NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 2414, Vol. 96] THURSDAY, FEBRUARY 3, 1916 [PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

THURSDAY, FEBRUARY 3, 1916.

INDIAN LOCAL FLORAS.

The Flora of the Nilgiri and Pulney Hill-tops (above 6500 feet), being the Wild and Commoner introduced Flowering Plants round the Hill-stations of Ootacamund, Kotagiri, and Kodaikanal. By Prof. P. F. Fyson. 2 vols. Vol i., pp. xxvi+475. Vol. ii., 286 illustrations. (Madras: The Superintendent, Government Press; London: Thacker and Co., 1915.) Price 10 rupees or 15s. 2 vols.

THE need for guides to the plants of particular Indian districts has been felt since English rule was established in the East. The wish to meet it, perhaps stimulated by the posthumous publication of Roxburgh's "Flora Indica" in 1832, led to the preparation of Graham's Bombay "Catalogue" in 1839, of Munro's "Hortus Agrensis" in 1844, and of Voigt's "Hortus Calcuttensis" in 1845. The appearance in 1855 of that fine fragment, the "Flora Indica" of Hooker and Thomson, led to Sir W. Elliot's "Flora Andhrica" for Madras, of which the only part was issued in 1859, and to Dalzell and Gibson's "Bombay Flora," published in 1861. In 1872 Sir Joseph Hooker commenced as an official undertaking his masterly "Flora of British India." After this date, except as regards Bombay, the requirements of forest officers involved the provision of Beddome's Madras "Flora Sylvatica" and Brandis's "Forest Flora of North-west and Central India" in 1874, Kurz's "Forest Flora of British Burma" in 1877, and Gamble's "List of the Trees, etc., of the Darjeeling District" in 1878. With these exceptions, between 1872 and 1897, when the last volume of Hooker's "Flora" appeared, the energies of Indian botanists were directed to assisting that author in his arduous task.

The official scheme involved the preparation, using Hooker's pioneer work as a basis, of local floras of Bombay, Madras, the Panjab, Upper and Central India, Bengal, the North-west Himalaya, the Eastern Himalaya, Assam, and Burma. These provincial floras were in turn to serve as the foundation, where required, of floras of still narrower areas. The necessary local flora of Bengal was completed in 1903; that of Bombay in 1908; that for Upper and Central India, begun in 1903, is nearly complete; that for Madras is in hand and has made considerable progress. Delays have attended the preparation of those for the Panjab and the North-west Himalaya; the time is not yet ripe for those of the Eastern Himalaya, Assam, or Burma. Based on the Bengal work, divisional or district floras of Chutia Nagpur and the Sundribuns have been issued; similar works for Central India and Dehra Dun, the district in which the Imperial Forest School is situated, have been based on that for Upper India.

India is a country where public officers aim at efficiency; the letter is never there permitted to kill the spirit of a prescribed programme. Hence the appearance in 1902 of Sir Henry Collett's "Flora Simlensis" for a North-west Himalayan district, before the preparation of the corresponding provincial flora could be undertaken, and the appearance now of a similar work by Prof. Fyson for a South Indian district, before the Madras local flora has been completed. The justification in both cases is the same and is ample. The Palnis and the Nilgiris, like the Simla hills, are holiday resorts, the visitors to which during vacation leisure take an intelligent interest in natural objects and desire to learn something of what they see.

The area dealt with by Prof. Fyson is not a continuous one and, apart from this, does not lend itself readily to physiographical delimitation. The author has therefore wisely confined his attention to the constituents of the relatively temperate and herbaceous vegetation met with above the level of 6500 feet, where there is a rapid, if not abrupt, change from the tropical and sub-tropical arborescent flora lower down, rather than endeavoured to include every species that occurs within a definitely circumscribed area. His descriptions are clear and full, and his field experience has led him to deal not only with species that may be regarded as indigenous, but with those that have almost certainly been introduced. How important the introduced element in his area is we gather from the fact that one-seventh of the species dealt with are thoroughly established aliens.

As in the case of the corresponding work for Simla, illustrations of a considerable number of the Nilgiri and Palni plants described by the author are provided. For the original drawings he has been particularly indebted to Lady Bourne, herself for many years a close and critical student of the vegetation of the Palnis; a number of the illustrations are by Mrs. Harrison and Mrs. Fyson. In order to secure most of the others, Prof. Fyson has successfully adopted the method of Roxburgh at the close of the eighteenth century and of Wight in the earlier half of last century, by enlisting the services of a skilful young Indian artist. The result has been satisfactory, and the flora before us should serve its purpose well. There are a few misprints in addition to those enumerated in the list of errata; perhaps the most obtrusive, if intrinsically one of the least important, is Thompson for Thomson on p. 277.

BRITISH WARBLERS.

The British Warblers: a History, with Problems of their Lives. By H. Eliot Howard. Illustrated by H. Grönvold. Two volumes. (London: R. H. Porter, 1907–1914.) Price 10*l.* 10*s.* net, 2 vols.

"IT is almost impossible to study systematically any species, no matter how common, without continually adding to our store of knowledge and noticing new facts; and such facts may lead to the solution of problems connected with the mystery of life and the greater mystery of development." This sentence of Mr. Howard's may seem trite enough; but it comes not amiss to British ornithologists, whose energies have been mainly occupied with the classification and distribution of species and with the discovery of new subspecies or local varieties rather than with biological questions. Mr. Howard's work, which has been coming out in parts since 1907, has certain decided advantages in comparison with its predecessors, though it deals only with a few species, and biologically only with about a dozen. First, it is the result of most persevering watching, mainly at that time of the day when birds are more full of life than at any other—the hours immediately following sunrise—and at the time of year when, from a biological point of view, they are best worth watching, *i.e.* the months from their arrival in this country to the end of the breeding season. It is true that we have to depend as yet largely on Mr. Howard's evidence alone. But that evidence is, to my ornithological feeling, not only to be trusted with confidence, but extremely stimulating; and as soon as the war is over we shall have numbers of good observers ready to spend their early hours in the woods as vigilantly as in the trenches.

Again, Mr. Howard has not been content with the collection of facts, but endeavours honestly and independently to interpret them, raising and discussing certain biological questions which they suggest. In fact, the work is a valuable study in biology. Imperfect it assuredly is, for the birds treated of from close personal experience are few, and Mr. Howard's experience has been growing during the seven years of publication; but these imperfections are of small moment compared with the stimulus given to inquiry, which has already begun to work among our field ornithologists. If the main results attained could be published in a small and comparatively cheap volume, well thought out, and perhaps more concisely and lucidly expressed than are the more scientific parts of these two big volumes, the benefits of the work would reach a much larger circle than is possible at present.

There is yet another advantage possessed by this book, viz., that it is illustrated by drawings of the most exquisite beauty and delicacy instead of by photographs. The most valuable of these, *i.e.* those which help us to "visualise" the author's observations, seem to be based on his own rough sketches made during observation, worked up to an artistic product with consummate skill and good faith by Mr. Grönvold. Mr. Howard is warmly to be congratulated on having the courage and the means to abandon the cumbrous camera for the mental impression and the pencil. When you are watching little creatures that creep about in dense cover, photography is really impracticable; and if you want to reproduce the attitude of such small birds for a third person you can do it much better if you are an artist than if you are a photographer, if only you have that tender feeling for the living bird which gives you intense delight in all its movements.

Mr. Howard's name will always be associated with what he calls the law of territory—a law which Mr. J. M. Dewar has recently been successfully applying in the *Zoologist* to the oyster-catchers of the Firth of Forth. We are all familiar with exemplifications of this law, and the only reason why it has not been promulgated before is that we have not been up early enough in the morning to realise its working fully. We know well enough that with the exception of the swallow tribe, which find their food in the air entirely, each pair of our summer migrants (and many, too, of our resident species) occupies a certain territory which serves as feeding-ground and playground. If a railway bank is patronised by whinchats, there will be a pair every hundred yards or so; along a roadside it is the same with yellowhammers; in a wood, in reeds, in osiers, with various species of warblers. In such positions as these three last the territories may differ from year to year according to the condition of the cover, but the rule holds good all the same.

Now Mr. Howard has gone far beyond this elementary statement of the law. His vigils have led him to the conviction that this territory is of immense importance in the life of our warblers; that the desire to secure it is what hurries on the males in front of the females during migration; that the vigorous singing on arrival is an announcement of occupation, and a defiance to other candidates for it; and that the bird's sense of boundary is unmistakable, though it may not exactly coincide with that which the observer imagines it to be. (See remarks on this point on p. 10 of the section on the willow warbler.)

There may well be some doubt as to whether the male birds, in hurrying on, are in any way conscious of this particular end to be attained. Mr. Howard knows well that the sexual organs of these males are beginning to be enlarged before migration, *i.e.* the sexual impulse lies behind the whole operation. If the females of these species are weaker in vitality at the time of migration, this might be enough (as Darwin, I think, thought) to account for the earlier arrival of the males. More convincing is Mr. Howard's oft-repeated assertion that he has seen nothing in these territories to support the theory of sexual selection. What seems to happen is this: a male arrives and takes possession of a territory, and sings vigorously, awaiting a female. If another male intrudes, either before or after the appearance of the female, fights ensue and the intruder is driven out, but there is no indication that the female ever chooses between two males. The song and the strange antics (of which the book contains many beautiful drawings) are the result of sexual emotion, but are not the result of rivalry with another individual. The object is rather to overcome the coyness of the female—which reminds me of Mr. Crawley's theory of a similar phenomenon among primitive human beings, only to be overcome by a ceremony, *i.e.* marriage. This view of the bird's emotional antics leads Mr. Howard to another theory, viz., that the instinct known as "shamming wounded" is only an emotional display of the same kind. In this he was in part anticipated by Mr. W. H. Hudson, who, in his "Birds in a Village" (p. 64, *cp.* "Naturalist in La Plata," chap. xv.), explained the nearly related death-feigning instinct by actual paralysis of the nervous system. More careful observation, combined with physiological knowledge, is needed here. Yet another interesting problem is discussed in connection with the blackcap and marsh warbler, viz., the imitative faculty in song, where the mystery consists in the fact that birds of the year seem to be able to make these imitations without having ever heard the songs which they mimic.

I have perhaps said enough to give some idea of the importance of this contribution to our knowledge of the life of these warblers, and of the urgent need of the embodiment of some of its main conclusions in a cheaper form. I will conclude this notice by congratulating the author on having written the first complete account of the marsh warbler and its life during the breeding season. It is, perhaps, a pity that he should have cumbered this account by a preliminary twenty pages of somewhat obscure biological discussion, which might have formed an appendix or a chapter by itself; but when he is telling what he has himself seen of this charming species, nothing could be better. Only on one or two small points does my experience differ from his. He believes that this bird originally built in reeds like the reed warbler, on no other ground that I can discover but that the nest is sometimes hung in its supporting plants after the fashion of that closely allied species. I do not for a moment doubt his statement, but during my long experience of marsh warbler nests, both in England and abroad, I have never seen one that I could not recognise as such at once. One other point I would contest with him. I believe it to be quite impossible that this species should have been freely distributed in England and yet undiscovered up to the middle of the last century; surely the extraordinary brilliancy of the song is sufficient proof of this. The nest, too, is by no means hard to find, yet among old collections the only undoubted marsh warbler's egg I have ever seen is one found in Somerset some sixty-five years ago, which is now in the possession of the Rev. O. Pickard-Cambridge, of Bloxworth. I am strongly of opinion that the bird has long been, and still is, *slowly* increasing its range.

W WARDE FOWLER.

EDINBURGH MATHEMATICAL TRACTS.

(1) *A Course in Descriptive Geometry and Photogrammetry for the Mathematical Laboratory.* By E. L. Ince. Pp. viii+79. (London: G. Bell and Sons, Ltd., 1915.) Price 2*s*. 6*d*. net.

(2) *A Course in Interpolation and Numerical Integration for the Mathematical Laboratory.* By D. Gibb. Pp. viii+90. (London: G. Bell and Sons, Ltd., 1915.) Price 3*s*. 6*d*. net.

(3) *Relativity.* By Prof. A. Conway. Pp. 43. (London: G. Bell and Sons, Ltd., 1915.) Price 2*s*. net.

(4) *A Course in Fourier's Analysis and Periodogram Analysis for the Mathematical Laboratory.* By Dr. G. A. Carse and G. Shearer. Pp. viii+66. (London: G. Bell and Sons, Ltd., 1915.) Price 3*s*. 6*d*. net.

(5) *A Course in the Solution of Spherical Triangles for the Mathematical Laboratory.* By H. Bell. Pp. viii+66. (London: G. Bell and Sons, Ltd., 1915.) Price 2*s*. 6*d*. net.

(6) *An Introduction to the theory of Automorphic Functions.* By L. R. Ford. Pp. viii +96. (London: G. Bell and Sons, Ltd., 1915.) Price 3*s*. 6*d*. net.

THE publication of this series may be taken to show that the experiment of issuing tracts on advanced mathematical subjects has been a success. The field is so wide that there is no serious risk of overlapping, especially if the different publishers will announce their programme as soon as they can. Sir George Greenhill, as a veteran tractarian, ought to be personally interested in these successors of his tract on the calculus.

The present series, so far, deals mainly with practical affairs—fortunately not without regard to theory; four of the six tracts are said to be "for the mathematical laboratory." It is to be hoped that this term will not be hackneyed: it is not very happy, in any case, for "a mathematical laboratory" ought to include any place where mathematical experiments are carried on, and experiments are more important than methods of computation. "Number-room" would be shorter and more descriptive; but let that pass, and let us go on to summarise the contents of this parcel.

(1) This has the merit of appreciating the work of Monge, in many ways the greatest master of orthogonal descriptive geometry. The introduction is interesting, though rather amorphous; for instance, the article on "laboratory methods" would have found a better place at the beginning of chapter ii. This chapter deals with a good number of the really fundamental problems on lines and planes; chap. iii. on curved surfaces and space-curves is of a more familiar and less valuable type; chap. iv. is on perspective, and, though very brief, gives some useful hints; chapter v. is on photogrammetry, and the most novel of all. The weakest point in the tract is that nothing is said about dealing with lines that do not meet on the paper; theoretically this is unimportant, but in a drawing-office it is another matter, and auxiliary vanishing points have to be used frequently.

(2) So far as we can judge, this seems to be very well done. There is an outline of the theory of finite differences, the classical formulæ of Simpson, Lagrange, Gauss, etc., and a number of worked and unworked examples. In another edition it might be worth while to give the constants required for Gauss's method (p. 88) in the form of decimals as well as in that of surds.

(3) It is difficult to say what will be the ultimate physical way of stating the principle of relativity, but, thanks chiefly to Minkowski, the mathematical theory is assuming a simple invariant form. The four chapters of this tract deal respectively with Einstein's formulæ, transformation of electromagnetic equations, applications to electron theory, and Minkowski's transformation. Criticism of a physical nature must be left to others; the purely mathematical treatment seems to be all that can be desired. Unfortunately there are very few references—not even one to Minkowski's papers. Without references, a tract cannot perform its proper service as an introduction to an important subject.

(4) This is perhaps the most interesting of the "laboratory" tetrad. The subject being limited, the author is able to give a detailed account, with good examples, of the way in which an irregular periodic graph can be reduced to its harmonic constituents. For work on electric oscillations this tract ought to be very useful. There is also a chapter on spherical harmonics.

(5) This will appeal to astronomers and ordnance survey people, and sailors. The main novelty is the last chapter, on graphical methods, which gives an account of the ingenious inventions of D'Ocagne, Chauvenet, and others. There are numerous examples, worked out to seven places; and others unsolved for the practice of the reader.

(6) This is an excellent tract on what is now an extensive subject. The main points are very clearly put; room has even been found for an outline of non-Euclidean geometry, and the expression of co-ordinates of points on an algebraic curve as one-valued functions. There is a bibliography which seems to include most of the books and papers of really first-rate importance; and there is a sufficient number of diagrams. English-speaking students ought now, at any rate, to appreciate Poincaré's wonderful discoveries in this field.

Mathematicians owe a special debt to Prof. Whittaker for the work he is doing in connection with this series; his encouragement and help are acknowledged in handsome terms by several of the authors.

G. B. M.

OUR BOOKSHELF.

Evolution. By J. A. S. Watson. Pp. vii + 153. (London: T. C. and E. C. Jack, 1915.) Price 5*s.* net.

THE object of this work is apparently to provide, in small compass and with copious illustrations, an account of evolution from the lowest forms of life to man. "The Evidence for Evolution" forms the subject-matter of the first chapter, in which well-chosen lines of argument are briefly laid down and illustrated. The three succeeding chapters treat respectively of "Unicellular and Multicellular Animals," "The Worms and some of their Posterity," and "The Early Vertebrates and the Fishes." The fifth, "The Conquest of the Land," leads on to the sixth and concluding chapter, "The Mammals and Man." The illustrations, 146 in number, are largely borrowed from German sources, although the author is wrong in attributing the bust of *Homo primigenius* (Fig. 145) to a German sculptor. It was modelled by an American lady, daughter of Alphæus Hyatt, who will be affectionately remembered by many British naturalists. It is unfortunate that the abundant illustration should have been permitted to justify the heavy, thickly loaded paper used throughout the book. Apart from this distressing feature, the printing is good and clear, and there are not many errors, among which, however, "Neandertal," "Axolotyl," and "trachea" for the plural (p. 71) were noticed. The figures are sometimes good and mostly adequate, a small proportion being distinctly bad. In some of them the description fails to account for the whole of the reference letters.

In speaking of the analogical groups of the Australian Marsupials (on p. 130), the wombat as a representative of the Rodents is an obvious omission (probably the author intended wombat when he wrote bandicoot); and in asserting that there are no marsupial bats, the flying phalangers should have been mentioned as analogous to the flying squirrels. The statement that the size of insects is "somewhat strictly limited" (p. 71) might have been modified by a reference to Carboniferous times, when these forms had the air to themselves.

We believe, in spite of the faults to which attention has been directed, that the book will be useful because of the wide ground covered, the good selection of examples, and the brevity and clearness of the text. E. B. P.

The Gases of the Atmosphere: The History of their Discovery. By Sir William Ramsay. Fourth Edition. Pp. xiii+306. (London: Macmillan and Co., Ltd., 1915.) Price 6*s*. net.

JUST complaint has been made recently in NATURE of the dearth of good modern popular or semi-popular literature calculated to inform the public of the methods and achievements of natural science. Nothing could be better for this purpose than Sir William Ramsay's book on "The Gases of the Atmosphere," for here we have a first-hand account of modern discoveries in a connected and highly interesting narrative, and presented in a sufficiently elementary style to make the subject intelligible to a large reading public.

