salt lake which compelled them to turn north-west. The deviation led to the discovery by the party of some fine seams of coal in the country at the mouth of the Arrowsmith. Two years later he was sent northwards to explore the Gascoyne River, and he succeeded in reaching a point 350 miles north of Perth. A third exploring expedition was undertaken in 1855, this time under the auspices of the Royal Geographical Society of London. The expedition had the dual object of exploring the interior and of searching for traces of the lost explorer Leichhardt. The party was absent for nearly a year and a half, and though sure traces of Leichhardt were not found, much rich country and new watersheds were discovered. Under the auspices of the New South Wales Government, the search for Leichhardt was renewed in 1858, but again little success rewarded the efforts of the explorer. The Royal Geographical Society, however, showed its appreciation of his labours by conferring upon him the gold medal. In the following year he was appointed Surveyor-General of Queensland, and he afterwards held several posts of distinction under the Queensland Government. He was the author of several papers on Australian geology and geography.

The editor of the Berlin *Post* has been kind enough to bring under our notice some flagrant instances of the publication in German newspapers, without acknowledgment, of translations of articles and other contributions which originally appeared in our columns. These translations have been published under the title of "Allgemeine wissenschaftliche Berichte," and the editor of the Berlin *Post* has supplied us with a list of no less than twenty cases in which articles have been taken from Nature and translated into German without any indication of their source. The free use which has thus been made of contributions to our pages may doubtless be regarded as a flattering testimony to their scientific interest and precision; but at the same time, we must express regret that the morality of some writers on scientific subjects in Germany should have sunk so low that they can calmly render our contributions into their own language and offer the translations to newspapers as original descriptive matter. We are glad to know that this iniquitous practice has been discovered by the editor of the Berlin *Post*, and we trust that it will be exposed by the newspapers which have unknowingly printed translations of contributions to our pages.

Among the biological contents of the second part of the ninth volume of the *Bulletin International* issued at Prague by the Académie des Sciences de l'Empéreur François Joseph is an article by Mr. F. Brabenec on a new discovery of fossil plants in the Tertiary deposits of Holedeč, Bohemia. In addition to a new acacia, the author records remains of two species of the S. European aquatic genus Salvinia, one of which is very rare. In another article Dr. B. Němec discusses the influence of light on the position of the leaves in *Vaccinium myrtilus*, while in a third Mr. J. Smolák records the existence of multinuclear cells in certain euphorbias. The European representatives of the insect family Dictyopterygidæ form the subject of the one article, by Prof. F. Klapálek, relating to morphological zoology.

Regeneration and development constitute the leading features of the second part of vol. lxxix. of the *Zeitschrift für wissenschaftliche Zoologie*, which contains three articles. The first of these subjects is discussed by Prof. J. Nusbaum, of Lemberg University, who takes as his text the polychæte annelids *Amphigene mediterranea* and *Nerine cirratulus*, and shows how almost every part of the organism may be reproduced. As regards development, Dr. E. v. Zeller discusses the vesiculæ seminales in newts, and Dr. E. Zander contributes an article on the male generative organs of the Microlepidoptera of the family Butalidæ. The latter communication has an interest not indicated in the title, since it discusses the statement that these insects depart from the normal type in possessing only nine (in place of ten) abdominal segments. According to the author, this is an error, due to the wrong orientation of preparations and the consequent mistaking of a true segment for part of the generative apparatus.

In honour of the International Ornithological Congress, the current issue of *Bird Notes and News* forms a double number, of which the contents include a four-page supplement dealing with protective legislation for birds throughout the British Empire, and likewise an article on international bird-protection, in which attention is directed to the urgency of international agreement on the subject, more especially in regard to rare species, migratory birds, and species persecuted for the sake of their plumage. Among other cases mentioned in the article on international bird-protection, special reference is made to the wholesale destruction of penguins in Macquarie Island, and perhaps elsewhere, for the sake of their oil, a destruction which if continued and extended can only result in the extermination of these remarkable and interesting birds. If certain current reports be true, not only is there need of the best efforts of the Bird Protection Society, but the Society for the Prevention of Cruelty to Animals has also a field for its operations, if its arm be long enough to reach the Antarctic.

THE amount of variation that was obtained in cultivating a five-rayed form of *Trifolium pratense* is the subject of a paper by Miss T. Tammes in part xi. of the *Botanische Zeitung*. The production of more than three rays may be regarded as the dominance of the variety, while the production of trifoliate leaves is a reversion to the original form. In the early stages, that is, on first order branches, the leaves generally showed more than three leaflets, but later the trifoliate character was almost constant.

THE avocado or alligator pear, *Persea gratissima*, is rapidly growing in favour with Americans as a salad fruit. On this account Mr. J. H. Rolfs has prepared an account of its cultivation in Florida, which forms Bulletin No. 61 of the Bureau of Plant Industry. Budding affords the most satisfactory method of propagation, as plants do not come true to seed. Two forms are cultivated, the West Indian and a smaller-fruited Mexican variety. The fruit, which only resembles a pear in shape, is eaten like an egg, without condiments or with salad accompaniments.

ALTHOUGH sandal-wood is an important source of revenue in the Indian States of Mysore and Coorg, the parasitic nature of the sandal-tree has been little studied. Mr. C. A. Barber, who originally pointed out that the sandal is a root parasite, producing haustoria, by which it absorbs nourishment from the roots of such host plants as Casuarina and Lantana, has published in the *Indian Forester* (April) an account of further investigations on the subject. The haustorial tissue penetrates the root along the line of the cambium, and thrusts aside the cortex of the host, while absorbent cells and tracheæ are formed to abstract and carry off the food solutions from the wood.

IN the *Engineering and Mining Journal* Mr. F. Danvers Power, professor of mining in the University of Sydney, publishes an important memoir on the Gympie Goldfield of Queensland. The district is of special geological interest in view of the enrichment of the gold-bearing quartz veins where they pass through four beds of black shale containing graphite. The deepest shaft in the district has attained a depth of 3130 feet.

WE have received from the Engineering Standards Committee three further reports, dealing respectively with structural steel for shipbuilding, with screw threads, and with pipe threads for iron or steel pipes and tubes. These standard specifications have been drawn up by influential committees composed of representatives of the Institutions of Civil Engineers, Mechanical Engineers and Naval Architects, the Iron and Steel Institute, and the Institution of Electrical Engineers, and will doubtless be generally adopted. In the case of screw threads, no departure from the Whitworth thread is recommended, and terms used by the British Association small screw gauge committee have, to a large extent, been adopted.

IN a recent paper on the determination of sulphuric acid in soils, attention was directed to the enormous loss of sulphuric anhydride due to the solubility of barium sulphate in ferric chloride solution. If such low results are obtained when determining the sulphur in the presence of small quantities of iron, what losses must be entailed where large amounts of iron are present, as in the case of iron ore? An experimental investigation of the subject has been made by Mr. J. Howard Graham, and the results are published in the *Journal of the Franklin Institute*. They show that barium sulphate is not soluble in ferric chloride to the extent mentioned, but rather that it acts restrainingly upon the act of solution of the barium sulphate in hydrochloric acid until too large quantities of the acid are present.

SINCE their discovery, the various constituents of steel have been the object of numerous researches; but the knowledge of the internal structure of steel has been to a great extent obscured by the acrimonious controversies that have been introduced into the discussion of this subject at meetings of the Iron and Steel Institute. An attempt to remove the existing confusion has been made by Dr. Glazebrook and Prof. H. Le Chatelier by suggesting the formation of an international committee to investigate the matter. The committee is composed as follows:—France: MM. Charpy, Pérot, and H. Le Chatelier; Great Britain: Mr. Hadfield (president of the Iron and Steel Institute), Prof. Arnold, Mr. Stead, F.R.S., and Dr. Glazebrook, F.R.S.; Germany: Prof. Martens; Russia: Mr. Kournakoff; Sweden: Messrs. Brinell and Gunnar Dillner; United States: Messrs. H. M. Howe and Sauveur. The scheme of investigation is published in the current issue of the *Bulletin de la Société d'Encouragement pour l'Industrie nationale*.

THE twenty-seventh report of the Deutsche Seewarte, Hamburg, for the year 1904, shows that the work of marine meteorology and weather prediction is being prosecuted with the usual vigour shown by this useful organisation, and that Admiral Herz is careful to maintain the high efficiency which it attained under the able direction of Dr. von Neumayer. At the end of the year 1904 the number of observers at sea amounted to no less than 837; they are encouraged in their work by the presentation of medals and diplomas, in special cases, in addition to free distribution of atlases and sailing directions. Eleven hundred pilot charts of the North Atlantic Ocean are published monthly, and a similar publication is contemplated for the Indian Ocean; and twelve hundred charts for the North Sea and Baltic are issued quarterly. These are in addition to the publication of larger general discussions at irregular intervals. In the department for weather telegraphy and storm warnings, it may be mentioned that the comprehensive daily weather report shows a considerable improvement by the insertion of kite observations on p. 1. Storm warning telegrams were issued on sixty days, the number of messages to hoist storm signals amounting to 2593. The report exhibits similar activity in other branches of the Seewarte.

THE report on the currents at the entrance of the Bay of Fundy and southern Nova Scotia for the year 1904 has recently been issued. The season from May to September was chiefly occupied by Mr. Bell Dawson, the surveyor in charge of the work, in examining the currents at the entrance of the Bay of Fundy extending from Grand Manan Island to Cape Sable. These currents were found to be strong, steady, and deep, and therefore contrasted with those previously surveyed on the coasts of Newfoundland. A correct knowledge of the currents in the region surveyed is of great importance to navigation, as it includes waters that lie on the lines of ocean steamships running to St. John's, N.B., as well as of steamers from the United States ports which round the southern end of Nova Scotia on their way to Europe. It has been ascertained from the tide gauges which have been fixed during the survey and the tides recorded since 1902 that from Cape Sable westward the tides can be satisfactorily referred to St. John's, while eastward of Cape Sable they can be referred to Halifax. One noteworthy fact brought out by the survey is that the difference in range between spring tides which fall at perigee or apogee respectively is as great as the difference between mean springs and neaps, showing the dominating influence of the moon's distance in this region; and the variation in the strength of the current is found to follow the same law. Thus at St. John's the range at S.T., when the moon is at perigee, is 27·10 feet, and at apogee 20·35 feet, showing a difference of 6·75 feet. Mean spring range is 23·72 feet, and neaps range 17·43 feet, showing a difference of 6·29 feet. Also the diurnal inequality which is a dominant factor in parts of the Gulf of St. Lawrence is not very strongly marked in this region, although still quite appreciable. It was found that wind disturbance seldom affects the currents at a depth of more than ten fathoms, and that while along the centre line of the Bay of Fundy between the fifty fathoms' line on each side the ebb current runs only at the rate of 1½ to 2½ knots, nearer the shore about eight miles to the right or left the rate is nearly double, or from 3 to 4 knots. The report is accompanied by a map of the Bay of Fundy showing the direction and strength of the tidal currents.