Since the book appeared in 1896 a second and third edition have been issued, keeping the story abreast of discovery. In this, the fourth, edition there is not much new matter beyond an account of the remarkable work done by the author and Dr. Whytlaw-Gray on *niton*. The passage of the story from a record of the intrepid and masterly discovery and isolation of the companions of argon into the realm of radioactivity and modern alchemy is perhaps natural and excusable to the author; but it has the effect of a change of key, and causes a fine record of fact to conclude on a note of speculation.

It is impossible in reading this history of the gases of the atmosphere, in which very even justice seems to be done to all discoverers, not to be struck by the honourable part which has been borne by British men of science. Boyle, Mayow, Black, Priestley, Cavendish, Ramsay, and Rayleigh; to these add Scheele and Lavoisier, and no name remains to attach to any capital discovery about the chemistry of the atmosphere. Without in the least wishing to fall into the evil habit of belittling German chemistry, one may be excused for remarking upon its inconspicuousness in this particular field of work. A. S.

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.]*

Colourless Crystals of Hæmoglobin.

MAY I have some of your valuable space in order to put a question to physiologists and physicists whom I could not reach so conveniently in any other way?

For a long time I have been puzzled by the existence of colourless—white—crystals of hæmoglobin. If one carries out the familiar experiment of mixing a drop of rat's blood and water on the microscopic stage, one finds that while the majority of the crystals grow out as reddish needles, a few crystals appear to be without colour from the first. But more striking still: I have in my possession a preparation of guinea-pig's blood in which, amongst the beautifully formed, deep red, regular tetrahedra (in which form that animal's hæmoglobin crystallises), there are a few crystals quite as well formed as the rest which are perfectly white. The preparation is two years old; originally all the crystals were red; only a few have become bleached during the last year or so. It may be suggested that the preparation has been unduly exposed to the light; this is not so; except when occasionally examined it has been in the dark.

But what *is* colourless hæmoglobin? Physiologists do not know it, or at least they have not described it. Colourless hæmoglobin in the above sense is not mentioned in the exhaustive monograph of Reichert and Brown. So far as I can learn, no leuco or colourless state of hæmoglobin is recognised analogous to the leuco state (reduced state) of hæmocyanin, a blue respiratory pigment, or to the leucoplastid condition of chromoplastids in plants.

Can these crystals of guinea-pig's blood be regarded any longer as hæmoglobin seeing that all trace of colour or pigment has vanished from them? Is there such a thing as colourless hæmoglobin; are these things not contradictory terms? There is no question here of the removal of hæmatin or of iron from the crystals. The crystals have not been in contact with living tissues or with any active chemical substances at all. Hæmoglobin in old blood-clots, etc., in the living tissues is converted by the removal of iron into hæmatoidin, which, though not always crystalline, is always coloured. Reduced hæmoglobin we know, but it is still a coloured substance (purple), still a pigment; it has a spectrum. If these white, crystalline forms are not hæmoglobin, what are they? And if they are still hæmoglobin, the essence of which is to be a pigment with a spectrum, how can hæmoglobin be colourless? The bush that burned and was not consumed is simple compared with the problem here.

D. FRASER HARRIS.

Dalhousie University, Halifax, N.S.,
January 12.

Asteroids Feeding upon Living Sea-Anemones.

THE following instances of asteroids feeding upon living sea-anemones may be of general interest.

On October 27 three healthy examples of the sun-star (*Solaster papposus*), of 8 to 9 cm. across their extended arms, were placed in an aquarium at the Horniman Museum at Forest Hill. The aquarium already contained a whelk shell on which was an average-sized "parasitic" sea-anemone (*Sagartia parasitica*). It should here be remarked that the sun-stars were well fed daily (on pieces of fish, beef, mussel, or starfish), and they could not therefore have been driven by hunger to eat unaccustomed food. At 9.30 a.m. on December 31 it was discovered that one of the sun-stars was on the pebbles, humped in the characteristic feeding posture over the sea-anemone, which had apparently been dragged from the shell. Some of the arms of the sun-star were raised and attached by their tube-feet to the glass of the aquarium, and the stomach of the asteroid could clearly be seen enveloping about one-half of the coelenterate. Numerous white acontia were attached to the under-parts of the sun-star. At 10.30 a.m. on the following day the sun-star was still upon the sea-anemone. The sea-anemone was now removed from the aquarium, and it was found on examination that the dead coelenterate was closed, and that the integument of its upper parts, together with most of the tentacles, had disappeared, having apparently been digested away.

On January 13 another "parasitic" sea-anemone, the diameter of whose circle of extended tentacles was about 4 cm., was placed in the aquarium, and at 9.30 a.m. on January 15 it was found that it also had been dragged from its shell and was enveloped by a sun-star, which may or may not have been the same individual. On this occasion the sun-star was not disturbed in its meal. On January 17 it was still upon the sea-anemone, but it had dragged its prey up a vertical rock. When the sun-star was gently lifted, it was found that the sea-anemone was inside the partially everted stomach, only the central part of the base of the coelenterate being exposed. On the morning of January 18 (that is, at least seventy-two hours after the attack) the sun-star was still humped a little, and on its being turned over it was found that there were no signs of the sea-anemone, except a small dark-brown slimy mass, which the sun-star hastily discharged from its mouth.

The apparent indifference of the sun-star, with its everted, and one would think vulnerable, stomach, to the acontia is to be remarked. It would be of interest to know whether any reader of NATURE who may be working at the asteroids has witnessed or heard of an incident similar to those described above. I may add that another average-sized "parasitic" sea-anemone has been in the tank since the introduction of the sun-stars, but it has not yet been eaten, although a sun-star will occasionally place itself over the coelenterate and then creep away again.

H. N. MILLIGAN.

Devonshire Road, Forest Hill, London, S.E., January 29.

William Smith's Maps.

I AM preparing a monograph on Smith's maps, etc., for the Yorkshire Geological Society, and am anxious to see a "Reduction of Smith's large Geological Map of England and Wales intended as an elementary map for those commencing the study of Geology, 1819," referred to in Phillips's "Memoirs of Smith."

I find that Smith's large maps of 1815 often bear a signature and a number such as "No. 66," or "a 33." If any readers of NATURE possess copies of this large map perhaps they would kindly inform me what number the map bears. It occurs under the "Section of Strata," which appears on the map to the east of the Humber estuary.

T. SHEPPARD.

The Museums, Hull, January 25.

OPTICAL SIGHTS FOR RIFLES.

OF all instruments needing accurate pointing, the rifle has been longest deprived of the aid of optical appliances. Probably this is due to a variety of reasons, among them being: (1) the rough usage to which a rifle may be subjected; (2) its use in warfare is essentially youth's prerogative, with ample visual accommodation, so that the disadvantage of open sights is not acutely felt; (3) the little incentive received from the use of the shot gun with its spreading discharge, and short range not demanding optical aid, as practice and judgment enter largely into the act of aiming in much the same way as they do in throwing a stone. Nevertheless, it is apparent that the rifle is progressing through various phases as other pointing instruments have done.

The drawbacks of open sights are obvious—a near back-sight, a foresight, and a distant object all require to be focused at the same time, or rapid visual accommodation made (see NATURE, June 24, p. 462).

Optical sights for rifles may be divided into three classes: (1) The use of lenses without any tube, as in the early aerial telescopes, the

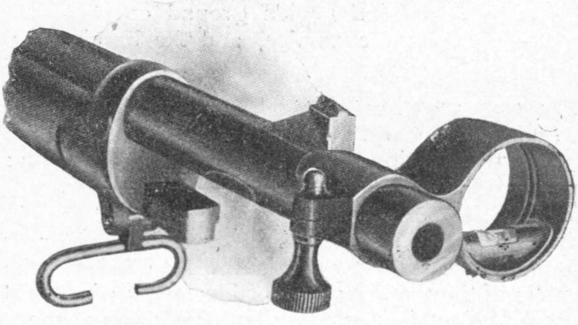

FIG. 1.—Common's optical sight, showing lens at muzzle end, as made by Ottway and Co., Ealing.

rifle itself being used as a base on which the lenses or lens and sighting hole are independently mounted. (2) Use of lenses to give a reference line, with or without other optical aid; these are termed collimating sights. (3) Telescopes, prismatic or otherwise, complete in themselves with optical or mechanical appliances for elevation or deflection, and means for ready attachment to the rifle.

One of the earliest of class 1 is to be found in a patent by Chase in 1893, in which the foresight consisted of a lens mounted near the muzzle of the rifle, the focal length of the lens being such that objects sighted at a distance had their images in the same plane as the rear sight. This image could be viewed either by the naked eye or by optical means, and, of course, it appeared inverted. Such an instrument has obvious disadvantages, but is capable of bringing all the demands on the eye to a vision of one plane.

Another single lens sight which is entirely practical, and has achieved considerable success, was patented by the late Dr. Common in 1901 and called by him "the optical rifle sight." It consists of a lens mounted near the muzzle of the rifle, and a pin-hole or orthoptic mounted near the breech; the focal length of the lens is greater than the distance between it and the pin-hole. Figs. 1 and 2 show one of the arrangements employed. The whole sight weighed about three ounces, and there was the minimum of apparatus to get out of order. The line of aim is provided by the line joining the pin-hole and a small dot ground on the lens at the optical centre, the lens being edged so that the spot is also the geo-

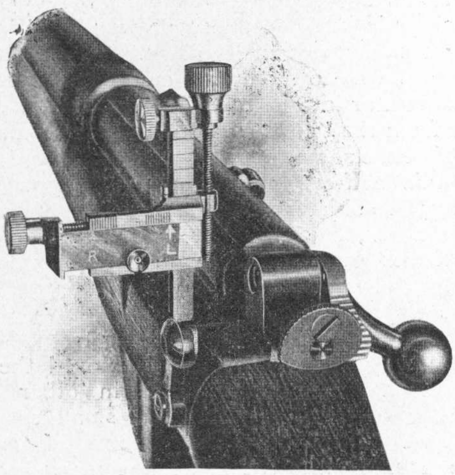

FIG. 2.—Pin-hole or orthoptic near breach end.

metrical centre in order to provide against rotation of the lens in its mount; the orthoptic can be elevated or deflected as shown, and thus any line of aim suitable for a rifle can be attained. The sight gives a magnification of about three times.

In introducing this sight Dr. Common offered a prize in the Bisley meetings of 1902 and 1903, the service rifle to be used, the range being 1000 yards, and the optical sight to be so mounted that it did not interfere with the ordinary open sights of the rifle. Some good shooting resulted,

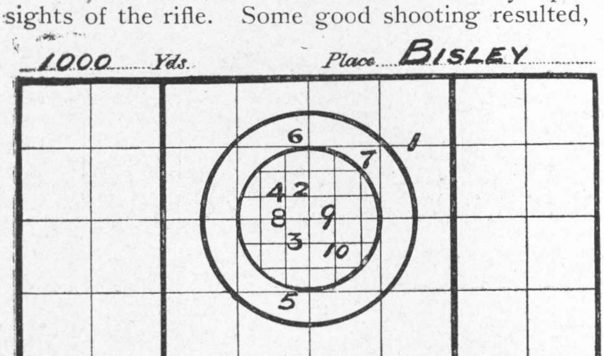

FIG. 3.—Hits by a tyro using Dr. Common's optical sight.

and as a proof of the efficiency of the sight Fig. 3 represents the hits by the writer, who had never previously shot at the butts. This sight received some theoretical criticism as regards its use by "myopes," but by practical trials with lenses of suitable focal length, two riflemen with eye corrections of -2 diopters were able to improve their shooting considerably. To make the sight suitable for different visions, the Birmingham Small Arms Co. made an improvement by adding a negative lens to the orthoptic, thus converting the sight into a Galilean telescope; this improves the definition of the target, and since vision is made through the concave lens and a peep-hole,

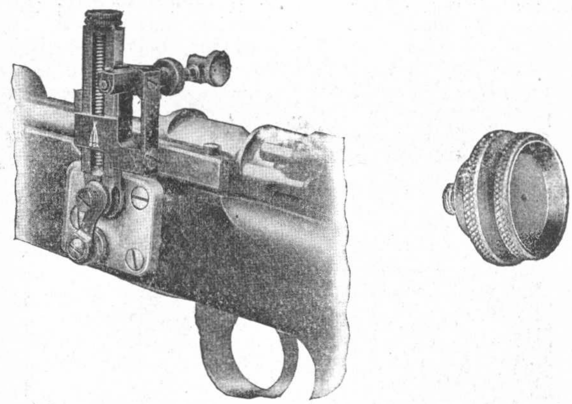

FIG. 4.—Orthoptic and negative lens back sight for use with optical fore sight, as made by the B.S.A. Co.

the definition of the mark on the lens is not seriously impaired.

Coming to collimating sights, the earliest, that by Sir Howard Grubb, was described in NATURE of January 9, 1902. The following is a quotation from that article:—

By means of the sight a virtual image of a small bright cross or circle is projected on the object aimed at. The earliest form in which the sight was made

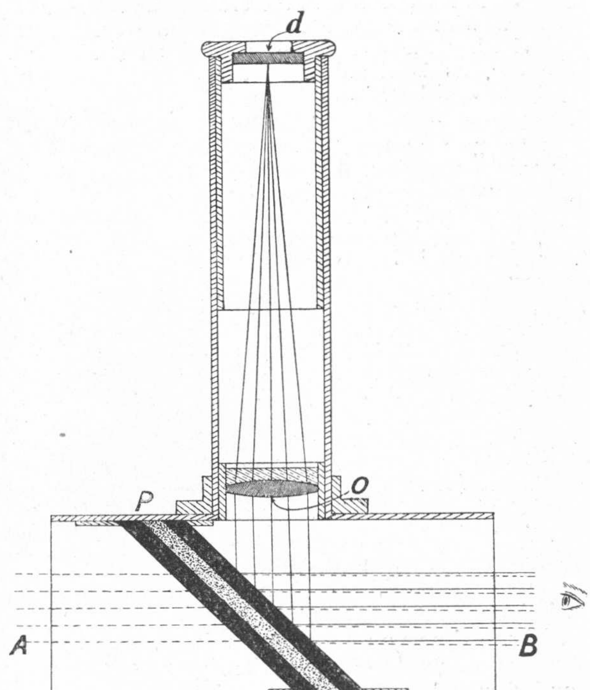

FIG. 5.—Sir Howard Grubb's collimating sight.

is shown in Fig. 5, in which the object aimed at is viewed through a tube open at each end, a piece of parallel glass, PP, being fixed at an angle of 45° to the axis of the tube. In another tube at right angles to the former a diaphragm d is fixed, made of an opaque substance through which fine lines are scratched in the pattern of a cross or star or circle. O is an achromatic lens, and the distance between the cross and the lens equals the principal focal length of the lens; so that rays of light passing through the cross, on reaching the lens, are by it made parallel; they

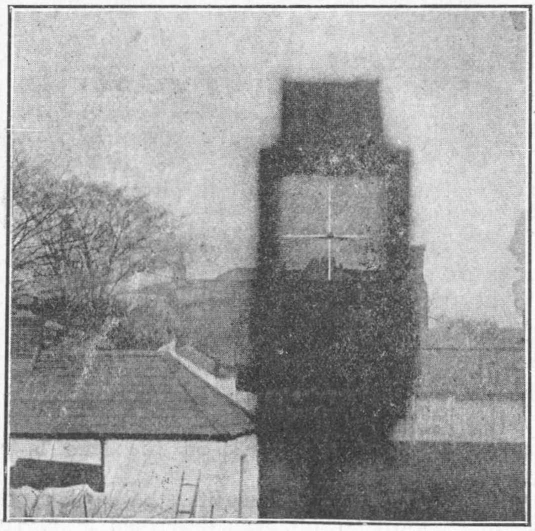

FIG. 6.—Grubb's sight aligned on a distant object.

are then reflected by the plates PP as parallel rays to the observer's eye, and the observer sees a "virtual" image of the cross coinciding with the object aimed at, and apparently at the same distance as the object. This optical device causes the cross to be seen sharply defined, with the same focusing of the eye required for viewing the distant object, and all straining of the eye, as is the case in the old system, vanishes; also there is no parallax, and therefore the eye need not be kept in one position. This "virtual" image of the cross forms a foresight projected to a long distance in front of the rifle, as if it were carried upon an invisible, imponderable, and inflexible prolongation of the barrel.

The optical arrangement of the sight was afterwards modified to make it convenient for mounting on a graduated arc attached to the rifle, but its principle remained the same. Grubb's sight may be used with or without a telescope, since the same focus suits both the object and the image of the cross; also by cutting divided scales on the diaphragm glass, useful estimates may be made of both distance and windage.

Fig. 6 shows a photograph taken by a camera placed behind the sight and focused on a distant object; both the fiducial cross of the sight and the distant object are seen to be in perfect focus.

Several other collimating sights followed, the simplest, apparently originating in France, though patented by Krupp in England, is one in which a long Stanhope lens is used, the lens having a V-shaped channel cut along its entire length, and the apex of the channel being the axis of the lens. A sight may thus be taken along the groove, whilst at the same time a portion of the pupil of the eye catches parallel rays issuing from the lens, on the flat remote face of which is a fiducial mark.

Mr. Dennis Taylor, of the firm of Messrs. Cooke and Sons, York, took out a patent in 1901, in which use was made of a Galilean telescope to which was attached a collimator; the upper half of the eye-lens of the telescope was cut away and a prism substituted in its place. The function of the prism was to direct the emergent beam from the collimator into juxtaposition with the emergent beam from the telescope, so that both beams were visible at the same time. Dr. Common and others used this half-eye or half-pupil arrangement for viewing two objects at the same time, but none met with success, chiefly because the average person experiences great difficulty in adjusting the eye with that nicety required to catch the two beams at the same time.

To obviate the difficulties arising from the half-pupil arrangement, Common employed the principle of the collimating sight in other ways; in a patent of 1901, he used a small collimator with its mark at the principal focus of the lens, hence, looking into the sight, the mark appeared at infinity. If, now, both eyes remained open, one might be used to look at the object aimed at, whilst the other eye looked into the collimator; the fiducial mark could then be superposed on the target. This sight would answer perfectly well

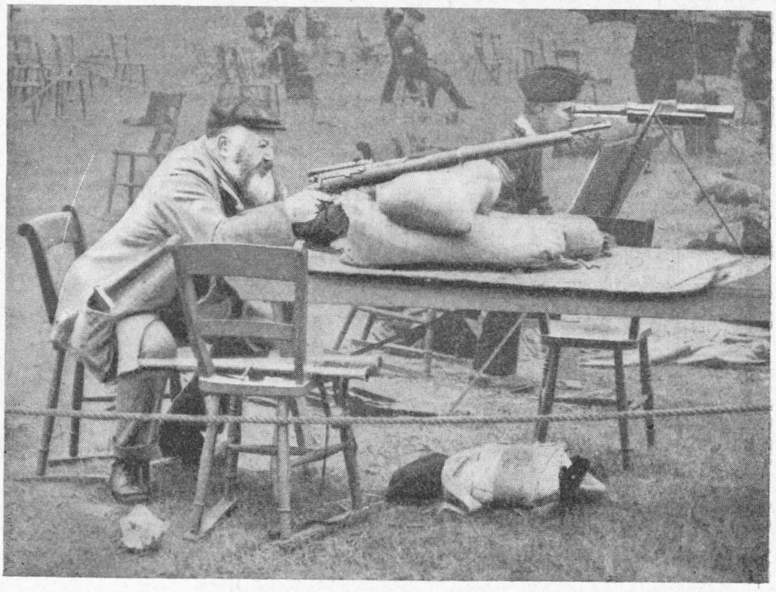

FIG. 7.—Dr. Common shooting with telescope rifle sight in "Winans" competition, Bisley, 1902.

if fusion of the different visual fields could be obtained, but when the eyes are used in this way, "antagonism of the visual field" occurs [1] and the whole or part of one of the fields may be suppressed and the sight becomes useless.

[1] Tscherning, "Physiological Optics," p. 323.

In a patent of 1902 Dr. Common used the combination of a collimator and a Galilean telescope, much in the same way as that of Mr. Dennis Taylor described above, but with this difference: the collimator mark was placed beyond the principal focus of the lens and thus the rays emerged convergent, the convergency being the same as the rays within the telescope proceeding from the objective. The rays were then deflected by an inclined mirror and were brought to a focus on the same image plane as that of the telescope's objective, and could thus be viewed by the same eye-piece.

Many of the above sights have the inherent defect of the Galilean telescope, *i.e.*, a very small field, and were merely side issues to the purely telescope sight, with its large field and compact form. One of the earliest telescope sights is to be seen at Bisley, and was used in the U.S.A. Civil War. From then onwards many attempts were made to combine successfully the rifle and telescope to withstand active service. By 1901 Common had perfected his telescope rifle sight, and he was shooting at Bisley in the "Winans" competition of that year with a telescope sight, which to this day has not been improved as regards the principles employed. The body of the telescope was of steel, light and strong, a minimum of parts was used, and every fundamental part was rigidly fixed so that the shock of firing could not disturb the optical axis. The lenses of the eye-piece were so arranged that the Ramsden circle was nearly two inches behind the telescope, so that the jerk of recoil could not easily cause injury to the eye, and the emergent pencil was large and easily picked up. Inside the telescope a parallel plate of glass, turning about a vertical axis, was provided to give a lateral deflection to correct for windage. The whole was mounted on a base, inclinable by means of a specially shaped cam to provide for elevation when long ranges were required; whilst for shorter distances the telescope was fixed and allowance for change of range was made by moving the sighting pointer by means of a screw. The whole was then so arranged that it could be instantaneously attached firmly to the rifle near the breech without interfering with the ordinary open sights.

Some German firms embodied all Common's ideas in the manufacture of telescope sights, even to the use of eccentric rings in which the object glass was mounted for the adjustment of the axis of collimation, but Zeiss made use of a "Leman" prism, a variety of the "Porro" prism system which the firm had used in the manufacture of binoculars. The Zeiss prism telescope sight is really a small periscope, the prism system enabling the eye to be placed on a lower level than the object glass. It is a small instrument, but in consequence of the number of reflections and thickness of the prism, more light is lost in transmission than in the simple telescope; further, its shape is not conducive to easy alignment. In order to obtain elevation for different ranges, the object glass is mounted in a sliding fitting which is actuated by a milled edge ring. On turning the ring a vertical motion is given to the object glass and a corresponding shift to the optical axis; the ring is graduated to suit the equivalent change in range.

In the Zeiss and the similar Goerz prism rifle sight, means are provided for illuminating the cross wires at night. A small beam of light is transmitted through the edge of the glass diaphragm on which the lines are engraved; most of the light passes through the diaphragm, since

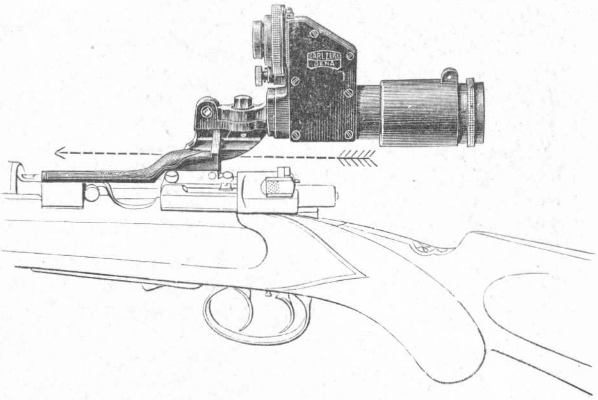

FIG. 8.—Zeiss prism telescope sight.

total internal reflection is secured, except where the rays strike the incisions in the glass, thus illuminating them, whence they appear as bright lines on a dark field.

Later, for long-range shooting and machine-guns, this sight has been mounted, by the Aktiengesellschaft Hahn für Optik, on an elevating arc to obtain the various ranges, and the objective made adjustable in a plane at right

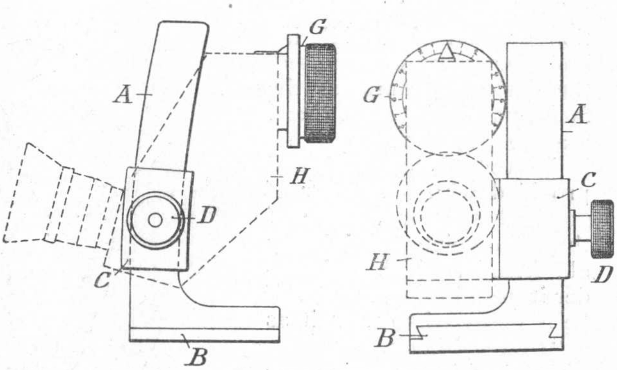

FIG. 9.—Prism telescope sight on elevating arc with lateral correction to object glass for windage.

angles to the line of vision to obtain the lateral displacement for wind and other causes.

Accurate shooting in modern warfare is essential, whether of rifle or machine-gun; a hit is more valuable than any number of misses. The telescope sight is an aid to this end, but it is handicapped by the fact that rifles are not made with breech ends suitable for its easy attachment, but probably its severest handicap is the lack of official encouragement of the optical industry in this country. W. S.

PREHISTORIC ART.[1]

IN an advancing science like anthropology, it is well to take stock periodically of the material which is so rapidly being accumulated. Mr. Parkyn in this book displays much industry in studying the literature of the subject; but his work must not be taken to be the last word on the subject, nor does it supply an adequate history of prehistoric art. His survey covers an enormous period, from the Palæolithic Age down to that of Late Keltic ornament, and the pressure on his space in dealing with such a mass of material necessarily forbids detailed investigation of evolution or æsthetics, while his imperfect sense of style and the desire to compress the facts make his book hard reading. At the same time, it is well documented and provided with a number of good illustrations, some of them in colour, and many old friends, which will render it useful to the student if he is prepared to treat it as a "source" book. It may be used with advantage as a supplement to the "Ancient Hunters," by Prof. Sollas, who has described with notable success early man from the physical and ethnographical side.

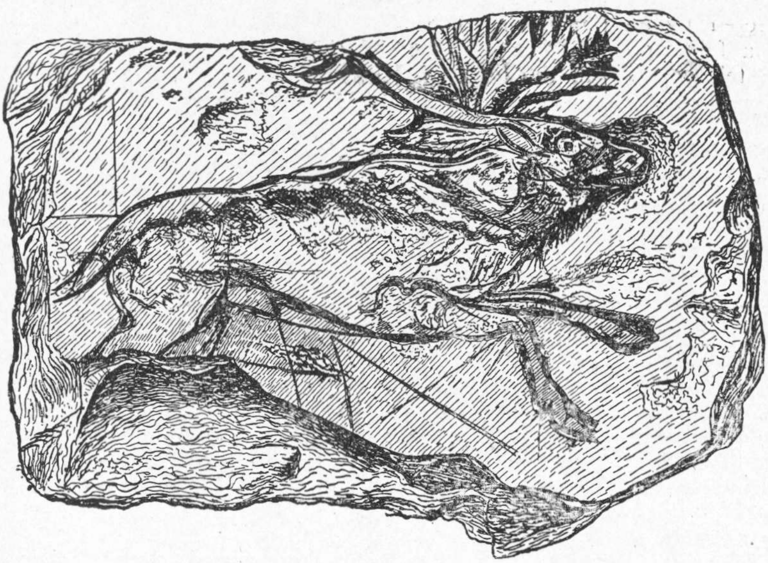

FIG. 1.—S. Marcel. Reindeer on schist. (Natural size.) From "An Introduction to the Study of Prehistoric Art."

The account of the cave frescoes, which constitutes the most valuable part of the book, opens up a school of art our knowledge of which starts from the discovery in 1879, by M. S. de Santuola, of paintings in the now celebrated cave of Altamira à Santilane, near Santander, in north-west Spain. Since then numerous discoveries in the Pyrenean and Dordogne regions and in Spain have largely added to our knowledge. They introduce us to an art school, keen observers of the animal life which surrounded the workers, and possessed of admirable skill both in drawing and painting. Mr. Parkyn, except in a summary way, does not discuss the many points of interest suggested by these frescoes. He believes that the art of sculpture preceded those of engraving and painting, but the materials at present available seem to be insufficient to indicate the seriation or course of evolution of these phases of art production. Another interesting fact is that while the artists represent animal forms with much skill and powers of observation, their delineations of the human form are little better than caricatures, even if it be admitted that some examples represent masked dancers. Again, as at the cave of Combarelles, the paintings occupy the walls, not of the outer dwelling-place, but are found in an interior gallery. These facts have led to the theory that the frescoes adorned the walls of some kind of shrine in which a form of animal or totemistic cult may have been carried on. The human performers are regarded as subordinate to this ritual, whatever form it may have taken, and the object of the cult may have been to promote the fertility of the fauna which supplied their food or to act as a kind of magical performance to ensure success in the chase. But all this is still very uncertain, and we must await fuller knowledge.

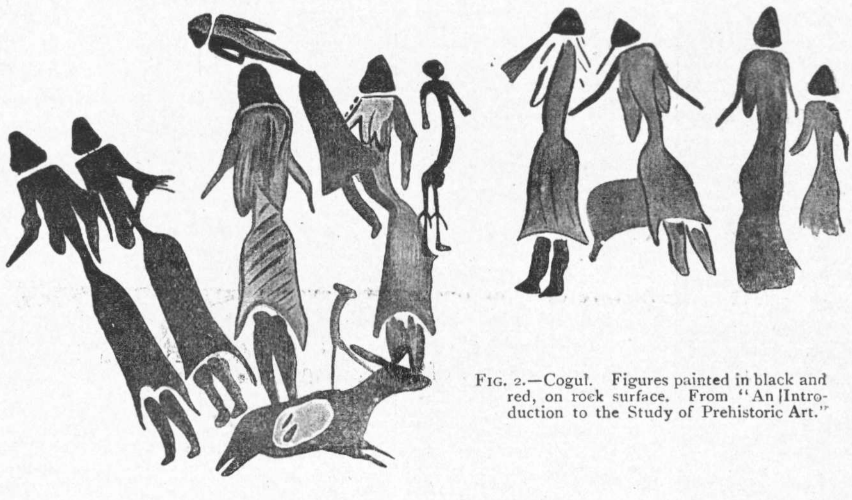

FIG. 2.—Cogul. Figures painted in black and red, on rock surface. From "An Introduction to the Study of Prehistoric Art."

Another interesting point which might have been discussed with more detail is the strange

[1] "An Introduction to the Study of Prehistoric Art." By E. A. Parkyn. Pp. xviii+349. (London: Longmans, Green and Co., 1915.) Price 10s. 6d. net.

break in artistic skill, of which we have at least two instances: the decline in skill in stone-work in the Solutrian period as compared with that of La Madelaine, and the equally remarkable failure in artistic powers of Neolithic as compared with Palæolithic man. In the first case, Mr. Parkyn suggests that the decline was due to the worker finding other fields for his artistic skill in the use of bone and horn instead of stone, and to the growth of the taste for engraving. In the latter case it can only be suggested that it depends on a difference of race and environment, the age of polished stone marking the beginnings of settled life, agriculture, and cattle-raising.

Enough has been said to indicate the value of this book, provided that the reader does not expect from it what it was not intended to supply. The field is still open for a monograph on the art of the Ages of Stone in which the evolution of the crafts of these early workers and the artistic spirit shown in fresco, sculpture, and the working of an intractable material like flint shall receive adequate examination.

THE ORGANISATION OF EMBRYOLOGICAL RESEARCH IN AMERICA.

WHEN British anatomists come to examine "Contributions to Embryology,"[1] which have been issued by the Carnegie Institution of Washington as publications numbers 221, 222, they will be less than human if they do not feel a twinge of jealousy. Five-and-twenty years ago anatomists in America were British in method and in spirit; they were easy-going, each man following leisurely his own individual bent. Since that time a remarkable change has taken place; the number of laboratories in which the structure and development of the human body are taught and investigated have increased tenfold; the number of investigators has grown in a still greater ratio; in quantity and quality their anatomical proceedings and journals have come to rival those of any country in Europe.

In effecting this transformation the chief credit must be assigned to one man—Franklin P. Mall, for twenty-three years professor of anatomy at the Johns Hopkins University. He planted in Baltimore the methods and aims which he acquired when working in the laboratory of the late Prof. His at Leipzig. By his personal influence and example, by pupils and disciples, and by reason of the inherent excellence of the Leipzig traditions, he has succeeded in Germanising the majority of the dissecting rooms and anatomical laboratories throughout the length and breadth of North America.

The issue of "Contributions to Embryology" marks a new phase in the career of Dr. Mall and the beginning of another period in the history of human anatomy in North America. In 1913 Dr. Mall issued "A Plea for an Institute of Human Embryology."[2]

[1] Carnegie Institution of Washington Publications, Nos. 221, 222. "Contributions to Embryology." Vol. i., No. 1. Vol. ii., Nos. 2–6. Vol. iii., Nos. 7–9.

[2] *Journal of the American Medical Association*, 1913, vol. lx., p. 1509.

"At present," he wrote, "it seems impossible for the investigator-teachers to make greater progress than is here shown without better organisation, and it is for this reason that I renew the plea of His for an Institute of Human Embryology. Only in this way can we hope to secure a complete *embryologic* and scientific basis for human anatomy which, it is being recognised, is in a chaotic state. . . . There should be an Institute of Human Embryology just as there is one for Human Palæontology recently founded in Paris by the Prince of Monaco."

The conception of founding such an institute in North America is Dr. Mall's, but the possibility of its realisation was Mr. Carnegie's. At the close of last year (December, 1914) the trustees of the Carnegie Institution of Washington established a Department of Embryology, appointed Dr. Mall as Director, and gave him an "investigatory staff," which includes some of the leading embryologists of the present day, with all forms of skilled assistants needed in laboratories of such a kind. At present Dr. Mall and his staff are housed in the cheap brick building which forms the Anatomical Department of Johns Hopkins University. The new institution or department of embryology is already at work, and the manner in which it is to fulfil its destiny may be inferred from the high quality of vols. i. and ii. of "Contributions to Embryology."

In vol. i. Dr. Mall gives the results of minute examination of 117 specimens where the human ovum had been arrested in the Fallopian tube, and started to develop there in place of passing on to its normal site in the uterus. When the late Mr. Lawson Tait, some thirty years ago, showed that the lives of women who were the subjects of tubal pregnancy could be saved by prompt operation, the condition was supposed to be rare; we now know that it is common, and there is an ever-growing body of evidence which demonstrates that it results from an inflammation of the tube, often venereal in nature. The facts observed by Dr. Mall support the theory of an inflammatory causation. In above 90 per cent. of the cases he found that the embryo was also diseased or arrested in development. For anyone who would continue a research on tubal pregnancy—or who may wish to know the best that can be known of the subject at present—a study of Dr. Mall's records and illustrations is absolutely essential.

In the second volume there are five papers, all of them forming definite and useful additions to our knowledge of the human embryo. Dr. James Crawford Watt describes two very young twin embryos, at a stage of development which has not been recorded before. Prof. Eliot Clarke gives an embryological explanation of a very rare anomaly—a subcutaneous vessel taking the place of the thoracic duct. Dr. Charles R. Essick describes certain transitory cavities which occur in the developing ganglia at the base of the brain. The two remaining papers are devoted to the growth of the human fœtus and to the development and nature of the corpus luteum of the ovary.

In vol. iii. the same high standard is maintained, both as regards the quality of the text and excellence of the illustrations. Prof. Florence Sabin gives a summary of her researches into the development of the great systemic veins of the abdomen, the result being to modify very considerably our present conception of the nature and origin of the inferior vena cava. She found that the posterior cardinal veins disappear with the Wolffian bodies during fœtal life, and take no part in the formation of either the inferior vena cava or azygos veins. We note that Miss Sabin has attained her ends by reverting to a method which had fallen into disuse—that of injecting the embryonic blood vessels. Dr. J. Duesberg contributes a paper on "Recherches cytologiques sur la fécondation des Ascidiens et leur développment," his conclusions being in support of those experimental embryologists who believe that the bases of the organs of an embryo are localised at certain definite points in the cytoplasm of the developing ovum. The final paper in vol. iii. is by Dr. P. G. Shipley and Dr. G. B. Wislocki, and describes the development and structure of the poison glands of *Bufo agua*. The secretion of these glands contains a substance identical with that secreted by the suprarenal bodies. At the same time, this paper shows the advantage of combining the labours of an expert chemist with those of an expert anatomist.

A. K.

SCIENCE AND COLONIAL AGRICULTURE.