An index to the literature of indium, by Dr. P. E. Browning, has just been published by the Smithsonian Institution, and forms part of vol. xlvi. of the Smithsonian Miscellaneous Collections.

Some remarkable finds of rare minerals have been made during the opening up of the noted gadolinite locality in Llano County, Texas; they are reported upon by Mr. W. E. Hidden in the June number of the *American Journal of Science*. The development of the mines was undertaken by the Nernst Lamp Co., of Pittsburg, Pa., and among the most notable discoveries were a double crystal of gadolinite weighing 73 lb., a mass of yttrialite weighing 18 lb., and a piece of pure allanite that weighed more than 300 lb. A single crystal of smoky quartz had a weight of 600 lb., and in a single year more than 1000 lb. of nearly pure gadolinite were extracted. Many of the minerals were radio-active, and deep work in the locality seems likely to bring to light new combinations of the rare earths and of uranium and thorium.

In No. 4 of the *Bulletin International* of the Academy of Sciences of Cracow, M. T. Godlewski shows that it is possible to separate from actinium by a similar method to that used for isolating ThX from thorium an intensely radio-active substance to which the name actinium X is given. The residual actinium is nearly inactive, retaining only 5 per cent. of its original activity, but it recovers its activity with time according to an exponential curve; the activity of actinium X, on the other hand, decays according to an exponential curve complementary to the curve of recovery. As in the case of thorium, the emanation of actinium is shown to be due to a transformation of actinium X. A complete analogy thus appears to exist between the radio-activity of actinium and thorium. It is interesting, however, to note that actinium itself is probably inactive, whilst thorium free from thorium X has never been obtained with less than 25 per cent. of its original activity. Moreover, the β rays of actinium are completely distinct in character from the β rays emitted by other radio-active elements, inasmuch as they are completely homogeneous with regard to their absorption by solid bodies.

A paper by Prof. Theodore W. Richards, Lawrence J. Henderson, and George S. Forbes, which is published in the *Proceedings of the American Academy of Arts and Sciences* (vol. iv., No. 1), deals with the question of the elimination of accidental loss of heat in accurate calorimetry. It is shown that the lag of the thermometer behind the temperature of a slightly cooling or slightly warming environment causes an appreciable error in estimating the temperature of the environment; by a simple method this lag can be accurately determined and allowed for. A new method for obviating this and all other corrections for cooling is shown to consist in systematically altering the temperature of the environment at the same rate and to the same degree as that of the calorimeter proper; this may be effected by allowing a chemical action which liberates heat to take place outside the calorimeter at a graduated velocity. This method is shown in a series of experiments to give a more constant result than can be obtained by introducing a correction for cooling according to the method of either Regnault or Rumford. It is shown, moreover, to give essentially the same value as that afforded by the older methods when these are corrected for the lag of the thermometer.

In studying the action of fluorine on some compounds of nitrogen, MM. Moissan and Lebeau found that whilst there was no reaction between fluorine and nitrogen peroxide (Nature, June 22, p. 183) there was a vigorous reaction between fluorine and nitric oxide. In the current number of the *Comptes rendus* they give a further account of their work on this reaction, from the products of which they have succeeded in isolating a new compound of fluorine, nitrogen and oxygen, nitryl fluoride, NO_2F. The gaseous products of the reaction, cooled to the temperature of boiling oxygen, gave a white solid which on fractionation at a low temperature proved to consist of a mixture of fluorine and a new substance, condensable at −80° C. By repeated distillation this latter was obtained in a pure state, and gave figures on analysis corresponding to the formula NO_2F. In the gaseous state this has a density of 2·24, the theoretical density being 2·26, a melting point of −139° C. and a boiling point of −63°·5 C. Nitryl fluoride possesses very active chemical properties, combining at the ordinary temperature with boron, silicon, phosphorus, arsenic, antimony, and iodine. It is without action in the cold on hydrogen, sulphur, and carbon, but decomposes water, producing nitric and hydrofluoric acids, and reacts with a large number of organic compounds, giving nitro- and fluor-derivatives.

There will be an extra meeting of the Physical Society on Friday, June 30, at the Royal College of Science, South Kensington, when the following papers will be read:—the comparison of electric fields by means of an oscillating electric needle: Mr. David Owen; (1) the magnetic rotatory dispersion of sodium vapour, (2) the fluorescence of sodium vapour: Prof. R. W. Wood. In addition to illustrating his papers by experiments, Prof. Wood proposes to show a number of other experiments.

AT a meeting of the Faraday Society to be held on Monday next, July 3, the following papers will be read:—some notes on the rapid electrodeposition of copper: Sherard Cowper-Coles; the use of balanced electrodes: W. W. Haldane Gee; (1) electrolytic oxidation of hydrocarbons of the benzene series, part ii., ethyl benzene, cumene and cymene; (2) electrolytic analysis of antimony: H. D. Law and F. Mollwo Perkin; notes on heat insulation, particularly with regard to materials used in furnace construction: R. S. Hutton and J. R. Beard.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JULY:—

July 4. 4h. Venus and Jupiter in conjunction, Venus 2° 30′ S.
,, 5. 11h. 34m. Minimum of Algol (β Persei).
,, 6. 1h. Venus at greatest elongation, 45° 44′ W.
,, 15. Venus. Illuminated portion of disc = 0·551; of Mars = 0·881.
,, 16. Uranus passes 1′ north of 1 Sagittarii (Mag. 5·3).
,, 23. Saturn. Outer major axis of outer ring = 43″·22; outer minor axis of outer ring = 6″·88.
,, 26. 11h. Conjunction of Jupiter with the Moon, Jupiter 4° 24′ N.
,, 27. 10h. 6m. Minimum of Algol (β Persei).
,, 27-31. Epoch of Aquarid meteoric shower (Radiant 339° − 11°).

NEW OBSERVATORY IN ALGERIA.—The accompanying illustration of the Mustapha-Supérieur Observatory (Algeria) is reproduced from *La Nature* (No. 1671), wherein M. Lucien Libert describes in detail the situation and

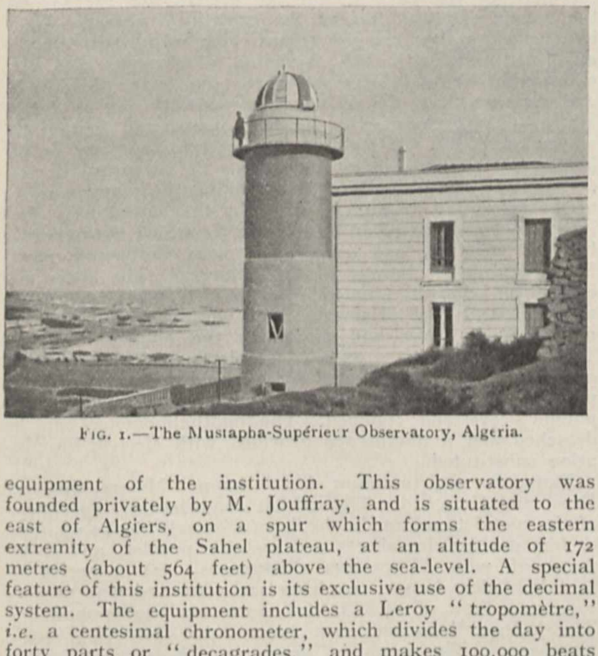

FIG. 1.—The Mustapha-Supérieur Observatory, Algeria.

equipment of the institution. This observatory was founded privately by M. Jouffray, and is situated to the east of Algiers, on a spur which forms the eastern extremity of the Sahel plateau, at an altitude of 172 metres (about 564 feet) above the sea-level. A special feature of this institution is its exclusive use of the decimal system. The equipment includes a Leroy "tropomètre," *i.e.* a centesimal chronometer, which divides the day into forty parts or "decagrades," and makes 100,000 beats per day instead of the 86,400 beats made by the ordinary chronometer. The elaborately fitted micrometer, which is used in connection with a Secretan equatorial of 135 mm. (5¼ inches) aperture and 187 cm. (6·1 feet) focal length, has its circle divided into 400 grades, the pitch of the screw being 1′ (centesimal), and M. Libert contends that the use of these scales effects an immense saving of time and labour. The electrical and mechanical arrangements for illuminating and controlling the instruments and the dome are described in detail, and appear to be as near perfection as possible. A complete meteorological equipment is also attached to the institution, and M. Libert pleads for the foundation of a similar observatory in southern Algeria, where the sky is but very rarely covered.

A SUSPECTED SUDDEN CHANGE ON JUPITER.—At the meeting of the Royal Astronomical Society held on May 12, a note from Major Molesworth, R.E., was read in which he described a suspected instance of sudden change on Jupiter. Observing at Trincomalee, Ceylon, on December 17, 1903, he made a sketch of the neighbourhood surrounding the dark spot F 87, situated on the southern edge of the S. equatorial belt. This observation was made at 1h. 45·5m. G.M.T. At 2h. the observer suddenly noticed a minute white spot, bright enough to cause him some surprise at having omitted it from his previous observation, preceding and touching F 87. At 2h. 3m. this spot was so obvious that its existence could not have escaped the most casual observer, and later, at 2h. 5m., it had developed into a bright oblique rift only separated by a narrow streak from the spot F 83. This appearance lasted so long as the region remained readily observable. The region was again examined on December 20, but no trace of the outburst could be discerned. When first observed the bright spot was *preceding* F 87, but later the oblique rift appeared to enter the belt from a point immediately *following* that feature.

With a lengthy experience in observing Jupiter, Major Molesworth has never before noticed any such change in this region of the planet, but he is perfectly assured that the phenomenon was real. The observations were made under almost perfect conditions of seeing with a 12¾-inch Calver reflector fitted with a Steinheil monocentric eyepiece magnifying 270 times (*Monthly Notices*, May).