AN article in a recent number of the *Agricultural News* (Barbados) discusses the probable effects of the war upon the organisation of science from the Imperial point of view in relation to industry generally and in particular to Colonial agriculture. This subject has been dealt with so exhaustively on all sides during the last twelve months that it would seem impossible to advance any new ideas about it, but the writer of the article selects two fundamental causes as responsible for the state of affairs prevailing until recently. He believes that the British character includes a keen appreciation of mechanical invention without any appreciation of the scientific research underlying it. The second reason is that science as a profession is considered by the older universities and public schools as lacking in the essentials of refinement, and that this social stigma deters able men of good position from entering it. But this deduction is surely incorrect; the true explanation lies in the fact that the prizes that science can offer are so meagre compared with those held out by other professions. The social question is merely a secondary effect. This aspect of the matter was referred to by Sir William Tilden, speaking as a representative of the Royal and Chemical Societies at a deputation to the Government a short time ago.

While in the case of manufacturing industries individual enterprise in recognising the true value of scientific work, can, and actually has, achieved much, practically nothing can be done in relation to agriculture without organisation. No single farmer can afford to employ an expert to advise him on the scientific cultivation of his land, nor can any single scientific worker, however able, cope with more than a few of the varied problems that practical agriculture constantly presents. For this reason agricultural science is, in most countries, much more highly organised than any other of the applied branches. We do not think there are serious grounds for the fear expressed by the *Agricultural News* that in the general move to help the manufacturer British and Colonial agricultural science may be neglected. The Imperial Government seems to be alive to the importance of encouraging agriculture in all its branches within the Empire, and while some alteration of methods may be necessary, it is unlikely that any permanent reduction of scientific work will occur.

It is interesting to learn that in the West Indies there is the same lack of intelligent contact between the actual producer and the scientific worker that is still too obvious at home. There is also a need of more frequent intercourse between the agricultural experts, which is hindered by the natural difficulties of communication among the islands, and now almost impossible owing to the war. An optimistic view is taken of the future; it is hoped that the brighter outlook for science will attract more men of the best type, and that in the renaissance of science throughout the Empire agriculture will play its part.

THE PROPOSED CLOSING OF MUSEUMS.

AS we write, there are rumours that the Government is reconsidering the question of the closing of museums, at all events as regards the Natural History Museum, but, whatever be the ultimate decision, the whole affair has been a moral victory for museums, especially for those illustrative of science. We might have gone on for years without suspecting this warm appreciation on the part of the public; but the mere threat of a temporary closing has aroused a hurricane of protest, remarkable alike for the variety and vigour of its expression and for the number of interests and classes represented. One of the advantages of a non-party Government seems to be that it elicits the real opinion of the nation, and surely it is long since a Government proposal has been rejected with so near an approach to unanimity. Its supporters in the Press have included Mr. Evelyn Cecil, whose unhappily chosen parallels of football, fox-hunting, and racing only make more clear the essential educational value of museums; and Mr. Harold Cox, who quotes Madame de Maintenon to the effect that we all advocate retrenchment except when it affects ourselves. This is true, but when everybody cries out, it is because the interest attacked has become almost a necessity of life.

The necessity and the value in their diverse aspects have been emphasised in the *Times* and other periodicals by Lords Morley, Bryce, Grenfell, Sudeley, and Sydenham, by Sir Richard

Temple, Sir F. Treves, Sir Thomas Barlow and other distinguished physicians, Sir Edward Fry, and Sir Harry Johnston, by Dr. A. E. Shipley and Dr. Gregory Foster, by Mrs. Creighton and Mrs. J. R. Green, by Messrs. Halsey Ricardo, Walter Sichel, and Frank Brangwyn, as well as by a number of distinguished people more immediately connected with museums of art or science. The dubious economy of the proposal was well brought out in letters by Mr. G. W. Prothero and a "Past President of the Museums Association."

In a few cases the writers attempted to overcome difficulties which really do not exist. The claim that the closing alone will effect a saving of 50,000*l.* cannot be maintained in the light of Lord Morley's figure of only a little more than 2000*l.* for the huge Natural History Museum. The idea that the galleries of this museum could be used for clerical work was, we believe, suggested some time ago, but presumably found impracticable. Many suspect a reason in the greater safety of the collections; but this was attended to long since, and the removal of the more valuable objects from the public galleries of various museums has not impaired their educational activities; indeed, the contrary has been maintained. The idea that a number of active young men are still at work in these establishments is on a par with the myth of the policemen of military age. No body of men rushed more readily to the colours, and we do not believe that one is left to be compelled. If convalescent soldiers were employed to watch the galleries they would only release veterans who are, or soon will be, candidates for Chelsea Hospital; far better let the commissionaires, who perform their duties so admirably, stay where they are, and employ the convalescents elsewhere. One offer, however, might well be accepted: if there are competent people willing to help with demonstrations in the galleries, by all means let them. Even if red tape delays an official welcome, there is nothing to prevent them from organising small parties on their own initiative, and so doing a really useful work. Such aid would at all times be valuable on Sunday afternoons.

The Government may withdraw, but have our rulers learned their lesson? Do they understand that, instead of suppressing museums, they should utilise them? And the museum-people in their turn—possibly if some of them were a little more ready to adapt their exhibitions to the necessities of the time, no Government would dream of dispensing with such potent allies.

SIR CLEMENTS ROBERT MARKHAM, K.C.B., F.R.S.

JUST the accident of setting his bed alight with a candle, and the shock resulting from his effort to subdue the flames, led to the death of Sir Clements Markham on the evening of Sunday last, January 30, at his residence in Eccleston Square, London.

Sir Clements was in his eighty-sixth year, and although intellectually vigorous he had been a sufferer from gout for some years past, and was frequently confined to his room, where his active mind was ever engaged in those literary researches in the field of geography the results of which are so well and so widely known. He was a member of a good old northern family; his great-grandfather (not his grandfather as stated in the *Times*) was Archbishop of York, and at one time Headmaster of Westminster School, a fact which accounts for the deep interest in that school which was maintained by Sir Clements during his lifetime. His grandfather was William Markham, private secretary to Warren Hastings and resident at Benares, who stood in the same relationship to Admiral Sir Albert Hastings Markham as to Sir Clements.

Sir Clements Markham was born at Stillingfleet in Yorkshire, his father (Rev. David Markham) being vicar of that parish and Canon of Windsor. His mother was a Milner. The Markhams were a naval family, and young Clements followed the family profession, entering the Service in 1844 and retiring as a lieutenant in 1852. His early experiences as a sailor coloured his scientific outlook during his whole career. He was a devoted friend to the sailor, and this devotion led to an enthusiastic support of naval (Royal Naval) enterprise in Arctic and Antarctic fields which occasionally pressed rather hard on the requirements of other geographical projects. It was as a sailor, after his experiences with the Franklin Search Expedition in 1850–51, that he commenced his literary career, a career which marked him as perhaps the most prolific geographical writer of the day.

So early as 1852 Sir Clements acquired his first experiences as a land explorer in South America, when he visited Peru on a quest for information about the Inca period, and it was there that he made those investigations which rendered him an expert authority on that country. His greatest work in the cause of humanity was undoubtedly the introduction of cinchona from Peru into India, on which enterprise he was employed by the Secretary of State for India in 1859–60. He was successful both in the collection of plants and in the arrangement of plantations in India. The beneficial results of that enterprise to the fever-stricken plains and jungles of India can only be compared with those which have been attained by the discovery of the germ-carrying mosquito. Quinine was at once placed within financial reach of the mass of the people. Peruvian experiences formed the subject of books and pamphlets which appeared from his pen at intervals for many years. "The Incas of Peru," published in 1910, was the latest.

From 1863 to 1888 Sir Clements was one of the Hon. Secretaries of the Royal Geographical Society. They were busy years when pioneer explorations from every part of the known world into regions of the unknown were leading to sensational revelations and extending our geographical map knowledge with great rapidity. His position as secretary brought him into direct contact with most of the leading explorers of the day, and his untiring energy and literary ability were of the greatest service to the Society in collating and recording the result of world-wide investigations. He received the gold medal of the Society in 1888, when he became its president, a position which he held for eight years. Meanwhile, in 1868, he joined the expedition which reached Magdala (Abyssinia) under Lord Napier; and it is evidence of his unusual capacity both for personal observation and the collection of material which would in these days be classed under the head of "intelligence," that he wrote the best popular account of that remarkable expedition which has yet appeared. For ten years after this Sir Clements was in charge of the Geographical Department of the India Office, and this appointment gave him the opportunity for rescuing from oblivion the neglected records of the Indian Navy, and of writing a history of the Indian Survey. The latter is the only popular work on this subject which exists, and it much wants a writer of the ability of Sir Clements to bring it up to date.

As president of the Royal Geographical Society Sir Clements Markham has left an abiding name. It is not too much to say that he gave his whole soul to the work of maintaining the usefulness of the Society in every branch of geographical activity. He succeeded in impressing the administrative authorities of Government, as well as those of the leading universities, with the necessity for widespread geographical education. Geographical schools and teachers began to be busy, and much of the present interest which is maintained in maps (to be found in every newspaper now) is due to his initiative. If Sir Clements appeared to be somewhat autocratic in council it is at least due to him to say that it was his personal determination which carried through many a project which would have failed in weaker hands. Notably he must be credited with the success of the first Antarctic expedition under his own nominee, Captain Scott. That expedition gave an impetus to Antarctic discovery which has not ceased yet. As president at the meetings of the Society he was a clear and vigorous speaker, and he always succeeded in importing something of his own vitality into every subject which he handled. A firm, strong friend was Sir Clements, and a somewhat pugnacious enemy; a man of strong views, and possessed of that rare courage—the courage of his opinions. As president of the Hakluyt Society he rescued many an old record from oblivion, and has given to the world a series of most interesting books of ancient adventure and travel—works which will survive through the ages. T. H. HOLDICH.

NOTES.

THE issue of *Science* for December 24 last prints an address by Dr. L. H. Baekeland delivered before a recent joint meeting of the New York Section of the American Chemical Society, the American Electrochemical Society, and the Society of Chemical Industry, on the recent proposals of the Naval Consulting Board of the United States. Dr. Baekeland is a member of the board, and this address is the first public report of the discussions of the board on the so-called "five-million laboratory" proposed by the Naval Consulting Board. The contemplated outlay for the navy for the next five years, for new ships, aviation, and reserve of munitions, amounts to 100,000,000*l.*, and the argument of the address is that an expenditure of this magnitude ought to be made as efficient as possible. All doubtful and inferior devices must be eliminated by direct experiment, by research and tests, before it is too late to remedy them. The advisory board has stated the facts as it saw them, and confronted the secretary of the navy with the probable maximum expenses for research and experimentation, commensurate to the five years' naval building programme now under contemplation. The five-million dollar budget, or 1,000,000*l.*, for experimental work to be expended during those five years, or about 200,000*l.* a year, may, says Dr. Baekeland, strike the uninitiated as needlessly large, although it is only about what some industrial enterprises have found necessary to spend on their own experimental work. The corrosion of condenser tubes of American warships involves an annual damage of about 400,000*l.* If 200,000*l.* were spent on research on this problem alone, with the result of reducing the damage to one-half, the total outlay would be compensated in a few months' time, aside from the important fact that the fleet would be stronger because less of the ships would be unavailable for service.

DR. C. GORDON HEWITT, dominion entomologist of Canada, has been elected president of the American Association of Economic Entomologists for 1916.

AT the annual meeting of the Challenger Society on January 26 the following officers were elected for the ensuing year:—*Secretary,* Mr. C. Tate Regan; *Treasurer,* Mr. E. T. Browne; *Committee,* Dr. S. F. Harmer, Mr. D. G. Lillie, and Prof. E. W. McBride.

THE gold medal of the Royal Astronomical Society has been awarded to Dr. J. L. E. Dreyer, for his contributions to astronomical history and his catalogues of nebulæ; and it will be presented at the annual meeting of the society to be held on Friday, February 11.

THE annual meetings of the Institution of Naval Architects will be held on Wednesday, April 12, and the following day, in the hall of the Royal Society of Arts, John Street, Adelphi, W.C. Owing to the continuance of the war, the council has decided that it would be unsuitable for the customary entertainments to be given; the annual dinner and evening reception will accordingly not take place.

THE death is announced of Mr. F. M. Webster, a leading American entomologist, at the age of sixty-six. He was professor of entomology at Purdue University from 1885 to 1888, and had held various scientific official positions in connection with the States of Illinois, Indiana, and Ohio, as well as the Federal Department of Agriculture. At the time of his death he was in charge of the cereal and forage-crop insect

NOTICE.

For the convenience of readers of NATURE wishing to inspect books *published abroad* which have been reviewed in NATURE such volumes are kept for the period of six months at the publishing office of the journal. The books are retained for the purpose of examination free of charge.

St. Martin's Street, London, W.C.

PRINTED IN GREAT BRITAIN BY R. CLAY AND SONS, LTD., BRUNSWICK STREET, STAMFORD STREET, S.E., AND BUNGAY, SUFFOLK.

investigations of this department. One of his most important inquiries was that on which he was engaged from 1886 to 1890 in the solution of the problem of the buffalo gnat in the valley of the Lower Mississippi.

DR. E. W. HILGARD, who has died in California at the age of eighty-three, was a native of Rhenish Bavaria, but was taken to the United States by his parents in early childhood. His scientific studies were pursued at Heidelberg, Zurich, and Freiberg. He became successively State geologist of Mississippi, professor of chemistry at the University of Mississippi, and professor of geology at the University of Michigan. His chief work was done as professor of agriculture at the University of California from 1874 to 1904, and as director of the California Agricultural Experiment Station from 1888 to 1904. In 1875 he established the first experiment station in the United States. He also inaugurated the system of "farmers' institutes." He received the Liebig medal from the Munich Academy of Sciences, and a gold medal from the Paris Exposition of 1900. Dr. Hilgard was the author of numerous reports and monographs, dealing especially with the investigation of soils.

BY the death of Sir Francis H. Lovell on January 28 tropical medicine has lost one of its most ardent advocates. For a period of many years, as dean of the London School of Tropical Medicine, Sir Francis directed and encouraged a work of incalculable benefit to mankind. By missions to the East and to the West he was able to bring home to the dwellers in the tropics the value of a study of tropical diseases, and collected funds to a substantial amount for the endowment of the school. Francis Lovell began his life-work as Colonial Surgeon of Sierra Leone, 1873–78. He then became chief medical officer of Mauritius, and member of the Legislative Council, 1878–93, and was afterwards appointed Surgeon-General of Trinidad and Tobago, and member of the Executive and Legislative Councils, 1893–1901. He retired from the Colonial service in the latter year, and in 1903 became dean of the Tropical School, to the council of which he brought a ripe experience and a full appreciation of the value of scientific research. He was a fellow of the Royal College of Surgeons, was created C.M.G. in 1893, and received the honour of knighthood in 1900. A man of sterling worth and genial personality, his death leaves a blank which will not be filled easily.

THERE is now at the London Library a small but very interesting exhibit of early printed books on astronomy, from the collection of Mr. Gilbert R. Redgrave. Many of them are from the press of Erhard Ratdolt, whose fine work at Augsberg and Venice is so well known. There is a splendid copy of a "Kalendar" by Monteregio (otherwise Regiomontanus), in Italian, and an even finer one in Latin, both printed by Ratdolt at Venice in 1476—works now of great rarity. There is also a very rare folio tract by the same author, "Universis Bonarum Artium Studi," printed at Nuremberg in 1476. These appear to be in absolutely perfect condition. Among other fifteenth-century books mention may be made of a fine copy of Hyginus, "Poeticon Astronomicon," of 1487, as well as the less rare edition of 1488. The diagrams of eclipses, etc., are frequently coloured—some by hand and some printed in colours. Two works of later date, but of special interest, are Galileo's "Istoria e dimostrazioni," of 1613, describing the newly discovered spots on the sun, and announcing the configurations of Jupiter's satellites, and his "Dialogo" on the Ptolemaic and Copernican systems, which occasioned his condemnation by the Inquisition. The only English book is a fine copy of the first edition of Newton's "Principia" (1687).

ON the occasion of the establishment of the Willard Gibbs chair of research in pure chemistry in the University of Pittsburgh, Prof. M. T. Bogert delivered an address on the "Value of Research in Pure Chemistry," which is printed in *Science* (vol. xlii., No. 1091, p. 737). The part played by chemistry, "the intelligence department of industry," in bringing about the astonishing achievements of the last fifty years is sketched briefly but convincingly. Investigations in pure science laid those broad foundations upon which has been erected the wonderful structure of modern industrial operations. It will be recalled that two years ago, when in England, Prof. Bogert put forward the opinion that the most pressing need of the day was the proper endowment of chemical research by the providing of great research institutes and the creation of research professorships. Whilst it seems that in England these words had little effect, the United States are "beginning to awaken to the fact that civilisation unarmed by science is at a terrible disadvantage in the event of a struggle for existence, and that *this arming cannot be done at short notice*. The result is a loud and urgent call upon the universities, colleges, and technical schools of the land for help." The establishment of a chair of research in pure chemistry in so eminently a practical centre as Pittsburgh is an occasion for warmest congratulations. It is peculiarly appropriate that the new chair should bear the name of Josiah Willard Gibbs, who has been styled by Ostwald "by far the greatest man of science America has yet produced."

MANY representatives of chambers of commerce, with mayors, lord provosts, bankers, merchants, and business men attended a meeting held at the Guildhall, London, on Monday, to consider measures which should be taken after the war for the promotion of trade and commerce, and to deal with the subject of industrial employment. The Lord Mayor presided, supported by the Sheriffs and many members of the Corporation. The following motion, proposed by Sir Algernon Firth, president of the Association of Chambers of Commerce, was carried unanimously:—"That in the opinion of this meeting it is desirable that immediate steps be taken by his Majesty's Government, chambers of commerce, and other kindred associations, throughout the country, to formulate in close co-operation adequate action for the defence and improvement of trade and employment after the war, and with this object in view this meeting suggests full discussion of the fiscal, legislative, and voluntary efforts which ought to be made, and of the concentrated action and decisions which must be taken; and recommends the establishment of a Ministry of Commerce to carry out a constructive commercial policy for this country." In moving this resolution, Sir Algernon Firth said that the President and officials of the Board of Trade have every desire to promote trade, and within their powers are efficient; but they have many functions and are choked with administrative work. Frequently since 1869 chambers of commerce have urged the appointment of a Ministry of Commerce. Twice a resolution in its favour has passed the House of Commons, and in 1905 a Bill was promised in the King's Speech. It is essential to have a new Minister who will gather round him men of experience and judgment, and confine himself to steps to be taken after the war for the development of trade.