BRIGHTNESS OF JUPITER'S SATELLITES.—In a recent note in these columns (May 18) attention was directed to the results obtained by Prof. Wendell from a photometric investigation of the relative brightnesses of Jupiter's satellites. He found that the invariable order of brightness of the satellites was iii., i., ii., iv., but, from a study of the photographic plates obtained at the Cape Observatory during 1891, 1903, and 1904, Prof. W. de Sitter finds that the order of magnitude was, invariably, iii., ii., i., iv., the interval ii.–i. being always of the same order as the intervals iii.–ii. and i.–iv. It thus appears that there must be a considerable difference between the visual and photographic magnitudes of these objects (*Astronomische Nachrichten*, No. 4026).

ELLIPTICAL ELEMENTS FOR THE ORBIT OF COMET 1905 *a*.—Finding that the places derived from parabolic elements for the orbit of comet 1905 *a* did not agree sufficiently well with those observed, Prof. Banachiewicz calculated the following set of elements for an elliptical orbit from several observations made at various places on March 27, April 7, and April 27, and publishes the same in No. 4027 of the *Astronomische Nachrichten*:—

$$T = 1905 \text{ April } 4{\cdot}08096 \text{ (Berlin M.T.)}.$$

$$\left.\begin{aligned} \omega &= 358^\circ\ 12'\ 17''{\cdot}40 \\ \Omega &= 157\ \ 27\ \ 41{\cdot}75 \\ i &= 40\ \ 11\ \ 20{\cdot}76 \end{aligned}\right\} 1905{\cdot}0 \qquad \begin{aligned} \log q &= 0{\cdot}0470173 \\ \log e &= 9\ 9856436 \\ P &= 200{\cdot}62 \text{ years} \end{aligned}$$

The places derived from these elements were found to agree far more satisfactorily with the observed places.

According to a set of elements published by Herr A. Wedemayer in No. 4023 of the same journal, the period of this comet is about 279 years.

RECENT POSITIONS OF EROS.—The following positions for Eros, on the dates named, have been derived from photographs taken by Mr. Manson at Arequipa with the Bruce telescope, apparently the first photographs of the asteroid to be obtained since its recent conjunction with the sun:—

1905	G.M.T.		Exposure.		α (1900)		δ (1900)
	h. m.		m.		h. m. s.		° ′
April 11	19 57	...	70	...	20 36 37	...	−25 4·5
12	20 41	...	134	...	20 38 34	...	−24 55·6
14	20 40	...	45	...	20 42 12	...	−24 39·1

(*Astronomische Nachrichten*, No. 4027).

TELESCOPIC WORK FOR OBSERVERS OF PLANETS.

THE possessors of telescopes now have an interesting variety of planetary objects for examination. These are Venus, Mars, Jupiter, Saturn, and Uranus.

Venus is visible, as a crescent, in the morning sky, increasing to half-moon shape in the second week of July, and arriving at her greatest elongation, west of the sun, on July 6, when her distance from that luminary will be 45° 44′. The conjunction of Venus and Jupiter will form an attractive spectacle on July 4.

Mars has now declined in diameter to 13″, but the principal markings are still very distinct, and some of the more delicate canals remain observable. After July the planet will have receded so far from the earth that further telescopic study of his physical lineaments cannot be pursued successfully.

Jupiter has just emerged into view as a morning star, rising about 2¼ hours before the sun. The most interesting point to be determined is the present position of the great red spot. The motion of this remarkable object has been curiously variable in recent years. Between October, 1904, and March, 1905, the rotation period corresponded very closely with that of system ii. of the ephemeris based on 9h. 55m. 40·63s., and the longitude remained constant at about 26°, so that the spot followed the passages of the zero meridian by 43 minutes. The exact position of the marking should be ascertained as early and as frequently as possible during the coming opposition, and the following are the probable times of a few transits during ensuing weeks:—

Date 1905	Approximate Transit Time h. m.	Date 1905	Approximate Transit Time h. m.
July 1	16 32	July 30	15 35
6	15 41	Aug. 4	14 45
11	14 51	6	16 23
13	16 29	9	13 53
18	15 39	11	15 32
23	14 48	13	17 10
25	16 27	21	13 49

The large dark spot seen in the south temperate zone of Jupiter in and since 1901, if still visible, will be in longitude 191° at the end of June, and will therefore follow the zero meridian by 5¼ hours and the great red spot by 4½ hours.

Saturn rises 5 hours before the sun. It is most important to learn whether there are any lingering signs of the extensive disturbance which affected the northern hemisphere in the summer and autumn of 1903. It is singular that, though a large number of observations of the spots were made and promptly reported in 1903, we have heard practically nothing of similar results in 1904. Yet the markings remained visible, if much less conspicuously, in 1904.

Uranus was in opposition to the sun on June 23, and is therefore easily discernible at the present time, though his southern declination is 23⅜°. An excellent opportunity will be afforded of identifying this planet during the third week in July, when he passes about 1 minute of arc north of the star 1 Sagittarii (mag. 5·3).

Added June 25.—The great red spot on Jupiter was seen by the writer at Bristol, and estimated central on June 24 15h. 43m. Its longitude was therefore 25°·1, and this sufficiently shows that its motion has exhibited no further change during the last three months.

Saturn was also carefully examined on the same morning, but no conspicuous spots were seen in a 12½-inch reflector by Calver, power 235. The observation of Jupiter was obtained with a 10-inch reflector by With-Browning, power 205.

W. F. DENNING.

THE ROYAL SOCIETY CONVERSAZIONE.

THE second, or ladies', conversazione of the Royal Society was held in the rooms of the society at Burlington House on Friday last, June 23, and was attended by a large and distinguished company. As on former occasions, many objects of scientific interest were exhibited, but most of them were shown at the earlier conversazione on May 17, and have already been described in these columns (May 25, p. 90). It is therefore only necessary now to refer to additional demonstrations and exhibits.

In the course of the evening there were demonstrations, with lantern illustrations, on recent work in mimicry and protective resemblance, by Prof. E. B. Poulton, F.R.S., and on the three-colour photographic process, by Sir W. de W. Abney, K.C.B., F.R.S. The photographs in colour that were shown were prints from three negatives taken of each subject. Each of the three negatives was taken through an appropriate coloured medium, and the three transparent prints were projected on a screen with appropriate coloured screens behind them, giving the colours of nature. The process and apparatus employed were based on those of Mr. Ives.

Brief descriptions of the new exhibits are given in the subjoined abstract of the official catalogue.

The metal sodium, prepared so as to show its true colour and lustre: Mr. G. T. Beilby. The specimen was prepared by Dr. Thomas Ewan by melting the metal *in vacuo* in one vessel and running the clean, bright part of the liquid into another communicating vessel which had been freed from condensed air or moisture by heating during exhaustion. After solidification of a crystalline crust on the glass, the surplus liquid was run back into the first vessel and the specimen globe was sealed off.—(1) Pictures produced in the dark on a photographic plate by different woods; (2) ordinary photographs of the same woods; (3) the woods used in the experiments: Dr. W. J. Russell, F.R.S. The pictures taken in the dark were obtained on an ordinary rapid photographic plate, the wood being in contact with the plate from one to eighteen hours at a temperature of 55° C. The pictures were developed in the same way as if they had been produced by light.

The entoptoscope, a new form of ophthalmoscope: Prof. W. F. Barrett, F.R.S. The instrument was devised by the exhibitor for the self-examination of the eye by means of pinhole vision—entoptic diagnosis (Listing). When an illuminated fine pinhole in a sheet of metal is held near the eye, sharp shadows of any opaque or semi-opaque object in the path of the rays within the eyeball are thrown on the retina. By this means the growth of cataract from its earliest stages can be traced. By using two closely adjacent pinholes in the revolving diaphragm, and the transparent scale in the eye-piece, the exact magnitude and distance from the retina of the opacity can be determined.—The Ettles-Curties ophthalmometer and ophthalmic microscope: Mr. C. Baker. The opththalmometer is an instrument for measuring the radius of curvature of the cornea, and consequently of ascertaining the dioptric value of the refracting medium bounded by that curvature. The instrument consists of an attachment by which the patient's head is steadied, and a telescope with Wollaston prism for observing the images of the "mires." The latter are carried on an arc graduated in terms of dioptres and radius of curvature, and prismatic steel bars provide a steady movement by rack and pinion to the adjustable parts. The whole is mounted on a telescopic floor standard which contains a plunger actuated by a spiral spring; by slight pressure this can be pushed down to the level of the patient's eye and clamped. The ophthalmometer can be detached and a microscope provided with electric illumination substituted.

Tantalum, and tantalum electric lamps: Messrs. Siemens Bros. and Co., Ltd. The exhibit comprised (1) specimens of the metal tantalum in the form of small blocks of more or less purity, also sheets and metallic powder, and specimens of wire of various thicknesses; (2) a series of tantalum glow lamps, requiring 110 volts and 0·34 ampere to give a light of 25 N.C. (1½ watts per candle-power).—The "Osmi" incandescent lamp: the General Electric Company. The lamp in appearance is similar to the ordinary electric bulb, but in place of carbon the filament is made from the rare metal osmium, which, when in a state of incandescence, glows with extreme brilliancy. The advantages claimed are:—high fusing point, white light, higher electrical efficiency, longer life, saving of current, less heat. The blackening of bulbs is inappreciable. The consumption of current with ordinary carbon filament lamp is 3·5 to 4 watts per candle-power. Consumption of current with Osmi lamp, 1·5 watts per candle-power.—Fery radiation pyrometer: the Cambridge Scientific Instrument Company. By means of a concave mirror the image of a hot body or of the inspection hole in a furnace wall is focused upon a copper-constantan thermo-couple connected to a direct-reading galvanometer on the centigrade scale. The instrument was shown working, being sighted upon a disc of hot iron within an electrical resistance furnace.