THE interest of the recently issued report of the Development Commissioners for the year ended March 31, 1915, lies not so much in its record of successful effort in the promotion of agricultural education and research, which have figured so prominently in former reports, as in its outline of the efforts of the commissioners to apply their energies and resources towards the practical necessities of the abnormal national situation which confronted them during the greater portion of the period under review. In the earlier days of the war, when widespread unemployment was generally anticipated, the attention of the commission was directed to the inception of preventive measures, but with the happy falsification of these fears it soon became necessary rather to discourage the inauguration of works requiring labour suitable for enlistment. At the same time, the commissioners have not lost sight of the possibility of a serious need for labour-employing works after the war, and have devoted their attention to the solution of the initial difficulties of certain projects of development, of which the construction of light railways, land drainage and reclamation, and afforestation are specified, with the view of ensuring that such schemes may be brought into operation quickly in case of emergency. The increase of the production and preservation of home-grown food supplies has been regarded as the chief question for immediate consideration, and substantial aid has been given to schemes designed to secure this end. The report contains much of interest with regard to the progress of schemes outlined in previous reports, but the amount of new work authorised and entered upon during the year was naturally but small. This is particularly the case in connection with the valuable scientific research work supported by the commission. It is gratifying to note, however, that no effort has been spared to ensure the continuity of the work of the newly-founded research institutes, although the inevitable depletion of staffs has necessarily greatly curtailed their activities.

THE *Psychological Bulletin* (vol. xii., No. 12) summarises in a useful form the recent published work on social and religious psychology. Perhaps the section of widest general interest is that relating to the causes and treatment of crime. All students of social problems, whether from the theoretical or practical point of view, will find much that is of value in this number. If the relation between crime and feeble-mindedness, for example, were realised more consciously, then as a corollary the State treatment of the criminal would have to be modified. Progress in criminal legislation is being made slowly, but the need for a definitely scientific study of those social phenomena we vaguely subsume under the concept of crime is still insistent.

THE Bureau of American Ethnology has for some time employed Miss Frances Densmore on the task of collecting by means of the phonograph the music of the Indian tribes. About one thousand songs have already been recorded. Many of those procured from the Chippewas have to do with the belief in the Mide, or Great Medicine, the object of the ritual being to secure health and long life for its members, and to promote temperance and other virtues. Many of the songs were handed down by tradition, and the singers were assisted by a system of mnemonics recorded on a strip of birch bark. A collection of songs, known as "Dream Songs," are said to have come to the Indians in the course of dreams and trances. These are used in treating the sick. One of their medicine-men demonstrated his supernatural powers by feats of jugglery, releasing himself from bonds in a manner familiar to European performers. Indian music, except the songs of daily life, is closely connected with the supernatural, and hence it is carefully guarded by the people.

THE important piece of apparatus known as the respiration calorimeter was invented by Atwater and Benedict at Middletown, Connecticut, in 1892. Since that time the instrument has played an important part in investigations on the metabolism in man and other animals. Many improvements have been introduced, and the present form of the Atwater apparatus is now installed at Boston in a building specially devoted to metabolic research under the supervision of Prof. F. G. Benedict. Modifications are also set up in New York and various other American universities, and the latest form of improvement has just been described by Drs. Longworthy and Milner, of the Home Economics Department at Washington. This is fully described and figured in the *Journal of Agric. Research* issued by the United States Department of Agriculture (November 22, 1915). Various other changes have been introduced from time to time to suit other animals than men. In this country the unfortunate lack of funds which characterises all efforts in research has prevented the prosecution of this branch of work. So far as we are aware, there is only one respiration calorimeter in Great Britain, and this was set up by Prof. Macdonald at Sheffield University. When it is possible to divert funds from the present urgent necessities of the country, we trust that the installation of respiration calorimeters will not be neglected.

THE annual report of the Dominion Museum of New Zealand for 1915 contains some valuable notes on the Tuatera "lizard" (*Sphenodon punctatus*), which have been furnished by the lighthouse-keepers and others on Stephen Island, The Brothers, Cuvier's Island, and the Little Barrier bird sanctuary. To judge from these reports, it would seem that a great deal of unnecessary slaughter, in regard to "hawks," is going on, and under official recognition. The hawks, which are diurnal birds, are accused of preying on the Tuateras, which are nocturnal. The real culprits, it would seem, are feral cats, of which considerable numbers have been killed. If these ancient reptilia are to be preserved, a much more carefully thought-out scheme of protection must be devised. So far as the evidence furnished by this report allows one to judge, it would seem that the haunts of these animals are not sufficiently protected by scrub. If this could be appreciably increased and the cats exterminated, the Tuatera would probably need little further protection.

THE curious habit which certain minute "Chloropid" flies have of entering human habitations in vast swarms, apparently for the purpose of hibernating, has long been known. A further instance is now recorded in the *Entomologist's Monthly Magazine* for January by Mr. Hugh Scott. In this case a house about six miles from Cambridge was invaded in October last by myriads of these flies, causing great discomfort to the occupants. They occurred in two rooms only, facing the south-east, and were clustered in seething masses along the bars of the window-panes, and on the ceiling immediately above the window. Samples of the swarm proved to consist mainly of a small yellow Chloropid (*Chloropisca ornata*) and a slightly larger Anthomyid (Spilogaster), but intermingled with these were several larger species, and a few wasps. These two rooms have been invaded after this fashion for at least five or six years in succession, and in every case that on the first floor has proved the most attractive. For some quite inexplicable reason Cambridge has suffered more from this plague than any other place in England. So far back as 1831 an enormous swarm invaded the Provost's lodge at King's College, and the visitation was repeated in 1870, while of late years similar swarms have occurred in certain apartments of the museums which are near King's College, and always in the same apartments. No clue whatever as to their origin has yet been obtained.

THE current number of the Journal of the Quekett Microscopical Club (Ser. 2, vol. xii., No. 77) contains an interesting note by Mr. James Burton on the fresh-water alga, *Hydrodictyon reticulatum*. This remarkable plant, which takes the form of a net, floating in the water, is not very often seen in this country. For more than thirty years Mr. Burton looked for it almost in vain, though it was known to have occurred in past times in the lake in Kew Gardens. In the autumn of 1914, however, it made its appearance in that locality in enormous quantities, so that boatmen were employed in gathering it in with rakes and piling it in heaps on the shore. In less than a month's time after first seeing it Mr. Burton was unable to find a single specimen. He compares this sudden outburst of Hydrodictyon to the so-called "breaking of the meres," caused by the sudden and rapid multiplication of other algæ. The same number also contains an obituary notice, accompanied by an excellent portrait, of the late Prof. E. A. Minchin, a former president of the club.

THE Indian jute industry formed the subject of a recent lecture by Mr. C. C. McLeod before the Royal Society of Arts, and this is now printed in the *Journal,* No. 3292, vol. lxiv., for December 24 last, with a number of illustrations showing the cultivation and mode of preparation of jute. In Bengal, Cooch Behar, and Assam more than 3,350,000 acres are under jute cultivation, and the value of raw jute exported in 1913 amounted to 20,000,000*l*. It was not until 1855 that a jute mill was started at Calcutta, and now the mills there turn out nearly 3000 tons of the manufactured article per day.

THE report of the agricultural department, Montserrat, for 1914–15 shows a satisfactory condition in the island's present position and future prospects. A definite attempt is being made to establish an onion trade in the island for the Canadian market, which promises to be successful. The bay oil industry is also receiving particular attention. Valuable work in cotton selection is being continued at the botanic station, and seed of high and uniform quality from types in the island is being selected for estate planting.

THE *Indian Forester* for November, 1915, vol. xli., No. 11, contains the first part of an interesting article on forest administration in Bashahr, the largest of the Simla Hill States. The State for its greater area lies within the drainage area of the Sutlej river, and consists of precipitous mountain country with narrow ravines. The deodar and blue pine (*Pinus excelsa*) are the prevalent trees, and the article is illustrated by photographs of some fine specimens of deodars. Girth measurements of more than 35 ft. are recorded, but the average girth in the forests is 15 ft., with height measurements of 120–150 ft. Some good pictures of the precipitous mountain-sides are also included. Mr. Glover gives a history of the forests, which have only been known since 1850. The destruction by fires and improper felling has been very great, especially about the year 1862, when scarcely a quarter of the trees felled ever reached the sale depôts, and it was estimated by Brandis that, between 1859 and 1863, 30,000 deodars had been felled from the more accessible forests. Now that the forests are under the forest service, conservation is being practised, and the natural regeneration is proceeding properly.

Symons's Meteorological Magazine for January, 1916, gives a tentative rainfall total for December, 1915, over the British Isles obtained from a representative selection of stations. The rainfall was everywhere in excess of the average except at a few stations in Scotland. The excess was greatest in the south-east and east of England, where in many places the rainfall was more than 250 per cent. of the average. At Arundel the rainfall was 289 per cent. of the average, and in London it was 255 per cent. The largest amount of rain was 21·03 in. at Borrowdale, in Cumberland, and the least was 3·43 in. at Geldeston, in Norfolk. The rainfall map for the Thames Valley shows the month to have been exceedingly wet, the rainfall values over the area ranging from about 10 to 4 inches. The general rainfall for England and Wales was 198 per cent. of the average, for Scotland 135 per cent., for Ireland 158 per cent., and for the British Isles as a whole 169 per cent. of the average. A tentative result for the whole of 1915 is also given.

THE Bulletin of the American Geographical Society for November (vol. xlvii., No. 11) contains two papers of considerable geographical value referring to people in relation to their environment. The first, by Mr. L. Dominian, deals with the peoples of northern and central Asiatic Turkey. The complexity of races in that region is analysed, and the results are shown on a coloured map. Another coloured map gives the distribution of Armenians in Turkish Armenia. The second paper is by Dr. J. Russell Smith, and discusses the adjustment of the Bedouin to his surroundings. Though it contains few new facts, it is of value for its fresh interpretation of the relations of place and people. Both papers are well illustrated.

SOME years ago Mr. G. H. Girty began to make a systematic study of the Carboniferous faunas of North America, and he has now completed a description of the fossils of the Wewoka formation in Oklahoma (Bulletin of the United States Geological Survey, No. 544). This formation is especially interesting because it is far distant from the well-known Carboniferous areas further north and east, and both its sediments and its faunas show marked differences from those already studied. Most of the fossils are in a fine state of preservation, and are found weathered out of the shales. The Mollusca are especially abundant, and the Brachiopoda do not predominate so much as usual. The beautiful figures which illustrate the descriptions will be welcomed by students of Carboniferous fossils.

DR. J. W. EVANS has drawn up for H.M. Stationery Office a very useful pamphlet (price 2*d*.), entitled "Directions for the Collection of Geological Specimens." The concluding paragraph suggests that it is intended for travellers in our colonies; but it will also be found of service by those who have any leisure in our war-zones, and by students and surveyors in the British Isles. The author's experience in various continents enables him to give admirable advice on larger questions than mere collecting, such as inquiries on water supply and physiographic changes in recent times. As an example of his thoroughness, we may note his suggestion of marking strike and dip on a bedded specimen where these are of interest. The lines and figures on the specimen will then permanently record its position in the mass from which it came.

THE railway development of Africa is the subject of a useful article and map by Sir Charles Metcalfe in the *Geographical Journal* for January (vol. xlvii., No. 1). The article contains a great deal of matter in small compass. The present railways are largely feeders of rivers, or independent lines to seaports, but many projects are on foot to make the railways continuous, when the navigable reaches of the rivers will become their feeders. There will be through communication between Port Said and Cape Town by rail and steamer when the line in the Congo is finished from Kambove to Bukama, and from Stanleyville to Lake Albert, and the short section of 100 miles from Dufile to Rejaf. From Stanleyville it is probable that a line will be built to Lake Chad and continued to link up with the French Trans-Sahara railway. An alternative Cape to Cairo route will be from Broken Hill in Rhodesia, on the existing line, to the south end of Tanganyika, through what is now German East Africa to the existing Uganda railway and thence to Senaar in the Sudan. The rapidly constructed link between the Cape railways and those of the protectorate of South-west Africa are shown on the map.

THE *Educational Times* has long been the medium adopted by a certain class of mathematicians when they wish to derive what pleasure there is to be derived from puzzling over riddle-me-rees in the form of mathematical problems. From the commencement of the present year these things are transferred to a separate publication, which is to be issued monthly under the title of *Mathematical Questions and Solutions*. It is edited by Miss Constance Marks and published by Mr. Francis Hodgson, 89 Farringdon Street, London, the subscription price being 5*s*. for six months, including postage and binding cover. It contains the usual series of out-of-the-way properties of conics, triangles, and collections of algebraic symbols, and the usual neglect of aeroplanes. The latter would with very little difficulty provide enough problems to keep a journal of this kind going almost indefinitely, but aeroplanes have always been tabooed by the British mathematical world. The possibility, however, suggests itself of using the journal as a medium for getting some of the analytical details of these investigations solved by reducing them to problems in pure mathematics.

THE *Mathematical Gazette* for January contains a "bordered antilogarithm table" drawn up by Prof. G. H. Bryan and Mr. T. G. Creak. In the description the authors claim that the object of the table is to enable logarithms, logarithms of reciprocals, and antilogarithms of numbers and their reciprocals all to be taken from the same table. To do this they use a table of antilogarithms or powers of ten, with the complementary logarithms entered in the right-hand column and the bottom of the page in the same way that the ordinary trigonometric tables avoid duplication in tabulating logarithmic sines and cosines. Another feature on which the authors lay great stress is that the antilogarithms are tabulated to five significant figures in the lower parts of the scale and to four in the higher parts. This degree of approximation is both necessary and sufficient to secure the maximum degree of accuracy in working with four-figure logarithms, as the tabular differences are neither too small nor unnecessarily large.

THE *Revue générale des Sciences* for December 30, 1915, contains a well-illustrated article by M. Jacques Boyer on the manufacture of X-ray tubes in France during the war. The bulbs of the modern tubes are much larger than they were a few years ago, and the rays they produce will penetrate several centimetres of steel, and allow a radiograph of the thickest part of the body to be taken by means of a tube three metres away. At the commencement of the war the military authorities requisitioned all the X-ray tubes in France, but as this supply was found insufficient for the proper equipment of the radiological stations, the two French manufactories, which had been closed owing to their directors being called to the colours, were reopened, in one case by the recall of the director from the front, in the other by the appoinment of a member of the Academy of Sciences as director. Under the guidance of a professor of the Collège de France a firm of glass-makers began the manufacture of the special glass for the bulbs, and in a few days was turning out the necessary quantity, so that France is now producing sufficient X-ray tubes to meet her own requirements, and is supplying some to her Allies.

THE essentials in the manufacture of a good rheostat are the use of first-class material and workmanship of a high grade. This useful piece of apparatus should therefore be particularly a British product; the rheostat cannot be considered to be a "competitive" article or one lending itself particularly either to what the Germans term "Massenfabrikation" or to dumping. Yet Messrs. Isenthal and Co., in sending us a new list of their rheostats, frankly admit that they had previously imported these from abroad, but are now manufacturing them entirely in England. The list before us is one of the most complete we have seen. Both the flat slate and the tubular types have hand-shield sliders with well-designed contact-makers, and the number of different arrangements listed should meet practically every requirement. A useful variation from the ordinary flat type is one with limbs of cross-shaped section which affords increased ventilation and enables the maximum number of watts to be dissipated for the minimum dimensions without undue heating. In the tubular type the slate bars are replaced by fire-enamelled steel tubes, and the resistance wire is oxidised so that the insulation of the oxide enables the turns to be wound closely. Dimensions, approximate resistances, weights, and diagrams of connections and arrangements of the terminals are given in detail, so that it should be possible to order rheostats for almost any purpose directly from the catalogue. We trust that Messrs. Isenthal and Co. will continue to manufacture them in England after the war.

THERE is a description of one of the new British projectile-making factories given in *Engineering* for January 28, illustrated by several good photographs showing some of the shops. The nine bays of the factory cover about 196,600 sq. ft., and are arranged so as to reduce to the minimum the distance which the shell has to travel in the process of manufacture. From the entry of the rough bar to the finished shell ready to be put into the breech of a gun, the distance travelled is only 400 yards. There are nearly one hundred operations in making a shell, and many of these take but little time; hence it is important that the time spent in moving the shell from operator to operator should be as small as possible. Small shells are machined in this factory by female workers, and there are 1800 women in this department. The girls are able to work the machines in three days, and are efficient in seven days; the highest efficiency is attained after two months' experience. One skilled worker suffices for the setting of the machines for twelve female operators. The accuracy demanded is 0·004 in., and it speaks well for the girls that the rejected shells do not amount to more than one per cent.

OUR ASTRONOMICAL COLUMN.

THE SOLAR ECLIPSE OF FEBRUARY 3, 1916.—Official European observatories have perforce had to refrain from participating in the observation of to-day's total solar eclipse, notwithstanding the fact that spectroscopic interest was so unexpectedly intensified by the change recorded in the coronal spectrum at the eclipse of August 21, 1914. From the success that then attended the Spanish expedition, it might almost have been expected that the Madrid observers, at any rate, would have attempted to take advantage of the present opportunities. It would appear, however, that the American observers will have the field to themselves.

Starting in the Pacific Ocean, February 3d. 2h. 29m. G.M.T., in long. 121° 35·6′ W., lat. 7° 20·8′ N., almost a minimum part of the central line of totality passes over land areas. This portion is nearly parallel to and somewhat north of the Bogota-Caracas line in Columbia and Venezuela. The line then crosses the Caribbean Sea to Guadeloupe. The duration of totality over all this section is about 2½ minutes; the maximum of 2m. 36s. is reached before quitting Venezuela. Sweeping across the Atlantic, centrality passes a little wide of the Azores, and ends about 200 miles off the south coast of Ireland (Mizen Head) at 5h. 31·0m., in long. 9° 50·2′ W. and lat. 49° 23·8′ N. A partial eclipse will consequently be visible over the greater part of the Americas.

In south-west Europe, north-west Africa, and the British Islands the eclipse will only be partly visible, the sun setting in partial eclipse. At Greenwich the eclipse begins at 4h. 31m., and the sun sets at 4h. 49m., with about one-quarter of the disc obscured. The magnitude of the eclipse increases as the observer is situated further west, until in the south-west of Ireland the obscuration reaches about nine-tenths of the disc.

COMET 1915*e* (TAYLOR).—Prof. E. Strömgren has sent to NATURE his latest observation of the position of this comet, made on January 23. At 5h. 47m. 6s. G.M.T. the comet's position was α app., 5h. 10m. 1·89s., δ app. +16° 56′ 54·1″, whence the corrections of the ephemeris of Copenhagen Circular No. 11, $\Delta\alpha$=0s., $\Delta\delta$=+0·8′ The comet is stated to have been of the eleventh magnitude.

COLOURS OF STARS IN THE CLUSTERS N.G.C. 1647 AND M. 67.—The first statistical investigation employing the colour classes recently proposed by Prof. F. H. Seares deals with the distribution of colours among the stars in the above clusters (Proc. Nat. Acad. of Sci., i., p. 483). Hertzsprung and Seares have respectively published effective wave-lengths and colour indices for a number of the stars in N.G.C. 1647 (NATURE, September 23, 1915). Hertzsprung's results were alone taken into account, leading to the following correspondences between effective wave-length and colour class:—

Effective w.l.	4190	4260	4330	4400	4470	4540
Colour class	bo	ao	fo	go	ko	mo

N.G.C. 1647 is principally made up of *a* and *f* stars, but contains a number of *b* and also some *km*, whilst

M. 67 (colour indices measured by Shapley) appears to be almost entirely made up of *g* stars, and contains neither *b* nor *m* classes, reminding us forcibly of the frequent association of the corresponding spectral types among the isolated stars.

Very significantly, in neither case does colour or magnitude vary with condensation. On the other hand, colour and magnitude are found to be connected, showing a marked relationship in the case of N.G.C. 1647, less pronounced in M. 67.

THE COLUMBUS MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE sixty-eighth annual meeting of the American Association for the Advancement of Science was held at Columbus, Ohio, from December 27, 1915, to January 1, under the presidency of Dr. W. W. Campbell, director of the Lick Observatory of the University of California. In spite of the fact that the second Pan-American Scientific Congress was held at the same time in Washington, D.C., there was an attendance of something more than eight hundred, and the meeting was unusually successful.

The address of the retiring president, Dr. C. W. Eliot, on the subject, "The Fruits, Prospects, and Lessons of Recent Biological Science," has already been printed in NATURE (January 27, p. 605). Addresses of presidents of sections were given as follows:—(A) H. S. White, "Poncelet Polygons"; (B) A. Zeleny, "The Dependence of Progress in Science upon the Development of Instruments"; (F) F. R. Lillie, "The History of the Fertilisation Problem"; (G), G. P. Clinton, "Botany in Relation to American Agriculture"; (H) C. Wissler, "Psychological and Historical Interpretations of Culture"; (I) E. E. Rittenhouse, "Upbuilding American Vitality: the Need for a Scientific Investigation"; (K) R. M. Pearce, "The Work and Opportunities of a University Department for Research in Medicine"; (L) P. H. Hanus, "City School Superintendents' Reports"; (M) L. H. Bailey, "The Forthcoming Situation in Agricultural Work."

One of the most interesting functions of the meetings was a public lecture complimentary to the citizens of Columbus by Dr. D. W. Johnson, professor of physiography at Columbia University, on "Surface Features of Europe as a Factor in the War." Dr. Johnson indicated the strategic reasons for the movements in the great war which have been dependent upon the character of the country involved, and threw a new light on the subject to those who have been puzzled especially by the operations in the eastern war zone. Other public lectures were delivered by Dr. R. F. Bacon, of the Mellon Institute of Pittsburgh, on "The Industrial Fellowships of the Mellon Institute: Five Years' Progress in a System of Industrial Service"; Dr. F. K. Cameron, of the Bureau of Soils, Washington, "The Fertiliser Resources of the United States."

An important symposium on the topic, "The Basis of Individuality in Organisms," was held by Section F and the American Society of Zoologists.

Section K conducted a symposium on the topic, "Foods and Feeding," in the course of which Prof. H. B. Armsby spoke of the "Energy Content of the Diet"; Prof. Ruth Wheeler on the "Effect of the Proteid Constituents of the Diet on Growth"; Prof. E. B. Forbes, "The Mineral Nutrients in Practical Human Dietetics"; Prof. Carl Voegtlin, "Vitamines"; Dr. C. F. Langworthy, "Food Selection for Rational and Economical Living."

The new section of Agriculture, Section M, conducted a symposium on the topic, "The Relation of Science to Meat Production," in which President W. O. Thompson (Ohio State University), President H. J. Waters (Kansas State Agricultural College), Prof. L. D. Hall (Office of Markets, U.S. Department of Agriculture), Prof. H. W. Mumford (University of Illinois), and Dr. A. R. Ward (Bureau of Animal Industry, U.S. Department of Agriculture) took part.

The following affiliated societies met with the American Association for the Advancement of Science:—American Association of Economic Entomologists, American Mathematical Society, American Microscopical Society, American Nature-Study Society, American Physical Society, American Phytopathological Society, American Society of Naturalists, Association of Official Seed Analysts of North America, Botanical Society of America; Entomological Society of America, Society for Horticultural Science, Southern Society for Philosophy and Psychology, Students and Collectors of Ohio Archæology; Wilson Ornithological Club.

New York was chosen as the meeting place for Convocation Week of 1916–17.

Dr. C. R. Van Hise, president of the University of Wisconsin, a distinguished geologist, was elected president of the association for the next year. The vice-presidents—that is, presidents of sections—elected were as follows:—Mathematics, L. P. Eisenhart, Princeton University; Physics, H. A. Bumstead, Yale University; Engineering, E. L. Corthell, Brown University, Providence, R.I.; Geology and Geography, R. D. Salisbury, University of Chicago; Zoology, G. H. Parker, Harvard University; Botany, T. J. Burrill, University of Illinois; Anthropolgy and Psychology, F. W. Hodge, chief of the Bureau of Ethnology, Washington, D.C.; Social and Economic Science, Louis I. Dublin, New York; Education, L. P. Ayres, of the Russell Sage Foundation, New York; Agriculture, W. H. Jordan, director of the New York State Experiment Station, Geneva, N.Y.

The general committee reaffirmed the recently adopted policy of the association in regard to the planning of future meetings, establishing a five years' schedule, largely for the benefit of the affiliated societies in making their plans for the future.

Members of the association who attended the last Columbus meeting in 1899 were greatly impressed by the growth of the Ohio State University during the intervening years, a growth, however, which is characteristic of a number of the great State universities in the United States. At the time of the 1899 meeting there were only one thousand students at this University, and at the time of the present meeting there are more than five thousand. Very many new buildings have been erected in the interim, and the equipment of all is modern and most excellent.

PARIS ACADEMY OF SCIENCES: PROPOSED PRIZES AND GRANTS.

PRIZES PROPOSED FOR 1917.

Mathematics.—The Francœur prize (1000 francs) will be awarded to the author of discoveries or works useful to the progress of pure or applied mathematics; the Bordin prize (3000 francs), for an improvement in some important point of the arithmetical theory of non-quadratic forms; the Poncelet prize (2000 francs), to the French or foreign author of the most important work in applied mathematics published in the course of the preceding ten years; the Vaillant prize (4000 francs), the question set for 1917 is to determine and study all surfaces which can in two different ways be formed by the displacement of an invariable curve.

Mechanics.—The Montyon prize (700 francs), for inventing or improving instruments useful to the progress of agriculture, mechanical arts, and the practical and speculative sciences; the Fourneyron prize (1000 francs), for the theoretical and experimental study of the question of combustion or explosion turbines; the Pierson-Perrin prize (5000 francs), for a discovery in mechanics.

Astronomy.—The Pierre Guzman prize (100,000 francs), to anyone finding a means of communication with a planet other than Mars, that is to say, to make a signal and receive a reply; the Lalande prize (540 francs), for observation or memoir most useful to the progress of astronomy; the Valz prize (460 francs), for similar work; the G. de Pontécoulant prize (700 francs), for the encouragement of researches in celestial mechanics; the Damoiseau prize (2000 francs), question for 1917, to calculate more exactly, taking the results of recent expeditions into account, the attraction of the moon on the wave formed at the surface of the earth by the tides. To examine the effect of this attraction on the angular velocity of the earth's rotation.

Geography.—The Tchihatchef prize (3000 francs), for the recompense or assistance of explorers in Asia (excluding British India, Siberia, Asia Minor, and Syria). The explorations may have as an object any branch of mathematical, physical, or natural science, excluding such sciences as archæology, history, ethnography, and philology. The work must result from actual observations made on the spot. Gay prize (1500 francs), the question proposed is the geographical distribution of tropical and subtropical plants presenting practical interest.

Navigation.—The extraordinary prize of 6000 francs for any progress of a nature as to increase the efficacy of the French naval forces; the Plumey prize (4000 francs), for the author of improvements in steam engines or any other invention contributing to the progress of steam navigation.

Physics.—The Hébert prize (1000 francs), for the best treatise or work for the popularisation and practical employment of electricity; the Hughes prize (2500 francs), for an original discovery in the physical sciences, especially electricity and magnetism and their applications; the Henri de Parville prize (1500 francs), for original work in physics; the Gaston Planté prize (3000 francs), for an important invention or work in the field of electricity.

Chemistry.—The Jecker prize (10,000 francs), for works leading to progress in organic chemistry; the Cahours prize (3000 francs), for the encouragement of young chemists who have already published good work; the Montyon prize (unhealthy trades; a prize of 2500 francs and a mention of 1500 francs), for a means of rendering an art or calling less unhealthy; the Houzeau prize (700 francs), for rewarding a promising young chemist; the Berthelot prize (500 francs), for researches in chemical synthesis.

Mineralogy and Geology.—The Delesse prize (1400 francs), for work in geology or mineralogy; the Joseph Labbé prize (1000 francs), for geological work or researches contributing to the mineral wealth of France, its colonies, or dependencies; the Victor Raulin prize (1500 francs), for work in geology or palæontology; the Fontannes prize (2000 francs), to the author of the best palæontological publication; the James Hall prize (700 francs), for the best thesis for the doctorate in geology during the last five years.

Botany.—The Desmazieres prize (1600 francs), for the best work published during the preceding year on Cryptogams; the Montagne prize (1500 francs), for work bearing on the anatomy, physiology, development, or description of the lower Cryptogams; the de Coincy prize (900 francs), for work on Phanerogams; the Thore prize (200 francs), for the best work on the cellular Cryptogams of Europe; the Jean de Rufz de Lavison prize (500 francs), for work in plant physiology.

Anatomy and Zoology.—The Savigny prize (1500 francs), for the assistance of young travelling zoologists, not in receipt of Government grants, and who occupy themselves with the invertebrates of Egypt and Syria; the Cuvier prize (1500 francs), for work in comparative anatomy and zoology.

Medicine and Surgery.—The Montyon prize (a prize of 2500 francs, mentions of 1500 francs), for works most useful in the art of healing; the Barbier prize (2000 francs), for a valuable discovery in surgical, medical, or pharmaceutical science, or in botany in relation to medicine; the Bréant prize (100,000 francs), for a radical cure for Asiatic cholera; the Godard prize (1000 francs), for the best work on the anatomy, physiology, and pathology of the genito-urinary organs; the Baron Larrey prize (750 francs), for the best work on the subjects of medicine, surgery, or military hygiene; the Bellion prize (1400 francs), for works or discoveries "profitable to the health of man or to the amelioration of the human species"; the Mège prize (10,000 francs), for the continuation and completion of Dr. Mège's essay on the causes which have retarded or favoured the progress of medicine from antiquity down to the present time; the Argut prize (1200 francs), for a discovery of a cure for a disease which at present can only be treated surgically, thus enlarging the domain of medicine.

Physiology.—The Montyon prize (750 francs), for work in experimental physiology; the Philipeaux prize (900 francs), for the same; the Lallemand prize (1800 francs), to recompense or encourage works relating to the nervous system in the widest sense; the Pourat prize (1000 francs), the subject proposed is the relations of the combined sugar of the blood with the albumenoid materials; the Fanny Emden prize (3000 francs), for the best work dealing with hypnotism, suggestion, and generally with physiological actions which can be exercised on the animal organism at a distance.

Statistics.—The Montyon prize (prize of 1000 francs and two mentions of 500 francs).

History and Philosophy of the Sciences.—The Binoux prize (2000 francs).

General Prizes.—The Arago medal; the Lavoisier medal, for eminent service in chemistry; the Berthelot medal, awarded each year to the prizewinners in the subject of chemistry; the Henri Becquerel foundation (3000 francs); the Gegner prize (3800 francs); the Lannelongue foundation (2000 francs), for the assistance of one or two persons in reduced circumstances who belong to the scientific world, either themselves or by marriage or by parentage; the Gustave Roux prize (1000 francs); the Trémont prize (1000 francs); the Wilde prize (one prize of 4000 francs, or two of 2000 francs), for a work or discovery in astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; the Lonchampt prize (4000 francs), for the best memoir on diseases of man, animals, or plants, from the special point of view of the introduction of mineral substances in excess as the cause of these diseases; the Saintour prize (3000 francs), for work in mathematical science; the Henri de Parville prize (2500 francs), for a book dealing either with original work or with the popularisation of science; the Vaillant prize (4000 francs), (see under mathematics); prize founded by the State (3000 francs); grand prize of the physical sciences, subject proposed for 1917, the modifications presented by trypanosomes in the bodies of insects; the Petit d'Ormoy prize (two prizes of 10,000 francs), one for pure and applied mathematics, and one for the natural sciences; the Serres prize (7500 francs), for works on general embryology, applied so far as possible to physiology and medicine; the Alhumbert prize (1000 francs), question proposed for 1917, the study of the action of the magnetic field on crystalline liquids; the prize founded by Mme. la Marquise de Laplace, to the pupil holding the first place leaving the Ecole Polytechnique; the Fêlix Rivot prize (2500 francs), between the four pupils leaving the Ecole Polytechnique with first and second places in mines and *ponts et chaussées*.

THE LOUTREUIL FOUNDATION.

As this is the first distribution of this fund, a summary is given of the regulations formulated by the committee for dealing with applications.

The grants recommended fall into three classes:—

(1) To institutions specially mentioned in the will of the founder.

The Natural History Museum, 1000 francs for the continuation of researches on orchids undertaken by Prof. J. Costantin, and 5700 francs for the purchase of accumulators, and 4300 francs for a radiographic installation needed in the laboratory of Prof. Jean Becquerel.

The Collège de France, 4000 francs to G. Gley, for the installation of an apparatus in his laboratory for the production of cold; 5000 francs to L. Cayeux, for completing the equipment of his geological laboratory for petrographical researches; 2400 francs to M. Müntz, director of the laboratory of vegetable chemistry of Meudon; 2000 francs to L. Nattan-Larrier for the purchase of a centrifuge and incubator for cultures of micro-organisms.

As the provincial observatories are all attached to the universities which have already received a special legacy from M. Loutreuil, the council will only consider claims for grants relating to researches of a personal order. Under this head 3000 francs is granted to M. Gonessiat, director of the Algiers Observatory, for the construction of an apparatus designed to measure the intensity of Hertzian waves and for a vertical seismograph.

Polytechnic School, 3000 francs to E. Carvallo, for the continuation of his researches on a method of shooting at airships.

The veterinary schools of Lyons and Alfort, each 5000 francs, for the upkeep of their libraries; the veterinary school of Toulouse, 3000 francs for the same purpose, and 1000 francs to M. Montane, for the reorganisation of the anatomical collections of this school.

(2) To institutions admitted by the president of the academy to participate in grants from the Loutreuil Fund.

The Conservatoire des Arts et Metiers: 3000 francs to Marcel Deprez, for his experiments relating to the transmission of the heat of gases to metallic walls, constantly cooled, and for experiments on electrical phenomena arising from internal-combustion motors; 4500 francs to A. Job, for the purchase of a calorimetric bomb, an electric transformer, and other apparatus necessary to his researches on the velocities of oxidising reactions; 6000 francs to Jules Amar, for improving his equipment for the study of the muscular forces of man at work by the graphic and chronophotographic methods.

(3) To other societies and to individuals.

The Société de documentation bibliographique, 2000 francs; 2000 francs to Henri Piéron, for the equipment of his laboratory at the Sorbonne for physiological psychology; 2400 francs to Louis Mengaud, professor at the Lycée of Toulouse, for exploratory work in the province of Santander; 10,000 francs to Charles Marie, for assistance in the publication of tables of physical constants; 3000 francs to Camille Flammarion, for his private observatory at Juvisy; 4000 francs to Emile Miège, for experiments at Rennes; 1000 francs for the preparation of plates illustrating fossils collected by J. Couyat-Barthoux.

The total grants recommended amount to 82,300 francs, and this does not exhaust the sum available. During the war it has been impossible for all the investigators to carry on work already commenced or to undertake new researches, and other expenditure considered desirable by the council has been excluded by the terms of the legacy.

BRITISH METEOROLOGY.[1]

OWING to the war every side of the work of the Meteorological Office has been affected, and many alterations in the staff have taken place, although it is highly satisfactory to note that in this period of emergency the office has risen in every way to the ever-increasing demands made on it by the Admiralty. This high efficiency is the outcome of the progressive development, organisation, and co-ordination of the work in all the divisional sections of the office and of the observations attached to it, gradually and systematically carried out, under the direction of Sir Napier Shaw, in the years preceding the outbreak of hostilities. Although all branches have supplied their quota of indispensable information to the authorities, the services rendered by the forecast division are more conspicuous than in other directions, so that it occasions no surprise to read that this division "has not failed to meet promptly and efficiently whatever wishes the Admiralty has expressed for information as to the weather over any part of the British Isles and neighbouring seas, for the use of the Navy, the Air Department, or the officials at headquarters."

The C.G.S. system of units for the expression of meteorological measurements has continued to make headway, and is being gradually introduced into all the publications. In this connection it is noted that the substitution of the millimetre for the inch in the measurement of rainfall "has met with less appreciation" than the other radical changes in progress. The necessity of uniformity is well shown by the publication of data dealing with the meteorology of the globe for 1911 on the basis of two stations for each 10° square, which is at present passing through the press under the title of the "Réseau Mondial, 1911." In this publication pressure is given in millibars, temperature in degrees absolute, and rainfall in millimetres for all stations.