Drawings made from combined photographs of the solar corona in 1898, 1900, and 1901: the Astronomer Royal. In 1901 a change in the corona on the west side appears to have taken place in the interval (thirty-seven minutes) between two photographs taken at different stations. The drawings were by Mr. W. H. Wesley.—(1) Photographs, maps, curves, and diagrams, in connection with the more recent researches on the astronomical significance of British stone circles. (2) Contact positives showing some of the results taken with the Solar Physics Observatory spectroheliograph. Also four enlarged pictures showing disc and disc-and-limb photographs, and a photograph of the instrument itself. (3) A series of curves to illustrate the relationship between the flow of the river Thames and pressure and rainfall changes in Great Britain. The close association between British pressure and the barometric see-saw between the Indian and South American areas was also indicated: Sir Norman Lockyer, K.C.B., F.R.S.—A new sundial that tells standard time, designed by Prof. Albert Crehore: Sir W. H. Preece, K.C.B., F.R.S. The gnomon of the common form of dial is abandoned, and the shadow of a small bead fixed on a wire is cast on the interior of a true cylindrical surface, upon which figure-of-eight curves are drawn marking standard noon for each day of the year. The cylindrical surface is inclined so that its axis, upon which the bead is fixed, is parallel to that of the earth. It thus represents the latitude of the place. The shadow of the bead travels across the cylindrical surface parallel to, or on, one of the circles drawn thereon. These circles represent days of the month. Each hour described in the circle is always of the same length, and a scale of minutes engraved on the cylinder enables true mean time to be read off directly to a few seconds.

Photographs illustrating the annual growth of a deer's antlers: Mr. H. Irving. The deer photographed was a wapiti, full grown. The first photograph showed the deer on the second day after the antlers were cast. Succeeding photographs were taken at fortnightly intervals covering four months' growth. The antlers were also shown with the velvet in strips, and finally clean and hard. The antlers of the previous year were shown for comparison. —Mendelian heredity in rabbits: Mr. C. C. Hurst. A pure-bred "Belgian hare," mated with a pure-bred white Angora, gave all wild-grey rabbits. These, bred together, gave the ten types exhibited, in which appear all the possible combinations of four pairs of coat characters, viz. short and angora, coloured and white, grey and black, self-coloured and Dutch-marked. The breeding behaviour of these types demonstrates clearly the Mendelian principles of dominance, segregation, and gametic purity. Dominant characters are short, coloured, and grey coat. Recessive characters are Angora, white and black coat. The black and Dutch-marked characters were introduced by the white Angora.—(1) Individual, local, and orthogenetic variation in Mexican lizards of the genus Cnemidophorus; (2) three specimens of *Chirotes canaliculatus* from Rio Balsas, South Mexico: Dr. H. Gadow, F.R.S. The former exhibit included:—*Cnemidophorus deppei*, showing orthogenetic variation in the number of white dorsal stripes from 7 to 11. Local variation from completely white to black underparts; from lateral white spots to double red bands. *C. striatus* and *C. guttatus*. Leading from a sharply striped pattern to the dull-coloured and completely spotted form which is characteristic of the eastern forest region. *C. gularis*, *C. mexicanus*, *C. bocourti*, and other closely allied forms, varying in size, colour, pattern, and scales.—(1) Demonstration illustrating the life-history of wood-boring wasps (Crabronidæ); (2) photographs from life of transformations of the brimstone butterfly (*Gonepteryx rhamni*): Mr. Fred Enock. The Crabronidæ, or wood-boring wasps, excavate (with their mandibles) deep burrows in decaying tree trunks, palings, &c., their work being carried on day and night until a sufficient depth has been reached. The female wasp then flies off in search of prey to stock her cells with food for the larvæ. A number of species inhabit Great Britain. Each selects its prey from certain insects, and invariably keeps to the species so selected. The intelligence exhibited by the wasp when "collecting" is marvellous, a momentary glance as the insects dart past being sufficient to identify the right one.—The membranous labyrinth of man and some animals: Dr. Albert A. Gray. The exhibit represented the membranous labyrinths of man, illustrating normal and pathological conditions; the membranous labyrinth of the seal showing otoliths; the membranous labyrinths of the mouse, the rat, the rabbit, the sheep, the cat, the lemur, the duck, the hen. The brain of the haddock, with the otoliths in their natural position.

(1) Restoration of a British Jurassic theropodous Dinosaur of the genus Streptospondylus from the Oxford Clay, Oxford; (2) British armoured Dinosaur: Dr. Francis Baron Nopcsa. The bipedal dinosaurian reptile shown in the first exhibit is the most complete representative of the genus discovered in this country. The type exists in the Paris Museum, but is very imperfect. The specimen from which Baron Nopcsa's restoration is prepared is in the private museum of Mr. J. Parker, of Oxford, and is about to be described by the exhibitor. The restoration was executed under the direction of Dr. Francis Baron Nopcsa by Miss Alice B. Woodward. Diagram reconstruction of skeleton and bony dermal armour of *Polacanthus Foxi*, Hulke, from the Wealden of the Isle of Wight. Reconstructed by Dr. Francis Baron Nopcsa, under the direction of Dr. Arthur Smith Woodward, F.R.S., and set up in the geological department of the British Museum.

Ethnological specimens from southern Mexico: Mrs. Gadow. The specimens comprised embroidered leather dancing dress; decorated cotton huipiles, from eastern Oaxaca and South Guerrero; white cotton shifts, embroidered with beads, South Guerrero; dancing masks, from Coacoyulichan, South Guerrero; clay and stone idols and sacred vessels; clay whistles, kitchen utensils, ancient and modern; copper, flint, and stone implements; and duck-shaped water vessels.

Photographs of the White Nile and its tributaries, taken by the Survey Department of Egypt, 1903: Captain H. G. Lyons. (1) Bahr el Jebel. The stations of Gondokoro, Lado, Mongalla, and Kiro; in this part the valley floor is about 2–4 feet above low-water level; at Ghaba Shambe and Hellet Nuer it is only 1–2 feet above it, and in this reach the greatest development of the marshes occurs, as well as the blocks of vegetation (Sudd). (2) Bahr el Ghazal and Bahr el Zaraf, showing their flat flood plains. (3) Sobat River in flood near its junction with the White Nile. (4) The White Nile. (5) Shilluk Negroes of the White Nile and Sobat.—Photographic views illustrative of the scenery of Tibet: the Royal Geographical Society.

SUBMARINE NAVIGATION.[1]

SUBMARINE navigation has engaged the attention of inventors and attracted general interest for a very long period. Its practical application to purposes of war was made about 130 years ago. Under the conditions which prevailed a century ago in regard to materials of construction, propelling apparatus, and explosives, the construction of submarines necessarily proceeded on a limited scale, and the type practically died out of use, almost at its birth. Enough had been done, however, to demonstrate its practicability and to make it a favourite field of investigation for inventors, some of whom contemplated wide extensions of submarine navigation. Every naval war gave fresh incentive to these proposals, and led to the construction of experimental vessels. This was the case during the Crimean War, when the Admiralty had a submarine vessel secretly built and tried by a special committee, on which, amongst others, Mr. Scott-Russell and Sir Charles Fox served. Again, during the Civil War in America, the Confederates constructed a submarine vessel, and used it against the blockading squadron off Charlestown. After several abortive attempts, and a considerable

[1] Abstract of a discourse delivered at the Royal Institution on Friday, June 9, by Sir William H. White, K.C.B., F.R.S.

loss of life, they succeeded in destroying the Federal *Housatonic*, but their submarine with all its crew perished in the enterprise.

It is impossible to give even a summarised statement of other efforts made in this direction from 1860 onwards to 1880; but one cannot leave unnoticed the work done in the United States by Mr. Holland, who devoted himself for a quarter of a century to continuous experiment on submarines, and eventually achieved success. The Holland type was first adopted by the United States Navy, and was subsequently accepted by the British Admiralty as the point of departure for our subsequent construction of submarines. In France, also, successive designs for submarines were prepared by competent naval architects, and a few vessels were built and tried. The *Plongeur*, of 1860, was a submarine of large size, considerable cost, and well considered design; but her limited radius of action and comparatively low speed left her for many years without a successor on the French Navy List.

The modern development of submarines for war purposes is chiefly due to French initiative. During the earlier stages of this development progress was extremely slow. The *Gymnote* was ordered in 1886 and the *Gustave Zédé* in 1888, and her trials continued over nearly eight years, large sums of money being spent thereon. In 1896 competitive designs for submarines were invited, but no great activity was displayed in this department of construction until the Fashoda incident two years later. Since that time remarkable developments have been made in France, considerable numbers of submarines have been laid down, rival types have been constructed, and many designers have been engaged in the work. Up to the present time about seventy submarines and submersibles have been ordered; in July, 1904, the total number of completed vessels was twenty-eight, and at the end of 1907 it is estimated that France will possess sixty completed submarines, with a total displacement of nearly 13,600 tons. The first French submarine of modern type, the *Gymnote*, was 56 feet long and of 30 tons displacement. The latest types are nearly 150 feet long and of 420 tons displacement. The cost of a French submarine designed in 1898 was about 26,000*l*. The estimated cost of the latest and largest vessels is about 70,000*l*.

Two years elapsed after the date when the French resolutely undertook the construction of submarines before the British Admiralty ordered five vessels of the Holland type from Messrs. Vickers, Sons and Maxim, who had acquired the concession for the use of the Holland Company's patents. These first vessels in essentials were repetitions of the type which had been tried and officially approved by the authorities of the United States Navy. It was agreed that all improvements made by the Holland Company should be at the service of the British Admiralty through the English *concessionnaires*. Our first five submarines are 63 feet in length, 120 tons in displacement, with gasolene engines of 160 horse-power for surface propulsion, giving a speed of 8 to 9 knots. The electric motors for submerged propulsion are estimated to give a speed of about 7 knots. The contract price for each vessel in the United States was about 34,000*l*., and that is about the price paid for our earliest vessels. The latest type of which particulars are available is said to be about 150 feet in length, 300 tons in displacement, and with gasolene engines of 850 horse-power for surface propulsion, giving a surface speed of 13 knots and a radius of action of 500 miles. The under-water speed is 9 knots, and the radius of action when submerged about 90 miles.

In French official classification a distinction is made between submarines and submersibles, and this terminology has been the cause of some confusion. Both classes are capable of diving when required, and both can make passages at the surface. In this surface condition a considerable portion of the vessel lies above the water-surface and constitutes what is technically called a "reserve of buoyancy." In the submersible this reserve of buoyancy and the accompanying freeboard are greater than in the submarine type, and in this respect lies the chief difference between the two types. The submersible has higher freeboard and greater reserve of buoyancy, which secure better sea-going qualities and greater habitability. The deck or platform is situated higher above water, and to it the crew can find access in ordinary weather when making passages, and obtain exercise and fresh air. Recent exhaustive trials in France are reported to have established the great superiority of the submersible type when the service contemplated may involve sea passages of considerable length. The French policy, as recently announced, contemplates the construction of submersibles of about 400 tons displacement for such extended services, and proposes to restrict the use of submarines to coast and harbour defence, for which vessels of about 100 tons displacement are to be employed. All recent British submarines would be ranked as submersibles according to the French classification, and it is satisfactory to know, as the result of French experiments, that our policy of construction proves to have distinct advantages.

In addition to these two types of diving or submarine vessels, the French are once more discussing plans which have been repeatedly put forward and practically applied by M. Goubet, namely, the construction of small portable submarine vessels which could be lifted on board large ships and transported to any desired scene of operations. In the Royal Navy, for many years past, it has been the practice similarly to lift and carry second-class torpedo or vedette boats about 20 tons in weight. Lifting appliances for dealing with these heavy boats have been designed and fitted in all our large cruisers and in battleships, and a few ships have been built as "boat-carriers." The first of these special depôt ships in the Royal Navy was the *Vulcan*, ordered in 1887–8, the design being in essentials that prepared by the lecturer at Elswick in 1883. The French have also built a special vessel named the *Foudre*, which has been adapted for transporting small submarines to Saigon, and performed the service without difficulty. Whether this development of small portable submarines will take effect or not remains at present an open question, but there will be no mechanical difficulty either in the production of the vessels themselves or in the means for lifting and carrying them.

Progress in mechanical engineering and in metallurgy has been great since Bushnell constructed and used his first submarine in 1776, during the war between the United States and this country. These advances have made it possible to increase the dimensions, speed, and radius of action of submarines; their offensive powers have been enlarged by the use of locomotive torpedoes, and superior optical arrangements have been devised for discovering the position of an enemy while they themselves remain submerged. But it cannot be claimed that any new principle of design has been discovered or applied. From descriptions left on record by Bushnell, and still extant, it is certain that he appreciated, and provided for, the governing conditions of the design in regard to buoyancy, stability, and control of the depth reached by submarines. Indeed, Bushnell showed the way to his successors in nearly all these particulars, and—although alternative methods of fulfilling essential conditions have been introduced and practically tested—in the end Bushnell's plans have in substance been found the best. The laws which govern the flotation of submarines are, of course, identical with those applying to other floating bodies. When they are at rest and in equilibrium they must *displace* a weight of water equal to their own total weight. At the surface they float at a minimum draught, and possess in this "awash" condition a sufficient freeboard and reserve of buoyancy to fit them for propulsion. When submarines are being prepared for "diving" water is admitted to special tanks, and the additional weight increases immersion, and correspondingly reduces reserve of buoyancy. In some small submarines comparative success has been attained in reaching and maintaining any desired depth below the surface simply by the admission of the amount of water required to secure a perfect balance between the weight of the vessel and all she contains, and the weight of water which would fill the cavity occupied by the submarine when submerged. For all practical purposes and within the depths reached by submarines on service water may be regarded as *incompressible*; the submarine should, therefore, rest in equilibrium at any depth if her total weight is exactly balanced by the weight of water displaced. If the weight of the vessel exceeds by ever so small an amount the weight of water displaced, that excess constitutes an accelerating force tending to sink the vessel deeper. On the contrary, if the weight of water displaced exceeds by ever so small an amount the total weight of the vessel, a vertical force is produced tending to restore her to the surface. In these circumstances, it is obvious that if the admission or expulsion of water from internal tanks (or the extrusion or withdrawal of cylindrical plungers for the purpose of varying the displacement) were the only means of controlling vertical movement, it would be exceedingly difficult to reach or to maintain any desired depth. This difficulty was anticipated on theoretical grounds, and has been verified on service—in some cases with considerable risks to the experimentalists—the submarines having reached the bottom before the vertical motion could be checked. It has consequently become the rule for all submarines to be left with a small reserve of buoyancy when brought into the diving condition. Submergence is then effected by the action of horizontal rudders controlled by operators within the vessels. Under these conditions, submergence only continues so long as onward motion is maintained, since there is no effective pressure on the rudders when the vessel is at rest. The smallest reserve of buoyancy should always bring a submarine to the surface if her onward motion ceases, and, as a matter of fact, in the diving condition that reserve is extremely small, amounting to only 300 lb. (equivalent to 30 gallons of water) in vessels of 120 tons total weight. This is, obviously, a narrow margin of safety, and necessitates careful and skilled management on the part of those in charge of submarines. A small change in the density of the water, such as occurs in an estuary or in the lower reaches of a great river, would speedily obliterate the reserve of buoyancy and cause the vessel to sink if water was not expelled from the tanks. Moreover, variations in weight of the submarine (due to the consumption of fuel, the discharge of torpedoes or other causes) must sensibly affect the reserve of buoyancy, and arrangements must be made to compensate for these variations by admitting equal weights of water in positions that will maintain the "trim" of the vessel. Additional safeguards against foundering have been provided in some submarines by fitting detachable ballast. The more common plan is to make arrangements for rapidly expelling water from the tanks either by means of pumps or by the use of compressed air. In modern submarines, with locomotive torpedoes, compressed air is, of course, a necessity, and can be readily applied in the manner described if it is desired to increase their buoyancy.

The conditions of stability of submarines when diving are also special. At the surface, owing to their singular form, the longitudinal stability is usually much less than that of ordinary ships. When submerged, their stability is the *same in all directions,* and it is essential that the centre of gravity shall be kept below the centre of buoyancy. This involves no difficulty, because water-ballast tanks can be readily built in the lower portions of the vessels. Small stability in the longitudinal sense, however, necessitates great care in the maintenance of trim, and in the avoidance of serious movements of weights within the vessels. Moreover, when a vessel is diving under the action of her longitudinal rudders, she is extremely sensitive to changes of trim, and great skill is required on the part of operators in charge of working the rudders. As the under-water speed is increased, the pressure on the rudders for a given angle increases as the *square* of the velocity, and sensitiveness to change of trim becomes greater. This fact makes the adoption of higher under-water speed a matter requiring very serious consideration. Some authorities, who have given great attention to the construction of submarines, have been opposed to the adoption of high speeds under water, because of the danger that vessels when diving quickly may reach much greater depths than are desirable. Causes of disturbance which might be of small importance when the under-water speed is moderate may have a greatly exaggerated effect when higher speeds are reached. Cases are on record where modern submarines in the hands of skilled crews have accidentally reached the bottom in great depths of water, and have had no easy task to regain the surface. For these reasons, it is probable that while speeds at the surface will be increased, under-water speeds will not grow correspondingly. Indeed, the tactics of submarines hardly appear to require high speed under water, seeing that it is an important element in successful attack to make the final dive at a moderate distance from the enemy. It is authoritatively stated that in our submarines complete control of vertical movements has been secured by means of skilled operators, and that a constant but moderate depth below the surface can be maintained. Proposals have been made and successfully applied to small submarines for automatically regulating the depth of submergence by apparatus similar to that used in locomotive torpedoes. For the larger submarines now used such automatic apparatus does not find favour, and better results are obtained with trained men.

The possibility of descending to considerable depths has to be kept in view when deciding on the form and structural arrangements of submarines, which may be subjected accidentally to very great external pressure. It is absolutely necessary to success that, under the highest pressure likely to be endured, there shall be rigidity of form, as local collapse of even a very limited amount might be accompanied by a diminution in displacement that would exceed the reserve of buoyancy. This condition is not difficult of fulfilment, and the approximately circular form usually adopted for the cross-sections of submarines favours their resistance to external pressure.

Under former conditions, there was difficulty in remaining long under water without serious inconvenience from the impurity of the air. Now, by suitable arrangements and chemical appliances, a supply of pure air can be obtained for considerable periods, sufficient, indeed, for any operations likely to be undertaken.

The use of gasolene engines for surface propulsion has many advantages. It favours increase in speed and radius of action, and enables submarines to be more independent and self-supporting. Storage batteries can be re-charged, air compressed and other auxiliary services performed independently of any "mother" ship. At the same time, it is desirable to give to each group of submarines a supporting ship, serving as a base and store depôt, and this has been arranged in this country as well as in France. With gasolene engines, care must be taken to secure thorough ventilation and to avoid the formation of explosive mixtures of gas and air, otherwise accidents must follow.

Little information is available as regards the success of "periscopes" and other optical instruments which have been devised for the purpose of enabling those in command of submarines to obtain information as to their surroundings when submerged. In this department, secrecy is obviously desirable, and no one can complain of official reticence. From published accounts of experimental working abroad as well as in this country, it would appear that considerable success has been obtained with these optical instruments in comparatively smooth water. It is also asserted that when the lenses are subjected to thorough washing by wave-water, they remain efficient. On the other hand, the moderate height of the lenses above water must expose them to the danger of being wetted by spray even in a very moderate sea, and experience in torpedo-boats and destroyers places it beyond doubt that the resultant conditions must greatly interfere with efficient vision. In heavier seas, the comparatively small height of the lenses above water must often impose more serious limitations in the use of the periscopes and similar instruments. Improvements are certain to be made as the result of experience with these optical appliances, and we may be sure that in their use officers and men of the Royal Navy will be as expert as any of their rivals. But when all that is possible has been done, it must remain true that increase in offensive power and in immunity from attack obtained by submergence will be accompanied by unavoidable limitations as well as by special risks resulting from the sacrifice of buoyancy and the great reduction in longitudinal stability which are unavoidable when diving. These considerations have led many persons to favour the construction of so-called *surface-boats* rather than submarines. They would resemble submersibles in many respects, but the power of diving would be surrendered, although they would be so constructed that by admitting water by special tanks they could be deeply immersed and show only a small target above the surface when making an attack. There would be no necessity in such surface vessels to use electric motors and storage batteries, since internal combustion engines could be used in all circumstances. Hence it would be possible without increase of size to construct vessels of greater speed and radius of action, and to simplify designs in other important features. It is not possible to predict whether this suggestion to adopt surface-boats rather than submersibles will have a practical result; but it is unquestionable that improvements in or alternatives to internal combustion engines will favour the increase of power in relation to weight, and so will tend to the production of vessels of higher speed.