A request received early in 1914 through the Foreign Office and the Board of Agriculture and Fisheries regarding the application in this country of meteorology to agriculture, forms the subject of an exhaustive reply given *in extenso* in appendix 2. It is pointed out that the line hitherto taken by the Meteorological Office, "as guided by tradition and precedent," has been to supply information likely to be of value to agriculturists in the form of weather forecasts and statistical reports, leaving the application of the data to the problems on hand to any who are disposed to take advantage of the material provided. The office resources do not include a staff to elucidate the questions involved, and a similar position obtains at the Board of Agriculture and Fisheries. The data provided are but little used by agriculturists. "Many persons are willing to receive forecasts by telegraph, but are unwilling to pay for the telegrams," and as the British race is not in the habit of paying for anything until its value has been amply demonstrated, both the Government and the farmer are waiting for the prac-

[1] Tenth Annual Report of the Meteorological Committee to the Lords Commissioners of His Majesty's Treasury for the Year ended March 31, 1915. Pp. 91. (London: H.M.S.O.; Wyman and Sons, Ltd., 1915.) Price 5½*d*.

tical value of the forecasts to be established. This can only be done by trial, and both sides are waiting for the other to demonstrate, beyond cavil, the value of the information to be supplied. The fundamental difficulty seems to be that the farmer has made his own study of the weather, and uses it in his own way without committing the results to writing, while the Meteorological Office prints large masses of data without knowing precisely in what directions to discuss them in relation to agricultural problems.

Appendix 4 deals with proposals for the establishment of a "Central Observatory for the Investigation of the Upper Air," in which it is pointed out that since 1905 the small sum of 45*ol.* a year has been available for the purpose of upper air research. Having in view the great and rapidly growing importance of the aeronautical and aerological aspects of the work, especially in relation to aviation, it is to be hoped that this scheme will go through. The services rendered by Mr. W. H. Dines, F.R.S., in the past are so well known that the mere mention of them is an ample guarantee that the annual appropriation of some 1000*l.* to 1500*l.* proposed would be money well expended. The site suggested is at Benson, in Oxfordshire, which has many advantages to recommend it as a position for the central aeronautical observatory contemplated.

THE NATURE OF EXPLOSIVES.

It was suggested in the review of Mr. A. Marshall's important work on "Explosives" in NATURE of June 3, 1915 (vol. xcv., p. 366) that the book would be improved if it had an introductory chapter dealing with the general principles on which the composition and action of explosives depend. Mr. Marshall, writing from Naini Tal, India, says that he had prepared a chapter on the lines suggested for another shorter work of a less technical character than that which was the subject of our review. Unfortunately, through pressure of other work, he has been obliged to postpone for the present the completion of this book, but he sends us the chapter; and we are glad to publish it as a separate article, as the subject is of particular interest at the present time.

EXPLOSION.—When gas or vapour is released so suddenly as to cause a loud noise an explosion is said to occur, as, for instance, the explosion of a steam boiler or a cylinder of compressed gas. Great and increasing use is made of explosive processes in gas, petrol, and oil engines for driving machinery of all kinds. In these engines the material that explodes is a mixture of air with combustible gas, vapour, or finely-comminuted liquid, and in the explosion these are suddenly converted into water vapour and the oxides of carbon, which latter are gases. Although all these things are liable to explode, none of them are called explosives; this term is confined to liquid and solid substances, which produce much more violent effects than exploding gaseous mixtures, because they occupy much smaller volumes originally.

EXPLOSIVE.—An explosive is a solid or liquid substance or mixture of substances which is liable, on the application of heat or a blow to a small portion of the mass, to be converted in a very short interval of time into other more stable substances largely or entirely gaseous. A considerable amount of heat is also invariably evolved, and consequently there is a flame.

GAS EVOLUTION.—That evolution of gas (or vapour) is essential in an explosion is rendered evident by considering thermit. This consists of a mixture of a metallic oxide, generally oxide of iron, with aluminium powder. When suitably ignited the aluminium is converted into oxide and the iron or other metal is set free in a very short interval of time with the evolution of an enormous quantity of heat, but there is no explosion. It is indeed because no gas is evolved that thermit can be used, as it is, for local heating and welding.

HEAT LIBERATION.—It is also an essential condition that heat should be evolved in an explosive reaction, otherwise the absorption of energy due to the work done by the explosion would cool the explosive and consequently slow down the reaction until it ceased, unless heat were supplied from without. Ammonium carbonate, for instance, readily decomposes into carbon dioxide, ammonia, and water, but in so doing it absorbs heat; consequently the reaction is much too slow to be explosive. Ammonium nitrate, on the other hand, is decomposed into oxygen, nitrogen, and water, with the evolution of heat, and is consequently liable to explode. A violent impulse is required to start the explosion, but once it is started the energy (or heat) liberated suffices to propagate the explosion, unless the conditions be such that the energy is dissipated more rapidly than it is liberated.

SENSITIVENESS.—Another essential for an explosive is that the reaction shall not set in until an impulse is applied. If the reaction set in spontaneously, it is obvious that its energy cannot be utilised in the form of an explosion. A mixture of sodium and water evolves hydrogen with the liberation of heat, but reaction sets in immediately the two substances come in contact with one another. Different explosives require impulses of very different strengths to cause them to explode. Some, such as diazobenzene nitrate, are exploded by a slight touch; these explosives are of no practical utility as they are too unsafe. Others, such as fulminate of mercury, are exploded by a moderate blow or a small flame; these are used principally for charging caps and detonators, a small quantity serving to explode a large amount of some other less sensitive explosive. Most of the explosives now used can be exploded by a blow only if it be extremely violent, and many of them cannot be exploded by a flame in the open in ordinary circumstances. The tendency is to use less sensitive explosives because they are safer to handle, but it should never be forgotten that the term "safe," when applied to an explosive, is only a comparative one. The duty of an explosive is to explode, and if it is not treated with proper respect it will, sooner or later, explode at the wrong time with extremely unpleasant results.

Before the subject of explosives was understood so well as it is now, inventors were very liable to think an explosive was very powerful, and therefore valuable merely because it was very sensitive, whereas too great a degree of sensitiveness is really a most objectionable feature. In the middle of the nineteenth century many such mixtures as potassium chlorate and picric acid were proposed through this want of comprehension of a fundamental condition.

CONSTITUENTS OF EXPLOSIVES.—The explosive gaseous mixtures used in gas and oil engines to which reference has been made are composed of a combustible material, consisting largely of carbon and hydrogen, and air, the useful constituent of which is oxygen. Similarly, nearly all commercial explosives are composed partly of combustible elements, of which carbon and hydrogen are the most important, and partly of oxygen combined, but not directly with the hydrogen and carbon. On explosion the oxygen combines with the hydrogen to form water, and with the carbon to form carbon monoxide or dioxide, or a mixture of the two. It is the heat set free in this combustion that is the main or entire cause of the rise of temperature. The formation of these two oxides of carbon liberates very different quantities of heat; 12 grams of carbon unite with 16 grams of oxygen to form 28 grams of carbon monoxide with the liberation of 29 large Calories, and the same quantity of carbon unites with 32 grams of oxygen with the liberation of 97 large Calories.

Consequently an explosive is considerably more efficient if it contains sufficient oxygen to oxidise the carbon entirely to dioxide, but the effect is reduced to some extent by the relatively high specific heat of carbon dioxide. In some classes of explosives, however, a very high temperature is objectionable; this is the case with smokeless powders and explosives for use in coal mines. Smokeless powders, therefore, are generally made of such a composition that the greater part of the carbon is oxidised only to monoxide. But there is always some carbon dioxide formed, for it takes up some of the oxygen from the water vapour and liberates hydrogen, or if the total quantity of oxygen be very small there may even be free carbon produced. In the case of safety explosives for coal mines, the temperature of explosion is also sometimes kept low by restricting the proportion of oxygen, but this means is not free from objection because carbon monoxide is poisonous. Other methods are therefore adopted in some safety explosives to reduce the temperature.

OXYGEN CARRIERS.—The oxygen may either be contained in a separate compound, such as saltpetre, which is mixed mechanically with the combustible material, or the two may be combined together in a single compound, as is the case with nitroglycerine, trotyl, and many other modern explosives. The substances rich in oxygen are often referred to as "oxygen carriers"; those most used are nitrates, chlorates, and perchlorates, in which the oxygen is united to nitrogen and chlorine respectively. Ordinary gunpowder, or "black powder," belongs to the class of explosives that have separate oxygen carriers, in this case saltpetre. The following table shows the properties of the principal oxygen carriers:—

Oxygen carrier	Molecular weight	Density	Reaction	Heat evolved per mol.	Heat evolved per 100 grams	Oxygen available per 100 grams	Oxygen available per 100 c.c.
Nitrates.							
Potassium	101·1	2·08	$2KNO_3 = K_2O + N_2 + 5O$	−75·6	−74·8	39·5	82
Sodium	85·0	2·26	$2NaNO_3 = Na_2O + N_2 + 5O$	−60·5	−71·3	47	106
Calcium	164·1	2·36	$Ca(NO_3)_2 = CaO + N_2 + 5O$	−70·6	−43·0	49	115
Barium	261·5	3·2	$Ba(NO_3)_2 = BaO + N_2 + 5O$	−94·4	−36·1	31	98
Lead	331·1	4·58	$Pb(NO_3)_2 = PbO + N_2 + 5O$	−54·6	−16·5	24	111
Ammonium	80·1	1·71	$NH_4NO_3 = 2H_2O + N_2 + O$	+27·6	+34·5	20	34
Chlorates.							
Potassium	122·6	2·00	$KClO_3 = KCl + 3O$	+11·9	+ 9·7	39	78
Sodium	106·5	2·29	$NaClO_3 = NaCl + 3O$	+13·1	+12·3	45	103
Barium	304·3	3·18	$Ba(ClO_3)_2 = BaCl_2 + 6O$	+25·9	+ 8·5	31·5	100
Perchlorates.							
Potassium	138·6	2·54	$KClO_4 = KCl + 4O$	− 7·8	− 5·6	46	117
Sodium	122·5	—	$NaClO_4 = NaCl + 4O$	−12·4	−10·2	52	—
Barium	336·3	—	$Ba(ClO_4)_2 = BaCl_2 + 6O$	− 4·3	− 1·3	38	—
Ammonium	117·5	1·89	$2NH_4ClO_4 = 2HCl + 3H_2O + 5O$	+29·5	+25·1	34	65

It will be seen that the proportion of available oxygen is about the same in the chlorates as in the corresponding nitrates, but whereas the chlorates decompose with the evolution of a small amount of heat, the nitrates require a considerable amount of heat to split them up, except in the case of the ammonium compound. Explosives containing chlorates are consequently much more powerful than those containing nitrates, but they are also very sensitive unless special measures are adopted to render them more inert. The perchlorates require considerably less heat to decompose them than the nitrates, and have more available oxygen. As they are now produced at quite low cost by electrolytic methods, it is not surprising to find that they are being used more and more for the manufacture of explosives. Ammonium nitrate and perchlorate decompose with the evolution of heat, this being due to the formation of water, but the available oxygen is diminished by the same cause. Ammonium nitrate can be detonated by itself, although only with difficulty, and then gives a large volume of gas at a comparatively low temperature. In consequence of this low temperature it has been found very useful as a constituent of safety explosives for use in coal mines, but it also forms part of many other high explosives. Ammonium perchlorate suffers under the disadvantage that amongst its products of explosion is the poisonous gas, hydrogen chloride, or hydrochloric acid.

Potassium permanganate and bichromate have also been used, but they possess no special advantages. Permanganate explosives are often inconveniently sensitive. Attempts have also been made to use liquid oxygen, which has the advantage of being cheap and containing 100 per cent. of available oxygen, but the difficulties of employing a liquid which boils at 200° C. below the ordinary temperature are so great that these attempts were given up. The Germans are, however, making great efforts to develop these explosives for work in mines, so as to set free a corresponding quantity of nitrates for military use. For the same reason the German authorities are encouraging the use of chlorates and perchlorates.

COMBUSTIBLE CONSTITUENTS.—In black powder the combustibles are charcoal and sulphur; in blasting explosives many sorts of organic matter have been used or proposed, and some inorganic substances, such as potassium ferrocyanide, ammonium oxalate, and antimony sulphide, but those in common use are not very numerous. For explosives containing nitroglycerin an absorbent material must be used, and of these wood meal is the most usual, but flour and starch are constituents of some nitroglycerin explosives, and in a few cases such substances as tan meal and prepared horse-dung are present. Cork charcoal has great absorptive power, but its high cost prevents its use. Ordinary charcoal is a constituent of some explosives, as also is coal-dust. American dynamites often contain resin and sulphur, and these constituents are sometimes met with in other explosives. Oily materials, such as castor oil, vaselin, and paraffin wax, reduce the sensitiveness of an explosive, and one or other of them may usually be found in a chlorate blasting explosive. The addition of aluminium greatly increases the heat of explosion; it is present in the explosives of the ammonal type.

NITRO-AROMATIC COMPOUNDS.—Modern high explosives very frequently contain nitro-derivatives of the aromatic compounds obtained from coal tar, especially the mono- di- and tri-nitro-derivatives of benzene, toluene, and naphthalene. The nitro-groups in these compounds contribute oxygen for the explosive reaction. The trinitro-compounds of substances containing only one benzene ring are explosives in themselves; trinitrotoluene, for instance. Trinitrotoluene is not only a constituent of composite explosives, but is also very largely used by itself as a charge for shell and submarine mines, and for other military and naval purposes, for which its insensitiveness combined with its great violence render it suitable. Picric acid (trinitrophenol) is also much used for these purposes, and trinitrocresol to a less extent. Although they detonate with great violence, these trinitro-compounds do not contain sufficient oxygen to oxidise the whole of the carbon they contain even to the stage of carbon monoxide. Their power as explosives is, therefore, increased by mixing them with oxygen carriers. Commercial explosives containing trinitrotoluene always have also some other constituent which can supply the deficient oxygen.

NITRIC ESTERS.—Nitroglycerin and the nitrocelluloses are the principal members of another very important group of substances that can be used as explosives without admixture. Strictly speaking, they are not nitro-derivatives, but nitric esters. The more highly nitrated celluloses, such as guncotton, contain enough oxygen to convert all the hydrogen into water and the carbon into monoxide, and even some of it into dioxide. Nitroglycerin, $C_3H_5N_3O_9$, not only has enough to oxidise entirely all its hydrogen and carbon, but also has a little oxygen left over. Nitroglycerin is the most powerful explosive compound known, but its power is increased by dissolving in it a small proportion of nitrocellulose, which utilises the excess of oxygen and at the same time converts it into a gelatinous solid known as blasting gelatin.

SMOKELESS POWDERS.—All smokeless powders consist largely of nitrocellulose, which has been more or less gelatinised and converted into a compact colloid by means of a suitable solvent; many of them contain practically nothing else, but in others there is a considerable proportion of nitroglycerin. Small percentages of mineral jelly, inorganic nitrates, and other substances are also added, in many cases to improve the ballistics or the stability. Powders for rifled arms are always colloided as completely as possible, whether they be for small-arms or ordnance, to make them burn slowly and regularly, but in shot-gun powders the original structure of the nitrocellulose is not always destroyed entirely, as they are required to burn comparatively rapidly.

ENDOTHERMIC COMPOUNDS.—There are some explosive compounds which do not depend at all for their action on oxidation or reduction. These are endothermic substances, which decompose with the evolution of gas and heat; they are usually rather sensitive. The only compounds of this class that are of commercial importance are fulminate of mercury, $Hg(CNO)_2$, and lead azide, PbN_6, both of which are used only for exploding other explosives.

VELOCITY OF EXPLOSION.—The heat and gas evolved are the two principal factors which govern the power of an explosive, *i.e.* the amount of work it can do in the way of displacing objects. But the time taken by the explosion is also a matter of great importance. The rate of explosion is measured by making a column of the explosive, confining it, if necessary, in a metal tube, and measuring the time that the explosive wave takes to travel a known distance. In black powder and similar nitrate mixtures the velocity of explosion is only a few hundred metres a second, but with modern high explosives the velocity of detonation is from two to seven thousand metres a second. This naturally makes them much more violent and destructive. Explosives of the gunpowder type are used when earth or soft rock is to be blasted, or when the material must not be broken up too much. Propellants for use in firearms are required to burn slowly; for rifled arms they must be slower even than gunpowder. They are not exploded by means of another high explosive, but merely lit by a powerful flame, and should then burn by concentric layers. The rate of burning increases with the pressure in the gun, but for completely gelatinised powders it is less than a metre a second.

A. MARSHALL.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Scottish Association for the Medical Education of Women has placed with the authorities of the University of Edinburgh the sum of 237*l.* for the purpose of founding a prize for women medical students.

THE Foulis memorial scholarship of the University of Glasgow has been awarded to Dr. John Cruickshank, pathologist to the Crichton Royal Institution, Dumfries, for distinction in original work in pathology.

IT is announced in the issue of *Science* for January 14 that four business men of Portland have contributed 5000*l.* toward the new buildings for the medical department of the University of Oregon, Portland. This makes available the 10,000*l.* appropriated by the State. The officers of the college now propose to raise an additional 20,000*l.*

THE issue of the *Pioneer Mail* for January 1 contains a report of the eleventh session of the Indian Industrial Conference, which commenced its sittings on December 24 last. It was the first time the conference had met in Bombay since its inception. There was an unusually large attendance of delegates and distinguished visitors. The president, Sir Dorabji J. Tata, is one of the pioneers of Indian industry. In the course of his address, he referred to the importance of industrial education, and said industrial education in the widest sense of the term is primarily the function of the State. But a good many people wish the State to go far beyond this *rôle* and to enter into the actual field of industrial enterprise. The president's message to the Congress, and through it to his countrymen, was "Educate, Organise, Co-operate." Scientific, technical, economic education is the function of the State, but he said they must take their share of the burden. If they really wanted higher scientific education and were determined to profit by it, they would get it. Dr. H. H. Mann, principal of the Agricultural College, moved a resolution earnestly recommending the establishment of a technological faculty at the principal Indian universities, the development of already existing technical institutions, the opening of new institutions, and the gradual introduction of technical instruction in primary and secondary schools. The resolution, which was adopted, appealed to men of capital and industry to help young Indians technically trained in finding practical work and employment.