Submarines and airships have certain points of resemblance, and proposals have been made repeatedly to associate the two types, or to use airships as a means of protection from submarine attacks. One French inventor seriously suggested that a captive balloon attached to a submarine should be the post of observation from which information should be telephoned to the submarine as to the position of an enemy. He evidently had little trust in periscopes, and overlooked the dangers to which the observers in the car of the balloon would be exposed from an enemy's gun-fire. Quite recently a proposal has been made by M. Santos Dumont to use airships as a defence against submarines, his idea being that a dirigible airship of large dimensions and moving at a considerable height above the surface of the sea could discover the whereabouts of a submarine, even at some depth below the surface, and could effect its destruction by dropping high explosive charges upon the helpless vessel. Here again, the inventor, in his eagerness to do mischief, has not appreciated adequately the risks which the airship would run if employed in the manner proposed, as submarines are not likely to be used without supporting vessels. Hitherto, submarines themselves have been armed only with torpedoes, but it has been proposed recently to add guns, and this can be done, if desired, in vessels possessing relatively large freeboard. No doubt if gun armaments are introduced, the tendency will be further to increase dimensions and cost, and the decision will be governed by the consideration of the gain in fighting power as compared with increased cost. As matters stand, submarines are practically helpless at the surface when attacked by small swift vessels, and it is natural that advocates of the type should desire to remedy this condition. Surface boats, if built, will undoubtedly carry guns as well as torpedoes, and in them the gun fittings would be permanent, whereas in submarines certain portions of the armament would have to be removed when vessels were prepared for diving.

Apart from the use of submarine vessels for purposes of war, their adoption as a means of navigation has found favour in many quarters. Jules Verne, in his "Twenty Thousand Leagues Under the Sea," has drawn an attractive picture of what may be possible in this direction, and others have favoured the idea of combining the supposed advantages of obtaining buoyancy from bodies floating at some depth below the surface with an airy promenade carried high above water. Not many years ago an eminent naval architect drew a picture of what might be accomplished by utilising what he described as the "untroubled water below" in association with the freedom and pure air obtainable on a platform carried high above the waves. These suggestions, however, are not in accord with the accepted theory of wave-motion, since they take no note of the great depths to which the disturbance due to wave-motion penetrates the ocean. The problems of stability, incidental to such plans, are also of a character not easily dealt with, and consequently there is but a remote prospect of the use of these singular combinations of submarine and aërial superstructures. There is little likelihood of the displacement of ocean steamships at an early date by either navigable airships or submarines, and the dreams of Jules Verne or Santos Dumont will not be realised until much further advance has been made in the design and construction of the vessels they contemplate.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE summer meeting of the Institution of Mechanical Engineers was held last week in Belgium. The opening proceedings took place in the city of Liége, the president, Mr. E. P. Martin, occupying the chair at the preliminary sitting. Six papers were down for reading and discussion, the mornings of June 20 and June 21 being devoted to their consideration. The following is a list of the papers:—Superheaters applied to locomotives on the Belgian State railways, by M. J. B. Flamme; the growth of large gas-engines on the Continent, by M. Rodolphe Mathot; ferro-concrete, and some of its most characteristic applications in Belgium, by M. Ed. Noaillon; electric winding machines, by M. Paul Habets; strength of columns, by Prof. W. E. Lilly; an investigation to determine the effects of steam-jacketing upon the efficiency of a horizontal compound steam engine, by Mr. A. L. Mellanby.

The first paper taken was the contribution by M. Flamme on superheating for locomotives. The author first dealt with the Schmidt superheater for simple expansion locomotives as applied on the Belgian State railways. Arrangements were made for superheating the steam, in order further to increase the power of the engines. As a result of experiments made, extending over some months, it was recognised that the utilisation of steam slightly superheated did not offer any appreciable economy of fuel or increase of power. On the other hand, with the Schmidt apparatus, when the steam was superheated from 570° F. to 662° F., favourable results were obtained. Two engines were tried, one using superheated steam and the other saturated steam. The saving in favour of the superheated steam locomotive amounted to 12·5 per cent. for fuel and 16·5 per cent. for water. Moreover, the speed reached showed an average increase of 9·5 per cent., all conditions being exactly the same. In regard to maintenance, the superheated steam locomotive type did not require special attention during its one and a half years' service. These favourable results led to the Belgian State railways venturing on the application of superheat to locomotives on a larger scale. With this in view, twenty-five locomotives, comprising five different types, all provided with the Schmidt superheater, were, at the time of the reading of the paper, actually in course of construction, or were about to be put to work. The Belgian State railway authorities had decided to persevere in their experiments in combining superheating of steam with compounding of the engine. The results obtained will be of very great interest. It was desirable to find whether it was more economical to divide the superheater into two parts in such a manner as to raise the temperature at the entrance to both high-pressure and low-pressure cylinders. The Cockerill Co., of Seraing, had completed a superheater which would enable this question to be settled.

The discussion on this paper was opened by Mr. Robinson, of Messrs. Sharp, Stewart, and Co., who stated that the Schmidt superheater had been tried on the Canadian Pacific Railway, and had been found to answer, whilst on the Cape railways the results had not been so satisfactory. He attributed the latter effect to the fact that the superheating tubes were placed at the lower part of the barrel of the boiler, instead of at the upper part as they should have been. Mr. Mark H. Robinson and the president also spoke.

The next paper taken was that of Mr. Paul Habets on electric winding machines. This was a long and somewhat abstruse paper, illustrated by many diagrams, and containing a large number of formulæ. It was read in brief abstract by the secretary of the institution. The author gave a dynamic investigation of haulage, dealing with the questions of resistance, statical moments, inertia of suspended loads, inertia of rope-roll, the head gear and winding gears of motors, and other elements of design. Formulæ were given for moments of the accelerating forces and power and expenditure of energy. Details of construction of motors were discussed, and some special devices explained. As a practical conclusion, the author stated that it might be safely concluded from trials of which particulars were given that the electric haulage machine, even if it were not more economical than the best steam-driven machines, was certainly not more expensive. The greater facility and safety with which electricity can be used, the smoothness with which it works, and its much greater flexibility, would often make it preferable to the use of steam, even in a case where transmission of energy was not required; there could be no hesitation in the choice between the two systems when the power had to be transmitted from a distance, or where the production of energy could be centralised at one power station.

M. Ed. Noaillon's paper on ferro-concrete was next read. Ferro-concrete constructions, as is well known, consist of a mass in which iron or steel reinforcement is bedded. The author stated that round bars were generally used, as they facilitated the escape of air and the proper ramming of the concrete; there were also no sharp angles which would cut the concrete. On the other hand, the round section gave the lowest coefficient of adhesion for a given cross-section of metal. The following rules governing the construction had been prepared by Prof. Rabut:—(1) No connection should be made of iron to iron, as the concrete itself holds the parts together in the most economical manner. (2) At least two distinct systems of reinforcement should be used, one to take up the tensile stress and the other to take up the shearing stresses in the concrete; when necessary a third system should be used to take up the compressive stresses. (3) The reinforcement should be so arranged that the separate members may be stressed in the direction of their length, so that the stresses produced between the iron and the concrete should be tangential, and not normal to the axis of the members of the reinforcement. (4) Homogeneity of the structure should be taken advantage of by prolonging the iron parts of one portion of the structure into the thickness of the concrete of the adjoining portion. Other points were also given.

Methods of construction were described and illustrated. Some examples of reinforced concrete were given in the paper, the handsome dome of the new Central Railway Station at Antwerp being a prominent instance. This dome is a fine piece of architecture, but was designed first of all for an ordinary masonry structure, a fact which made it somewhat difficult for the architects to adapt it for ferro-concrete. The entire structure is 1800 tons in weight, and rests wholly upon the columns at the angles of the glass lights; these columns are Y-shaped in cross-section. The external shell has a uniform thickness of 3·15 inches, and is relieved by six moulded ribs following the meridian lines. The Renommée Hall at Liége was the next example of this kind of construction. It was designed expressly for the use of this material. The principal hall is covered by three cupolas, each 55 feet in diameter, placed at a height of about 50 feet above the level of the ground. Each cupola forms part of a sphere, which continues in haunches, pierced with lights, and descending to the corners of the circumscribed square. The intersections of the spheres with the vertical spans passing through the sides of the squares are formed by arched beams, which spring from the capitals of short cylindrical columns. The cupolas are 4½ inches thick, and are made of concrete composed of cement clinker finely broken up; they are reinforced by a layer of expanded metal with a lattice work of bars. Members of the institution had a good opportunity to examine this structure, as one of the banquets during the meeting was given in the Renommée Hall.

An interesting application of reinforced concrete was also described in the widening of La Boverie Bridge at Liége. Particulars were also given of another bridge, built upon the Hennebique system; the length between abutments was 260 feet, and comprised a central span of 180 feet and two side spans. The total width of the roadway was 32·8 feet. An interesting feature about this bridge is the design of the foundations, and the way they were erected by mechanical compression of the soil. The piers and abutments rested upon a group of concrete piles driven deeply into the bed of the gravel, which thus became strongly compressed. The concrete piles were reinforced by vertical bars of steel which were continued into the piers and abutments, so that the whole was solidly bound together. By this method the advantage was obtained of solidly rooting the bridge into the earth, so that it had a resistance amply sufficient in case of a floating accumulation of ice, such as would temporarily transform the bridge into a dam. A skew bridge, also on the Hennebique system, was referred to, and a description was also given of a framework for lead chambers at the chemical works of the Engis Co. In the brief discussion which followed this paper, Mr. W. H. Maw suggested that it would be interesting if experiments could be made upon the effect of tension upon bars held in concrete. He had heard that a better hold of the concrete was obtained if the bars were previously treated to a wash of cement.

Mr. Mellanby's paper on the efficiency of the steam jacket was next read. This paper may be said to form part of a series of contributions on the same subject which have been given by various authorities during recent times. The results of a series of somewhat elaborate trials were given, from which the following general results may be taken. A compound engine, with boiler pressure at 150 lb., may be worked with the mean pressure referred to the low-pressure cylinder of about 40 lb. per square inch without any loss of efficiency in terms of the brake horse-power. Steam jackets have their maximum efficiency when the whole of the high-pressure and the ends of the low-pressure cylinders are jacketed with high-pressure steam. When jackets are applied to the high-pressure cylinder, the total indicated horse-power is slightly reduced, but when applied to the low-pressure cylinder the total indicated horse-power is considerably increased. Jackets have little effect in the high-pressure, but have considerable effect in the low-pressure cylinder upon initial condensation. The temperature supplied to the cylinder walls next to the steam must be considerably less than that of the steam, because, firstly, the actual "missing quantity" is much less than it would have been had the steam and metal gone through the same temperature changes, and secondly, because the mean temperature of the metal is higher than that of the steam. The author concluded that the greater part of the "missing quantity" must be due to leakage, and not to initial condensation, in this respect agreeing with the conclusions of Messrs. Callendar and Nicolson.