THERE is a widespread opinion among competent authorities that an independent inquiry should be made into our system of education, particularly as regards its organisation, the powers of the Board of Education, the relations of the Board to local education authorities, and even the qualifications of members of the Board assigned to special posts in connection with work of science and technology, subjects and methods of instruction, and the like. The matter was brought before the House of Commons on January 26 by Sir Philip Magnus, who asked the Prime Minister "whether he will consider the desirability of appointing a Committee of Members of the House of Commons, and of other persons interested in and having a practical knowledge of the subject, to inquire into the present organisation of education in this country, and to report as to whether, having regard to the experience gained in the operations of the war and to the new social and economic conditions that may result when the war is over, any and, if so, what changes it may be thought advisable to introduce into our national system of education, with a view to establishing, without unduly interfering with other aims, a closer connection between our commercial and industrial requirements and the teaching provided in our several educational institutions, and in order to secure such further development as may be found necessary of existing facilities for scientific research and the better training of all classes of the population for the activities in which they may be severally engaged?" Mr. Asquith's reply was somewhat evasive of the points raised; and the substance of it was that he did not think it would be desirable to set up the Committee suggested, and that the President of the Board of Education would be glad "to consult all persons or bodies who are in a position to give advice on this matter." As the functions and influence of the Board itself are among the main points requiring consideration, the reply cannot be regarded as very satisfactory, and we hope that Sir Philip Magnus will raise the matter again. The Board is now practically the supreme governing body, not only of almost every grade and class of school, but also of most of our university institutions; and in its hands lies the scheme for the development of scientific and industrial research. As we understand the question, one of the objects of the Committee would be to inquire whether the Board is promoting educational and other work adapted to modern conditions and national needs, and whether practical and scientific studies can receive adequate attention under its present constitution. There are many who think otherwise, and a Committee could determine whether the dissatisfaction is well founded or not.

A COMMITTEE of the Association of Public School Science Masters has drawn up a strong memorandum on the unsatisfactory position which science occupies in national affairs, and particularly in our public schools and the old universities. The memorandum is signed by many distinguished leaders of scientific work and thought, and communications with reference to it are invited by the committee; they should be addressed to the secretary, Reorganisation Committee, 107 Piccadilly, London, W. A few of the matters mentioned in the memorandum are here summarised: Not only are our highest Ministers of State ignorant of science, but the same defect runs through almost all the public departments of the Civil Service. It is nearly universal in the House of Commons, and is shared by the general public, including a large proportion of those engaged in industrial and commercial enterprise. An important exception to this rule is furnished by the Navy, and also by the medical service of the Army. Our success now, and in the difficult time of reorganisation after the war, depends largely on the possession by our leaders and administrators of scientific method and the scientific habit of mind. For more than fifty years efforts have been made by those who are convinced of the value of training in experimental science to obtain its introduction into the schools and colleges of the country as an essential part of the education given therein. At Cambridge only four colleges are presided over by men of scientific training; at Oxford not one. Of the thirty-five largest and best known public schools thirty-four have classical men as headmasters. Science holds no place in the list. Science has been introduced as an optional subject for the Civil Service examinations, but matters are so arranged that only one-fourth of the candidates offer themselves for examination in science. It does not pay them to do so; for in Latin and Greek alone (including ancient history) they can obtain 3200 marks, while for science the maximum is 2400, and to obtain this total a candidate must take four distinct branches of science. For entrance into Woolwich, science has within the last few years been made compulsory, but for Sandhurst it still remains optional. This college is probably the only military institution in Europe where science is not included in the curriculum. If a Bill were passed directing the Civil Service Commissioners and Army Examination Board to give a preponderating—or at least an equal—share of marks in the competitive examination to science subjects, with safeguards so as to make them tests of genuine scientific education and not an incentive to mere "cram," the object we have in view would be obtained. Eventually the Board of Trade would be replaced by a Ministry of Science, Commerce, and Industry, in full touch with the scientific knowledge of the moment. Public opinion would compel the inclusion of great scientific discoverers and inventors as a matter of course in the Privy Council, and their occupation in the service of the State. Our desire is to direct attention to this matter, not in the interests of existing professional men of science, but as a reform which is vital to the continued existence of this country as a Great Power.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 27.—Sir J. J. Thomson, president, in the chair.—Prof. J. **Joly**: A collision predictor. The collision predictor is a mathematical instrument of simple construction. It enables the mariner when navigating in fog or thick weather to foretell risk of collision with another ship, and also the moment at which the risk is greatest. The ships concerned are supposed to be aware of each other's course and speed, and (at intervals) of their distance apart. The determination of distance is made according to principles described in a previous communication to the Royal Society. The operation of taking a reading on the collision predictor takes less than half a minute. The construction of the instrument and the principles involved cannot be conveyed without diagrams.—Dr. C. **Chree**: Discussion of Kew magnetic data, especially the diurnal irregularities of horizontal force and vertical force, from ordinary days of the eleven years 1890 to 1900. The paper is mainly devoted to a discussion of the results of measurements of the horizontal force and vertical force curves from the magnetographs at Kew Observatory for the eleven years 1890 to 1900. Subsequent to 1900, artificial electric currents diminished the value of the curves. One of the main objects is the study of the diurnal variation as given by "ordinary" days, *i.e.* all days with the exception of the highly disturbed. The changes of the regular diurnal variation throughout the year are dealt with in detail, and the inequalities are expressed in Fourier series. An investigation is also made of the annual inequality. For this purpose use is made of results for years subsequent to 1900, as well as of those between 1890 and 1900. The relation of the diurnal inequality to sun-spot frequency is considered in the light of Wolf's formula, the constants in the formula being determined by least squares. Considerable attention is also paid to the absolute daily range or difference between the extreme values for the day. The frequency of occurrence of ranges of different size is considered in detail.—G. W. **Walker**: A portable variometer for magnetic surveying. The paper contains an account of a portable magnetic variometer for measuring horizontal force in a magnetic survey. The results obtained with it and with a Kew unifilar at forty-eight stations in the course of the magnetic survey of the British Isles in 1915 are discussed. The operation of measuring force is reduced to a single reading of the instrument, with a reading of the temperature, at a definite instant of time, in place of the elaborate system of readings taking over an hour when a unifilar is used. It is estimated that the normal error is not likely to exceed 5γ.—Prof. J. C. **McLennan**: The single-line spectrum of magnesium and other metals, and their ionising potentials. It has been shown that magnesium vapour traversed by electrons can be stimulated to the emission of a single-line spectrum consisting of the wavelength $\lambda=2852{\cdot}22$ A.U. It has been shown that the absorption spectrum of non-luminous magnesium vapour contains an absorption band at $\lambda=2852{\cdot}22$ A.U., and one at $\lambda=2073{\cdot}36$ Å.U. As the lines $\lambda=2852{\cdot}22$ Å.U., and $\lambda=2073{\cdot}36$ Å.U., are respectively the first members of the series $\nu=2,p_2-1{\cdot}5$, S, and $\nu=1{\cdot}5$, $S-m$, P, respectively, the absorption spectrum of magnesium vapour has been shown to be analogous to the absorption spectra of the vapour of mercury, zinc, and cadmium. The ionising potentials have been deduced for atoms of magnesium, in addition to those for the atoms of mercury, zinc, and cadmium. Considerations have also been presented which show that if Bohr's theory affords an explanation of the origin of single-line spectra, then Frank and Hertz and also Newman must have placed a wrong interpretation on the results of their direct investigation of the ionising potentials for mercury atoms.—F. **Tinker**: The microscopic structure of semi-permeable membranes, and the part played by surface forces in osmosis. Microphotographs of the common precipitation membranes, taken by a new method, show that such membranes are composed of small precipitate particles packed closely together, and ranging from $0{\cdot}1\ \mu$ to $1{\cdot}0\ \mu$ in diameter. Each of these precipitate particles is, however, not simple in structure, but is itself an aggregate formed by the flocculation of smaller ultra-microscopic particles. Of the membranes examined, copper ferrocyanide and Prussian-blue have the smallest particles. Precipitation membranes show most of the physical properties of gels as ordinarily prepared by bulk precipitation, but they have not the same mechanical structure as the latter, the membrane having a much finer texture than the gel proper. The pores in a copper ferrocyanide membrane range from 8 $\mu\mu$ to 60 $\mu\mu$ in diameter. Their size is such that they can block colloidal molecules mechanically, but not the ordinary crystalloidal molecules even when highly hydrated. The order of a series of membranes with respect to pore size is the same as that of their efficiency as semi-permeable membranes. Copper ferrocyanide and Prussian-blue are the most efficient membranes, and they have also the smallest pores. There is a very close connection between the osmotic properties of a membrane and the extent to which the membrane capillaries are under the control of surface forces. Osmotic effects are probably the result of adsorption phenomena occurring at the surface of the membrane and in the capillaries, the membrane being relatively impermeable to solutes negatively adsorbed, but permeable to solutes positively adsorbed.—E. **Newbery** and J. N. **Pring**: The reduction of metallic oxides with hydrogen at high pressures. Metallic oxides have been heated to temperatures of 2500° C. in dry hydrogen at pressures up to 150 atmospheres, water vapour being removed by metallic sodium. The following oxides were reduced to metals:—

Cr_2O_3 to Cr. MnO_2 to Mn.

The following oxides were reduced to lower oxides:—

V_2O_5 to VO TiO_2 to TiO.
Nb_2O_5 to NbO. CeO_2 to Ce_2O_3.
U_3O_8 to UO_2.

The following oxides were unchanged:—

Al_2O_3, MgO, ZrO_2, Y_2O_3, ThO_2.

The metals obtained, chromium and manganese, are probably the purest samples of these metals that have been prepared up to the present. This supposition is supported by the sharp nature of their melting points, a feature which has not been observed with samples prepared by other methods.—H. **Levy**: Discontinuous fluid motion past a curved boundary. The author considers the regions in the $w(=\phi+i\psi)$ and $\Omega(=\log dz/dw)$ planes, corresponding to the problem of the discontinuous motion of a fluid in two dimensions past a curved boundary, and shows that the problem will be solved if the formulæ can be found to transform these regions conformally into the same region in a t-plane. This the author succeeds in accomplishing by a synthetic method he has devised—the vectorial superposition of rectangles in the Ω-plane. By this means it is demonstrated that the problem of the impact of a fluid against a boundary, differing by as little as may be desired from a given boundary, may be easily solved. The author pursues in full detail the case of symmetrical surfaces and of plane surfaces with curved ends. A few particular cases are worked out completely.

Royal Meteorological Society, January 19.—Major H. G. Lyons, president, in the chair.—Major H. G. **Lyons**: Winter climate of the eastern Mediterranean. During the last fifteen to twenty years a large number of meteorological stations have been in operation, and from their published results we have an accurate and detailed knowledge of the meteorological conditions which prevail there at the different seasons of the year. These vary from the true continental climate of the Balkans, with its low winter temperatures and moderate rainfall at all seasons, to the Mediterranean climate of southern Greece and the Levant, with its mild winter, hot summer, and a strongly marked rainy season in winter. In lower Egypt these characteristics also prevail in a more intense form. The geographical character of the Balkan Peninsula and the surrounding seas, Syria and Palestine, and lower Egypt, affect to some extent the general climatic conditions. The temperature in the Balkan region in winter is frequently very low, descending to 0° F., and often below this at many stations, while frost occurs often at inland Greece, and occasionally throughout the eastern Mediterranean. January is the coldest month, and February differs but little from it, the first marked departure from winter conditions occurring in March. By this month, too, the waters of the Mediterranean begin to grow warmer. In winter rainfall is heaviest on the western shores of Greece and Syria, and markedly less on the eastern coasts. The Balkan rainfall has a maximum in November and afterwards decreases slightly, but it is not heavy at any time. Rainfall decreases southward, and in lower Egypt the amount is insignificant. Northerly winds which cause rough sea in the Ægean Sea during the winter months are more frequent than southerly winds in the proportion of 2·5 to 1.

Challenger Society, January 26.—Prof. E. W. McBride in the chair.—C. Tate **Regan**: Larval fishes from the Antarctic. The development of *Myctophum antarcticum* was contrasted with that of the northern *M. glaciale,* and larval and post-larval stages of species of Nototheniidæ and related families were described.

BOOKS RECEIVED.

A History of the Family as a Social and Educational Institution. By Prof. W. Goodsell. Pp. xiv+588. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Anuario del Observatorio de Madrid para 1916. Pp. 645. (Madrid: Bailly-Balliere.)

Transactions of the Royal Society of Edinburgh. Vol. li. Part 1 (No. 4). The Temperatures, Specific Gravities, and Salinities of the Weddell Sea and of the North and South Atlantic Ocean. By Dr. W. S. Bruce, A. King, and D. W. Wilton. Pp. 169. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 8*s*. 3*d*.

Proceedings of the Royal Society of Edinburgh. Session 1914–15. Part iii., vol. xxxv. Pp. 225–402. (Edinburgh: R. Grant and Son; London: Williams and Norgate.)

East Lothian. By T. S. Muir. Pp. viii+117. (Cambridge: At the University Press.) 1*s*. 6*d*. net.

The Observer's Handbook for 1916. Pp. 76. (Toronto: Royal Astronomical Society of Canada.)

Termodynamik. By P. B. Freuchen. Pp. 144. (Kobenhavn: Lehmann and Stages Forlag.)

Calendario del Santuario di Pompei Basilica Pontificia del SS. Rosario in Valle de Pompei, 1916. (Valle di Pompei.)

Senescence and Rejuvenescence. By C. M. Child. Pp. xi+481. (Chicago: University of Chicago Press: London: Cambridge University Press.) 4 dollars net.

Chemical Constitution and Physiological Action. By Prof. L. Spiegel. Translated, with additions, by Dr. C. Luedeking and A. C. Boylston. Pp. v+155. (London: Constable and Co., Ltd.) 5*s*. net.

Forging of Iron and Steel. By W. A. Richards. Pp. viii+219. (London: Constable and Co., Ltd.) 6*s*. 6*d*. net.

The Carnegie Trust for the Universities of Scotland. Fourteenth Annual Report (for the year 1914–15). Pp. 81. (Edinburgh: T. and A. Constable.)

Annuaire Astronomique et Météorologique, 1916. By C. Flammarion. Pp. 431. (Paris: E. Flammarion.)

Flora of the Presidency of Madras. By J. S. Gamble. Part 1. Pp. 200. (London: West, Newman and Co., and Adlard and Son.) 8*s*.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 3.

ROYAL SOCIETY, at 4.30.—Note on an Orderly Dissimilarity in Inheritance from Different Parts of a Plant: Prof. W. Bateson and C. Pellew.—Observations on Coprozoic Flagellates, together with a Suggestion as to the Significance of the Kineto ucleus in the Pinucleata: H. M. Woodcock.—Investiga ions dealing with the Phenomena of Clot Formations. III. Further Investigations of the Cholate Gel: S. B. Schryver.—The Mechanism of Chemical Temperature Regulation: J. M. O'Connor.

ROYAL INSTITUTION, at 3.—Industrial Applications of Gaseous Fuels derived from Coal: Prof. W. A. Bone.

FRIDAY, FEBRUARY 4.

ROYAL INSTITUTION, at 5.30.—Fifteen Years of Mendelism: Prof. W. Bateson.

GEOLOGISTS' ASSOCIATION, at 8.—Presidential Address: The Geological History of Flying Invertebrates: G. W. Young.

MONDAY, FEBRUARY 7.

SOCIETY OF ENGINEERS, at 5.30.—Presidential Address: P. Griffith.

ARISTOTELIAN SOCIETY, at 8.—The Relation between the Theoretic and Practical Activities, with some reference to the views of Croce: Miss Hilda D. Oakeley.

SOCIETY OF CHEMICAL INDUSTRY, at 8.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Communications in the Balkans: H. C. Woods.

ROYAL SOCIETY OF ARTS, at 4.30.—National and Historic Buildings in the War Zone: Rev. Dr. G. H. West.

TUESDAY, FEBRUARY 8.

ROYAL INSTITUTION, at 3.—Nerve Tone and Posture: Prof. C. S. Sherrington.

ZOOLOGICAL SOCIETY, at 5.30.—A Collection of Moths made in Somaliland by Mr. W. Feather, with descriptions of new species by Sir G. F. Hampson and others: Prof. E. B. Poulton.—Report on the Deaths which occurred in the Zoological Gardens during 1915, together with a list of the Blood parasites found during the year: Prof. H. G. Plimmer.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Notes on the working of a Rack Railway: W. T. Lucy.

WEDNESDAY, FEBRUARY 9.

ROYAL SOCIETY OF ARTS, at 4.30.—The Organisation of Scientific Research: Prof. J. A. Fleming.

THURSDAY, FEBRUARY 10.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Theory of the Helmholtz Resonator: Lord Rayleigh.—The Oxhydrogen Flame Spectrum of Iron: Sir N. Lockyer and H. E. Goodson.—The Consumption of Carbon in the Electric Arc. II. The Anode Loss: W. G. Duffield and M. D. Waller.—Surface Friction. Experiments with Steam and Water in Pipes: C. H. Lander.—The Structure of broadened Spectrum Lines: T. R. Merton.

ROYAL INSTITUTION, at 3.—Measurement of the Brightness of Stars; Visual and Photographic Magnitudes: Sir F. W. Dyson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Testing of Underground Cables with Continuous Current: O. L. Record.

OPTICAL SOCIETY, at 8.—Optical or Visual Signalling: Dr. W. J. Ettles.

FRIDAY, FEBRUARY 11.

ROYAL INSTITUTION, at 5.30.—Egyptian Jewelry: Prof. W. M. Flinders Petrie.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Annual General Meeting.

CONTENTS.

PAGE

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.

Advertisements and business letters to be addressed to the Publishers

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.

NOTICE.—Advertisements and business letters for **"Nature"** *should be addressed to the Publishers; Editorial Communications to the Editor. The telegraphic address of* **"Nature"** *is* **"Phusis," London.** *Telephone*—**Gerrard, 8830.**

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.	To all Places Abroad:—	£	s.	d.
Yearly	1	8	0	Yearly	1	10	6
Half-yearly (26 Numbers)	0	14	6	Half-yearly (26 Numbers)	0	15	6
Quarterly (13 Numbers)	0	7	6	Quarterly (13 Numbers)	0	8	0

(A charge of 6*d.* is made for changing Scotch and Irish Cheques.)
Cloth Cases for binding "Nature" are issued at 1*s.* 6*d.* each, and can be sent post free for 1*s.* 9*d.*

NET CHARGES FOR ADVERTISEMENTS.

	£	s.	d.		£	s.	d.
First Two Lines in Column	0	2	6	One Sixth Page, or One Third Col.	1	3	6
Per Line after	0	0	9	Quarter Page, or Half a Column	1	15	0
One Sixteenth Page, or Eighth Col.	0	10	0	Half a Page, or a Column	3	5	0
One Eighth Page, or Quarter Col.	0	18	6	Whole Page	6	6	0

For the re-direction of replies to advts. a charge of 3*d.* per advt. is made.
Cheques and Money Orders should be Crossed and made payable to MACMILLAN & CO., Limited.
OFFICE: ST. MARTIN'S STREET, LONDON, W.C.

Printed in Great Britain by R. CLAY & SONS, LIMITED, at Brunswick Street, Stamford Street, S.E., and published by MACMILLAN AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN CO., 66 Fifth Avenue, New York.—THURSDAY, February 3, 1916.