A somewhat extended discussion followed the reading of this paper. It was opened by Mr. V. Pendred, who said that compression in the cylinder had a considerable effect. If the compression corner of the indicator diagram was square, the utility of the jacket appeared to be small, but if it were rounded off by compression jacketing appeared to be more effective. Mr. Saxon, of Manchester, took exception to the statement as to a mean effective pressure of 40 lb. being the most efficient for a compound engine; he considered that the ratio of the cylinders should be taken into account. Mr. Henry Davey did not regard the results obtained as a guide for engineers, on account of the bad performance of the engine. Mr. Mark Robinson confirmed the author's opinion in regard to a mean pressure of 40 lb., and, in reply to a remark of Mr. Saxon's, said that the size of the cylinders should be in accordance with the power needed, and their ratio should be governed by the conditions of working.

On the second day of the meeting the first paper taken was a contribution by Mr. R. Mathot on large gas-engines. This was a long and interesting paper, containing a considerable amount of historical matter, and dealing with many of the details of construction by Continental makers in the design of large gas-engines, which have formed so prominent a feature of the engineering of Germany and Belgium within the last few years. The paper was illustrated by a number of engravings and diagrams, and results of engine tests were given in a table. Although English engineers early took the lead in the manufacture of gas-engines of moderate size, they have been to some extent left behind by Belgian and German manufacturers in regard to large gas-engines using blast-furnace gas; and even such of the latter as have been constructed in England have been mostly to German designs. It would be impossible in a report of this nature to give an account of the many details of construction dealt with by the author, especially without the aid of the numerous illustrations by which the paper was accompanied.

The discussion that followed the reading of the paper mainly consisted of a speech by Mr. Crossley, of Manchester, who defended the position of the English gas-engine makers, pointing out what had been done in the past. He did not, however, deny that the Continental makers were in advance of the English makers in regard to the size of the gas-engines manufactured.

The remaining paper was Prof. Lilly's contribution on the strength of columns, but the time for adjournment having arrived, this was only read in brief abstract, and was not discussed.

A large number of excursions and visits to works in the neighbourhood of Liége had been arranged by the local committee. Visits were also paid to the exhibition, and there were the usual social functions, including the reception, the dinner at the Renommée Hall already mentioned, and the institution dinner held at Liége. Thursday was entirely given up to these excursions, and on Friday members travelled to Antwerp, where they viewed the extensive docks of that city and some of the works in the neighbourhood. This brought a very successful meeting to a close.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Dr. Ritchie, Fellow of New College, the present reader in pathology, has been constituted professor of pathology so long as he continues as reader. Dr. A. J. Herbertson, non-collegiate, has been appointed university reader in geography.

The Rev. H. T. Morgan, Trinity College, has offered to continue the unfinished carving in the corridors of the university museum. Much of the elaborate plan for the sculptural decoration of the museum, undertaken in 1860, has remained uncompleted, and the Rev. H. T. Morgan has generously undertaken to provide for the carving of the capitals and corbels of at least two of the four upper corridors. The delegates propose to continue the original plan, according to which the capitals were to represent various plants in systematic order.

On June 20 a deputation from the medical graduates of the university, Sir William Church, Dr. Sharkey, Dr. Shornstein, Dr. Collier, and Mr. Whitley, presented an address to the Vice-Chancellor urging the importance of pathology in the medical curriculum of the university, and stating the steps that have been taken to provide permanent endowment for the teaching of this subject. A "pathology endowment fund" has been started, and an appeal that was limited to members of the profession has resulted in the contribution of more than 500*l*. A member of the university, who has already given 1000*l*. towards the endowment of a pathology chair, has offered to cover all subscriptions from the medical faculty by an equal amount.

IT is announced that General W. J. Palmer, of Colorado Springs, Col., and Mr. Andrew Carnegie have given respectively 20,000*l*. and 10,000*l*. as a nucleus to the 100,000*l*. endowment fund for Colorado College.

MR. T. P. BLACK has been appointed demonstrator in physics in Armstrong College, Newcastle-upon-Tyne. Mr. Black was a student of the college from October, 1900, to June, 1903, when he was elected to one of the Royal (1851) exhibition scholarships.

WE learn from *Science* that the proposed affiliation of the Massachusetts Institute of Technology with Harvard University was approved at a meeting of the corporation of the institute on June 9. It was agreed to accept the terms of the agreement recently drawn up by the committee of the two institutions. Before the agreement can become effective the corporation and overseers of Harvard University must take action, and several legal questions must be settled.

THE committee appointed to inquire into the present condition of fruit culture in Great Britain, and to consider whether any other measures might with advantage be taken for its promotion and encouragement, has reported to the Board of Agriculture in favour of the establishment of a special sub-department to deal with matters connected with the fruit industry. The main recommendation is that there should be two branches of such sub-department—(*a*) a bureau of information, (*b*) an experimental fruit farm. It is further proposed that horticulture should be taught in elementary schools in country districts, that such schools should have gardens attached wherever possible, and that the attention of local education authorities should be directed to this, and also to the desirability of encouraging the study of practical horticulture in training colleges.

THE programme of the summer meeting of university extension students, which is to be held at Oxford in August, has now been published. The lectures in the natural science section will be devoted to an explanation of the scientific method and to the illustration of its application to scientific work. General introductory lectures will be delivered by Prof. T. Case, on the scientific method as an operation of the mind, and by Prof. F. Gotch, F.R.S., on the development of the scientific method. Special lectures illustrative of the applications of the scientific method to numerous branches of science have been arranged, and these lectures will be directed to show the extent to which the general conception of the particular science has been developed by the use of the scientific method, and the way in which the method is used in the experimental investigation of some group of phenomena. Among the varied list of lectures from which students may choose we notice those by Prof. W. F. R. Weldon, F.R.S., on variation and heredity; by Prof. C. S. Sherrington, F.R.S., on a general survey of physiology and psychophysics; by Prof. W. M. Flinders Petrie, F.R.S., on crucial instances in archæology; and by Dr. G. J. Burch, F.R.S., on modern conceptions of matter.

MR AILWYN FELLOWES, President of the Board of Agriculture, presided at an agricultural conference held at Aberystwyth last week. The object in view in holding the meeting was the extension and development of the work of the agricultural department of the University College of Wales by the establishment of a more definite connection between its extension work and that done inside the college, and by better organisation of the department of agriculture itself. Mr. Fellowes said that the Board of Agriculture has been able to give 800*l*. a year to Aberystwyth College and 200*l*. a year towards the college farm which was opened the same day. The college is also largely aided by the residue grant which since the year 1890 has been handed over to the county councils of the kingdom. In the counties connected with Aberystwyth College, one-sixth of the residue grant has been given to agricultural education. Mr. Fellowes said he hoped, as time went on and as Imperial funds improved, that the Board of Agriculture will be able to do more for agricultural education and for agricultural colleges. He strongly commended the suggestion that a descriptive pamphlet should be issued by the college authorities setting forth what are the proceedings of the college and what young men are able to learn there. It was decided to ask the county councils to appoint representatives to consider the details of a scheme of organisation for the agricultural department at a conference to be held in October. The following resolution was passed:—that this conference desires to record its warm gratitude to the Board of Agriculture for the invaluable aid it has rendered to agricultural education in the counties affiliated to the University College of Wales at Aberystwyth. The conference is of opinion that the results already attained and the response to the help and guidance received from the Board by the local authorities out of their limited resources constitute a strong claim for largely increased grants from the central Government towards agricultural education, which is a matter of the highest importance in the interests of the kingdom and the Empire at large. In the afternoon Mr. Fellowes opened the recently acquired college and counties' training farm, which is situate about four and a half miles outside Aberystwyth, and has an area of 200 acres.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, June 7.—Dr. J. E. Marr, F.R.S., president, in the chair.—The microscopic structure of minerals forming serpentine, and their relation to its history: Prof. T. G. **Bonney** and Miss C. A. **Raisin.** The authors embody their investigations in the following conclusions:—(1) That both a tint and pleochroism are accidental rather than essential characteristics of antigorite. (2) Neither are low polarisation-tints characteristic, unless two mica-like minerals exist, otherwise indistinguishable. (3) That it is doubtful whether any hard and fast line can be drawn between antigorite and the more fibrous forms in ordinary serpentine rocks. (4) That the most typical antigorite appears when the rock has been considerably affected by pressure, but it becomes less so when the latter has been very great. (5) That so far from the nearly rectangular cleavage of augite originating the "gestrickte struktur," it is worse preserved than any other original one in the process of serpentinisation. Typical antigorite, however, apparently is rather more readily produced from augite than from the other ferromagnesian silicates, but is more directly a consequence of pressure than of chemical composition.—The tarns of the Canton Ticino: Prof. E. J. **Garwood.** The lakes dealt with comprise the larger Alpine tarns which occur in the Canton Ticino. Most of these drain into the Ticino basin; one or two, however, flow into the Reuss or the Rhine. These lakes owe their origin, when they are rock-basins, to the presence of lines of weakness, along which in many cases solution has taken place, while in some shallow tarns ice may have removed detached fragments; but in no case has a lake been found which can reasonably be assigned to ice-excavation independent of rock-structure.

Mineralogical Society, June 14.—Prof. H. A. Miers, F.R.S., president, in the chair.—The chemical composition of lengenbachite: A. **Hutchinson.** A quantitative analysis of the new mineral from the Binnenthal recently described by Mr. R. H. Solly leads to the formula $7PbS.2As_2S_3$, part of the lead being replaced by silver and copper, and part of the arsenic by antimony.—The chemical composition of hutchinsonite: G. T. **Prior.** Chemical examination of this new and extremely rare mineral from the Binnenthal described by Mr. R. H. Solly showed that it could be added to crookesite and lorandite as a third mineral containing the rare element thallium as an important constituent. Quantitative analysis, made on a small amount of material (about 70 mg.), showed the presence of about 20 per cent. of thallium, and suggested the formula $(Tl,Cu,Ag)_2S.As_2S_3 + PbS.As_2S_3$.—The identity of the amiantos of the ancients with chrysotile: Dr. J. W. **Evans.** The principal source of amiantos appears to have been Cyprus. Specimens brought by Prof. Wyndham Dunstan from the ancient workings on the slopes of Mount Troodos prove to be chrysotile, and not tremolite asbestos. A chemical analysis by Mr. G. S. Blake confirmed this result.—Gnomonic projection on two planes at right angles: Dr. J. W. **Evans.** By means of these projections and the rotation of one plane on an axis at right angles to the other, simple solutions of crystallographic problems are obtained.—The **President** exhibited supersaturated solutions of sodium nitrate showing the transition from the metastable condition, in which crystallisation is only possible in the presence of solid crystals, to the labile condition, in which the liquid can crystallise spontaneously.

Physical Society, June 16.—Prof. J. H. Poynting, F.R.S., president, in the chair.—On the ratio between the mean spherical and the mean horizontal candle-power of incandescent lamps: Prof. **Fleming.** This paper contains a theoretical deduction from first principles of experimental results given by Mr. G. B. Dyke in a paper read before the Physical Society on November 11, 1904, respecting the ratio of the M.S.C.P. of incandescent electric lamps to the M.H.C.P. taken when the lamp was rotating round a vertical axis. In the case of nine different types of electric glow-lamps, this ratio was found to be a number near 0·78. The author shows, by discussing the simple case of linear filament, that the ratio of the M.S.C.P. to the horizontal candle-power for this last case must be represented by the value $\pi/4 = 0{\cdot}785$, and hence that the constant ratio found experimentally by Mr. Dyke necessarily follows as a simple consequence of the fact that the light sent out in any direction from each unit of length of an incandescent filament varies as the cosine of the angle of inclination of the ray to the normal to the filament. In the paper it is shown also how a simple correcting factor may be obtained for reducing the actual horizontal candle-power of a linear filament of finite length to the candle-power in the same direction which would be found if the elements of the filament were concentrated on the axis of the photometer and all normal to it.—The electrical conductivity of flames: Dr. H. A. **Wilson.** The paper contains an account of a series of experiments on the conductivity of a coal-gas flame for electricity between platinum electrodes immersed in the flame. The variation of the current with the distance between the electrodes and the fall of potential along the flame are investigated by using a special burner producing a long narrow flame. The burner consists of a fused quartz tube with a series of small holes parallel to its diameter. The electrodes are two parallel discs of platinum, one fixed at one end of the flame, and the other capable of movement horizontally in the flame, so that it can be placed at any desired distance from the fixed electrode. The current through the flame was measured by a moving coil galvanometer, and the potential difference between the electrodes by an electrostatic voltmeter. The quartz-tube burner being a good insulator enables a current to be passed from one end of the flame to the other without fear of any of it going through the tube instead of through the flame. It thus enables the effect of putting salts into different parts of the flame to be easily studied.—Contact with dielectrics: Rollo **Appleyard.** Among the conclusions arrived at are the following:—(*a*) Except in the case of homogeneous dielectrics, it is misleading to deduce specific values referred to unit cube of the material from the results of tests on sheets. (*b*) With tin-foil electrodes, the apparent resistance of press-spahn diminishes as the load increases, and it attains a fairly constant value at a load of 400 grams per $cm.^2$. (*c*) If, with tin-foil electrodes, the load is gradually diminished after a load of 543 grams per $cm.^2$, the resistance gradually rises, but the rise is less rapid than the diminution in the former case (*b*). (*d*) When the full load with tin-foil electrodes is again restored the resistance falls to its minimum value. (*e*) For small loads, with tin-foil electrodes, the 2nd-minute deflection is in general greater than the 1st-minute deflection. As the load increases, a point is reached at which these deflections become approximately equal. For loads greater than about 360 grams per $cm.^2$, the 1st-minute deflection is in general greater than the 2nd-minute deflection. (*f*) Increase of voltage, with tin-foil electrodes, especially with small loads, behaves like increase of load, apparently increasing the contact area, and diminishing the observed dielectric resistance. Load, voltage, and the normal effect of "absorption" thus combine to determine the ratio of the 1st-minute deflection to the 2nd-minute deflection. (*g*) When mercury electrodes are used, the dielectric-resistance, as measured at different voltages, is sensibly the same, even for abrupt and great changes of voltage. (*h*) When mercury electrodes are used, the 2nd-minute deflection is in general never greater than the 1st-minute deflection. The inference is that when, with tin-foil electrodes, the converse is the case, it arises from imperfect contact, and not from the material itself. (*i*) When mercury electrodes are used, the dielectric-resistance, as measured with a voltage applied in a given direction, is sensibly the same as that measured with the voltage reversed, and this equality appears to become greater after a few reversals. (*j*) There is a critical load at which tin-foil electrodes yield fairly accurate results. With greater loads there is danger of crushing the material. With a less load the contact is faulty.—The pendulum accelerometer; an instrument for the direct measurement and recording of acceleration: F. **Lanchester.**—A new form of pyknometer: N. V. **Stanford.**

Royal Meteorological Society, June 21.—Mr. Richard Bentley, president, in the chair.—Normal electrical phenomena of the atmosphere: G. C. **Simpson.** In no branch of physics has the discovery of "ions," "electrons," and "radio-activity" produced a greater revolution than in that devoted to atmospheric electricity. In this paper the author endeavoured to state the chief line along which during the last few years investigations have been made and the conclusions arrived at, and also to point out some of the problems awaiting solution. The amount of radio-active emanation in the lower regions of the atmosphere is increased by all those meteorological conditions which tend to keep the air stagnant over the earth's surface. The meteorological conditions which either cause or often accompany stagnant air are calm, low temperature and high relative humidity, while, on the contrary, high winds, high temperature, and low humidity generally accompany the mixing of large masses of air. This all agrees with the observed facts that the atmospheric radio-activity increases with falling temperature, rising humidity, and increasing wind strength.—Two new meteorological instruments: G. P. **Ferguson.** The instruments described were:—(1) automatic polar star light recorder for recording the amount of cloudiness at night; and (2) the ombroscope, an instrument for determining the time and duration of rain. Both these instruments are in use at the Blue Hill Observatory, Mass., U.S.A.

PARIS.

Academy of Sciences, June 19.—M. Troost in the chair.—On the preparation and properties of nitryl fluoride: Henri **Moissan** and M. **Lebeau** (see p. 206).—On some alkyl thujones and the combinations of thujone with aromatic aldehydes: A. **Haller.** The thujone was converted into its sodium derivative by means of sodium amide in ethereal solution, and this acted upon by the alkyl iodide. The preparation and properties of methyl, ethyl, propyl, and allylthujone are described, the special object of the work being to study the influence of the introduction of the alkyl group on the rotatory power. Thujone was also condensed with benzaldehyde, anisaldehyde, and piperonal, the effect in these cases being an enormous increase in the rotatory power. Special experiments were made to see if in the course of the work the thujone had been converted into isothujone, but this was found not to be the case. An improvement in the method of preparation of isothujone from thujone is also described.—Observations on the Giacobini comet (1905 *a*) made with the large equatorial of the Observatory of Bordeaux: Ernest **Esclangon.** The observations were made on May 2 and 9.—On the influence of concentration on the magnetic properties of solutions of cobalt: P. **Vaillant.** If A be the coefficient of magnetisation of a solution containing N equivalents of water and n of salt, then $A=K'N+Kn$, where K and K' are the coefficients characteristic of the water and the salt. It was found that the value of K was nearly independent of the concentration and of the nature of the salt, the chloride, nitrate, and sulphate being studied. The slight variation of K observed would appear to be due to ionisation.—On a basic ferric sulphate: A. **Recoura.**—The chemical properties of the anhydrous chloride of neodymium: Camille **Matignon.** Hydrogen at 1000° C. has no action upon the dry chloride, no trace of a subchloride being detected. Oxygen slowly converts the fused chloride into the oxychloride, NdOCl, water giving rise to the same substance. Hydriodic acid slowly converts the chloride into the iodide, and the bromide is formed with hydrobromic acid by a similar reaction.—On a method for determining the specific heats of solutions. The molecular heat of good and bad electrolytes: P. Th. **Muller** and C. **Fuchs.** The liquid is heated by a glass spiral containing mercury through which a constant current is passed, water and the solution being alternately introduced into the calorimeter. The causes of the differences between the specific heats of solutions of electrolytes and non-electrolytes are discussed.—Researches on the mercury formates: Raoul **Varet.** A thermochemical paper.—On some new nitrodinaphthopyranic derivatives: A. **Robyn.**—On sparteine; the stereoisomerism of the two iodomethylates: Charles **Moureu** and Amand **Valeur.** These two iodomethylates cannot be distinguished by their behaviour on heating, as they both split up quantitatively into methyl iodide and sparteine, and hence the author regards the isomerism as of a stereochemical order.—The influence of electrolytes on the mutual precipitation of colloids of opposite electrical sign: Larguier **des Bancels.**—On a new form of tartrate of thallium, and on isomorphous mixtures of the tartrates of thallium and potassium: Jean **Herbette.** Although the tartrates of thallium and potassium belong to different crystalline systems, mixtures of these salts exhibit a true isomorphism; the properties of the mixed crystals of these two salts do not vary in proportion to the chemical composition. A case analogous to this has already been pointed out by Groth for a mixture of potassium chlorate and permanganate.—The action of liquid air on the life of the seed: Paul **Becquerel.** The resistance of seeds to low temperatures depends entirely upon the quantity of water and gas contained in their tissues. If this quantity of water and gas is sufficient, the cold disorganises the protoplasm and nucleus in such a manner that life is impossible, but if the protoplasm has by drying attained its maximum concentration, it completely escapes the action of the low temperature, and the seed preserves its germinating power.—An enemy of the Tonkin coffee plant, the Xylotrechus of the dry bamboo: Louis **Boutan.**—Researches on the ethnology of the Dravidians. The anthropological relations between the mountain tribes and the castes of the plain: Louis **Lapicque.**—On the presence of graptolith schists in the High Atlas of Morocco: Louis **Gentil.**—On the formation of the Rochefort Cave (Belgium): E. A. **Martel.**—On the evolution of the fossil mammals: Marcellin **Boule.** A reply to a criticism of M. Depéret.—The meteorology of total eclipses of the sun: W. **de Fonvielle** and Paul **Bordé.** Remarks on the work done by Sir John Elliot on the lowering of the temperature during the eclipse of the sun.

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